Research Timeframe

The research effort described below – The Isaiah Project – commenced in February 2000 and concluded in September 2000. The research team, headed by Gerard F. McDonough, DBA, consisted of six raters, three econometricians, and one project administrator.

Objective

The objective of building the "Isaiah Model" was to develop a capability to predict the probability of success of a new product, service, business line, or commercial concept in the marketplace. The predictive capability of the model was established by analyzing certain historical information on the product, service, or business line, combined with certain "viability" factors that were expected to influence business success. We did not constrain our analysis, a priori, on certain industries, products, or services, but data availability did pose some limitations.

The Isaiah modeling effort initially focused on businesses with annual sales revenues between $15 million and $50 million. The second phase of analysis included business with annual sales of between $50+ million and $200 million. Both phases of research excluded certain industries or sectors of the economy, including restaurants, pharmaceutical companies, mining, farming, and government.

Literature Search

An exhaustive search yielded a large amount of literature on the topic of business or product survivability. A review of this literature was useful in and by itself because it generated information that was ultimately applied, in a general sense, to the Isaiah predictive model. It enabled the research team to more clearly distinguish its efforts from other research and to identify potential factors that influenced business or product success. The literature review also influenced our choice of methodologies used in the statistical analysis. As the search matured, the team narrowed its focus on the theoretical and empirical Industrial Organization literature.

Business or product success is a result of company decision making over time. We reviewed different classes of models in the Industrial Organization literature that described company behavior over time.

The decision taken by a firm to exit an industry is sometimes modeled as a war of attrition. Here, firms decide at each date whether to remain in the market or to exit. In the simplest war of attrition models, the probability of exit will depend on fixed costs of production, the level of profits that can be made by remaining in the market and the opportunity cost of remaining in the market.

Another class of models we reviewed described dynamic price competition between firms. In these models, firms choose their prices simultaneously at each date. Firms that collude have higher profits than firms that don't, where the ability of firms to collude depends on demand conditions in the market and the number of firms.

A third line of research the team examined looked at standardization and network externalities. Network externalities occur when the value of a good to a consumer depends on the number of other consumers who consume the good. These models explain how firms can initially build an installed base for their product with which they eventually corner the market.

We found rich empirical Industrial Organization literature that looked at the success of a firm or product in the marketplace. We studied two areas of empirical research: the first uses limited

dependent variable models to investigate the factors that affect the probability that a firm leaves the marketplace; the second employs linear regression analysis to examine the factors affecting firm performance, where firm performance is defined using balance sheet indicators such as the net profit before tax to revenue ratio.

Collect Data

Three distinct areas of data collection were required:

- Business level information
- Viability scoring information
- Product level information

As our objective was to develop a model that covers a broad range of businesses, the availability and relevance of data varied depending on the type of industry. Survivability of new products, for example, relates to manufacturing and consumable goods industries, but the services industry does not have "products" per se. In the latter case, business level information was necessary for our analysis.

We considered three data sets as our primary sources of quantifiable data on businesses: the Bureau of the Census' Characteristics of Business Owners (CBO), Dun & Bradstreet's Business Data, and Experian Business Profile Data.

The CBO is the result of three Bureau of the Census surveys, sponsored by the Small Business Association (SBA) and Minority Business Development Agency (MBDA) and conducted in 1982, 1987, 1992 and 1997. Its longitudinal nature and small business focus made it ideal for the Isaiah study. The study team was able to identify the closing year for sampled small businesses that began operations in either of the study years. The CBO also included variables that the study team considered to identify factors that impact business success. In particular, the CBO had data on startup capital, type of industry, location, number of owners, whether it is an employer firm, and demographic information on the owners such as age, race, gender and education levels.

Dun & Bradstreet and Experian maintain large databases on individual businesses. Both databases incorporate business startups and business closures by updating their databases regularly, and both databases include a field that records the year a business started. We were able to use this field to obtain survival rates of a business in the following manner: first, we chose a fixed period of time, for example, 1991-2001. Next, we obtained the data sets for each of these years. If a company was purged from the data set in a given year, we considered it closed.

The study team also made use of Dun & Bradstreet's bankruptcy file. This file has the year a business started as a field, and we were able to use it to analyze survival rates.

The study team also used the sales amount data contained in both Dun & Bradstreet and Experian. We used these data as an indicator of business success and employed a statistical methodology discussed later to do so.

Both databases – Experian and Dun & Bradstreet – include variables that may relate to business success such as location, SIC code, and age of business. Dun & Bradstreet also has data on the legal status of the business and square footage. Experian data has information on executives such as gender and number of executives and data on change in ownership. It also has numerous variables that describe the credit worthiness of a business. In particular, Experian offers a variable called "Intelliscore," which models risk assessment and probability of business performance relating to credit worthiness. Experian also offers a variable called "OXXFORD Life Style," which characterizes a business as "maturing," "static/declining," and "growth." Our first generation Isaiah model included this variable to represent the dependent or target variable in our statistical analysis.

Other data of a more qualitative nature, not available in these or similar sources, was drawn from Booth Morgan client databases. Booth Morgan works with several Fortune 500 companies that have very large (20+ million) customer portfolios. At the time of the study, three of Booth Morgan's clients had customer databases that were the second, seventh and twelfth largest commercial Oracle® databases in the world. These databases provided an enormously rich quantitative and qualitative data set for our study. These data sets reflected somewhat less tangible factors potentially affecting business success, such as benefits provided to customers, credibility of the brand, and uniqueness of the offering, and methods and quality of communications.

Given the more time consuming effort required to obtain qualitative data, we selected a sample of companies to research for this type of information. The sample was drawn from a larger sample taken from Dun & Bradstreet and Experian. A sample of 4,000 was required to meet generally accepted standards of statistical representation; we chose to use 4,600 companies from 97 industries in our study.

In addition to investigating the data available for evaluating businesses and services, we also explored the data that was available on products. We found that there was no one source that contained all the information we needed, however, we identified two databases that provided valuable data elements.

IRI has sales data information for a number of individual products; along with data on the year the product was introduced. The drawback of this source was that it did not have any information on the copy or packaging for the product, which is part of the scoring methodology the study team used.

The second source, Productscan, tracks the introduction of any new product to the market, compiling its information directly from manufacturers. It provided more information on the copy and packaging of the products, including scans of the artwork and descriptions accompanying the product. There were disadvantages in using this source, though. First, product sales data were not available. Second, the database had information on when the product was introduced into the market, but the product was entered into the database anytime there was new packaging created, ingredients added, or anything else that slightly changed the product. Linking product sales data to a specific iteration of a product was difficult and labor intensive, but it provided useful information to help us construct the Isaiah model.

Develop Viability Factors

The predictive model was designed to be based, to the largest extent possible, on hard data, not on soft opinions. Our analysis sought out the key drivers or discriminators of success versus failure for a product or business line. As indicated above, some of the discriminators included certain characteristics that were readily quantifiable such as SIC industry code, size of business, or location.

However, there was a "middle ground" of qualitative data that was neither hard quantitative data nor soft opinions. These were qualitative data such as benefits, credibility, language synergy and uniqueness. We did not characterize data representing these factors as soft opinions, but they were not readily quantifiable either.

We exercised a certain operations research methodology – the Analytical Hierarchy Process (AHP) – to assimilate such information into the analysis in an organized and rigorous manner and to quantify them for further analysis.

AHP uses a hierarchical model comprised of a goal, criteria, and different levels of sub-criteria and scenarios for each problem or decision. It is a general method for structuring qualitative information and is built around three principles:

- The principle of constructing hierarchies
- The principle of establishing priorities
- The principle of logical consistency

By performing pair wise comparisons on the criteria, it was possible to derive quantitative values (or weights) for the criteria and scenarios. The model derived numerical values for distinctly different qualitative outcomes that yielded ordinal scale values. By incorporating both subjective judgments and hard data into the AHP process, we arrived at a structured variable suitable for empirical analysis. AHP enabled the research team to:

- Incorporate qualitative information with business knowledge, intuition and experience.
- Consider trade-offs among competing criteria.
- Synthesize from the goal to determine the best scenarios.
- Communicate the rationale for variable values to others.
- Incorporate group judgments.

A hierarchical approach supported the study team's efforts to organize the Isaiah marketplace viability questionnaire and systematically incorporate data into the statistical model. The pair wise comparison approach of AHP helped to establish numerical scales of values for the qualitative factors such as uniqueness of product/service, language synergy, credibility, and benefits. Uniqueness, for example, was often manifested by a patent, copyright, judgment of the product or service as "evolutionary" vs. "revolutionary," or perception of how distinct the product or service was from competitive offerings. AHP was used to establish the relative importance of these different outcomes in measuring the quantitative outcome for the uniqueness variable.

Six selected members of the study team, working in concert with each other during a three-month period, iterated on the Isaiah marketplace viability questionnaire, constructed the hierarchy, and performed the pair wise comparisons. These six members were referred to as "raters." They were viewed as subject matter experts in making judgments on benefits, descriptive language, uniqueness, credibility, and other qualitative factors that potentially contribute to business success. A seventh member of the study team, an expert in the AHP method, served as "facilitator" to provide technical guidance to the raters and calculate the resulting numerical outcomes of the rating process.

Once the raters had established the variables and numerical scales for the qualitative factors, the next step was to actually rate individual companies selected in the sample. The six raters evaluated 1,000 of the same companies in a group setting in order to "calibrate" their respective ratings to be in close proximity with each other. The AHP method was applied at this stage to check for logical consistency in the raters' decisions.

Predicting the success of a product relies on selecting an applicable measure of product success for an industry. This variable could differ depending on the industry and what value it places on sales volume, market share, profit, or durability to define success. For example, a low priced product may measure success through sales volume while a higher priced product may measure success through market share. We relied upon our literature review and experience to determine that marketplace tenure – the survivability of a product or company in the market – was the most relevant available measure for our study. Marketplace survivability was the best surrogate of success of the many we tested.

There are numerous factors that can have a slight or considerable effect on the success of a product, and these factors will differ depending on which market is being modeled. For example, the effectiveness of package communication is more important in some industries than others. In the personalized computer industry, communication on the packaging of the product is generally limited to the name of the company. With laundry detergent, the communication on the packaging is meant to reinforce other advertising and branding strategies. The differences between the markets indicated the need to develop more than one generic model.

Using the same AHP methodology as the business/service model, a team of reviewers worked together to develop the models, score the criteria, and produce a success prediction for each product. We then compared our results to those products that had been successful or unsuccessful in their market based on our literature review to ensure that we were accurately predicting success.

A significant amount of effort was required to gather success criteria from the various markets, compiling of the individual product sales and promotional data, and development of the numerous models. The end result, however, was the tremendously useful list of factors, and their weights, that contribute to the success of a product in ANY market. We now are able to offer a service that takes the proposed product information, scores it, puts the information in the Isaiah model, and produces a probability of success rating for that service or product (or for any commercial concept that can be described in writing and/or images).

Conduct Statistical Analysis

The research team then applied rigorous multivariate statistical techniques such as econometric analysis to quantify the effects of certain variables on business success. Depending on the industry and data, the "dependent" variable, that is, the target variable that represents business success, was longevity or survival rate of a product or growth or decline in sales of a business or business line (e.g., change in annual sales over a given period of time).

In cases where we represented business success as longevity or the survival rate of a firm or product, we employed either duration data models or binary dependent variable models as our econometric technique.

A duration data model estimates both a hazard rate as well as the number of years a firm will remain in the market. To investigate the factors that contribute to the failure of a firm or product, we modeled the hazard rate as a function of "control" variables, some of which we describe below.

For our binary dependent variable model, we fitted a logit model. Our logit model estimated, for a given year that a firm or product enters the market, the probability that a firm or product will cease to exist in the market by a given time period. To investigate the factors that determine the probability of success, we included control variables in the model.

In cases where we defined business or product success by a measure of revenue (e.g., sales or profit) we fitted a linear regression model. Our linear regression estimated the percentage change in sales between the start year and most recent year of data, or the average yearly increase in sales between the start year and the most recent year of data. Likewise, we included control variables in our model to explore the relationship between business or product characteristics and revenue.

As previously mentioned, the technique that the research team employed was governed by the availability and quality of data. In particular, the duration data model and the logit model required data on either the number of years a firm or product was on the market or the date that a firm or product ceased to exist on the market. In instances where we chose to estimate the linear regression model, we used sales information, which was more readily available.

The "independent" variables, that is, variables that statistically contribute to predicting business success, included a mix of different variables including control variables such as SIC code and location and "viability" variables representing customer benefit, perceived value, communications clarity and synergy, credibility, and uniqueness. The control variables are the relatively straightforward characteristics of a product or business. The viability variables developed with the aid of AHP were included to sharply distinguish our research from other research efforts. In particular, the viability factors developed, as part of this study, were of great interest in the analysis as we expected these variables to provide unique insight into business success, and how to predict it.

The statistical analysis determined which variables affected business success and the relative impact as

well. That is, we answered the question – "How much is each independent measure contributing to business success?" The statistical analysis was iterative in nature with trial and error in testing different model specifications.

Develop User Interface

Finally, the estimated parameters obtained from the statistical analysis were applied in a simulation model to "score" the likelihood of business success for products, services, or businesses not evaluated as part of the baseline statistical analysis. The user does not need to know specifically how the underlying model was estimated. The model application has a user interface with text boxes for easy entry. After data are entered, the user simply clicks a "Display" button and, depending on the user's choice, either: 1) displays a summary of the simulation model's results, or 2) displays the complete results of the model.