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Determination of the Impact of a Human Capital Decision Cost Model on the Economic Performance Measures of a Technical Services Company

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DETERMINATION OF THE IMPACT OF A HUMAN CAPITAL DECISION COST MODEL ON THE ECONOMIC PERFORMANCE MEASURES OF A TECHNICAL SERVICES COMPANY

by

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ABSTRACT

DETERMINATION OF THE IMPACT OF A HUMAN CAPITAL DECISION COST MODEL ON THE ECONOMIC PERFORMANCE MEASURES OF A TECHNICAL SERVICES COMPANY

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Human Capital has a major impact on cash flow management decisions in a Technical Services company. Decisions to hire or terminate employees to meet contract requirements affect the company's economic value. The objective of this research is to develop a model that assists management in establishing a starting point in making, as efficiently as possible, those decisions that impact employees' lives. To understand that impact, the operations and economic parameters of a Technical Services company are compared with those of a manufacturing company. This analysis establishes two essential points for Technical Services organizations; first, that the capital investment decision is one of human capital skills and that cost is critical for an organization's financial success.

Building on this conceptual base, the research develops a starting point for managerial decisions associated with human capital using two parallel decision models. First, the Quality Function Deployment (QFD) technique is applied to map service industry business objectives with employee skill sets. This determines which job classifications are most critical. A weighting factor is then developed to identify skill importance. Concurrently, a linear programming model determines the impact of hiring and termination on costs. This approach provides a quantitative methodology that

supports service industry managers in understanding both the strategic and tactical (bottom line) financial value of their Human Capital decisions. Armed with that knowledge, they can begin an employment decision process based on the quantitative information provided by these models and that integrates with other subjective and system based factors that must also be a part of a comprehensive human resources plan.

Members of Advisory Committee: Dr. Andres A. Sousa-Poza
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INTRODUCTION

1.1 Purpose

Much has been written concerning how business is conducted in a product oriented environment, but there is very little information pertaining to how a services company – one that provides personnel as its product – makes decisions and how utilization of this human capital affects the value of that company. This research contributes to understanding business decision processes in a services industry, and focuses specifically on organizations providing technical services to the Department of Defense. It models the effect of human capital on meeting a company's strategic and business goals and applies that information to a decision model to provide quantitative information on the impact of those factors on the company's financial performance.

1.2 Background

A Technical Services company provides people and expertise to customers as its "product." The customer expects the product to provide the overall greatest value in these services. Specifically, the customer expects technical knowledge and quality support, and not merely the lowest cost – this concept is known as "best value." In a competitive environment, where there are multiple sources able to provide the required

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The journal model for this work is the *Engineering Management Journal.*

services, an entity must provide this "best value" in order to win new business and maintain current business. Providing the right people at an acceptable cost is key to both assuring best value for the customer and increasing the economic value of the company. A strategic thrust of any company is to grow business volume. For a Technical Services company, the professional staff and its value-added services are the essential elements to winning the proposals necessary to achieve this growth. This staff is the human capital of a Technical Services company that drives the company's "bottom-line" value. The premise of this thesis is that this human capital must be considered, in many aspects, in the same way as a manufacturing concern considers its machinery, processes and raw materials. At the same time, the successful Technical Services company realizes that people are not machines, and that human factors are the most significant delineators between success and failure. Current management thinking supports the view that the health of the company is related to free cash flow – minimizing costs while increasing sales intrinsically equates to a better financial picture.

Dr. Fitz-enz, a noted expert in the field of human relations, states in unequivocal terms that the people in the work force are much more important than the equipment. "All the assets of an organization, other than people, are inert. They are passive resources that require human application to generate value. The key to sustaining a profitable company or a healthy economy is the productivity of the workforce, our human capital" (Fitz-enz, 2000). This is especially true in a services industry where the people are the product and their knowledge and abilities are what is relied upon for the company to survive. As a result, proper utilization of the available "Human Capital" resources

positively affects cost and directs profitable business decisions. The question is how to identify a management tool that considers both the strategic and tactical work force planning that minimizes cost and contributes to increasing cash flow.

The key to the models provided in this thesis is that they help management provide the right people at an acceptable cost to increase company value. The two parallel decision models proposed have strategic and tactical objectives. Strategically, Quality Function Deployment (QFD) is utilized to select and prioritize what business planning sees as the long term best objectives, while Linear Programming (LP) focuses tactically on how to select the best mix of resources to present the best cost. These models and the information they provide are then integrated into a systemic decision process that management utilizes to take a holistic view of business decisions. This systemic decision process takes into account other factors such as the impact of layoffs, customer impact, future endeavors, etc., that are germane to business success in order to arrive at a management decision that best suits the needs of the company.

1.3 Literature Research

The information presented in this thesis is an amalgamation of the author's experience with Technical Services companies and research involving libraries, journals, textbooks and the Internet. In the field of human capital, Dr. Jac Fitz-enz, among others such as Paul Strassmann (Strassmann, 1985), enabled a thorough referencing of the importance of human capital to business success. Common business performance measures were researched. Kaplan, Cooper, Stern & Stewart with the American Express

Small Business Exchange and the Electronic College of Process Innovation were the primary resources.

In the field of model application, Dr. Paul Kauffmann and his applications of the QFD model obtained from Engineering Management Journal entries (Kauffmann, 1999, 2000) were paramount to obtaining a feasible approach to quantitatively assessing the strategic goals of a company. Texts on QFD and advanced QFD were also consulted to clarify this model. Linear programming information was obtained primarily from texts including Productions / Operations Management sixth edition (Stevenson, 1999) and Linear Programming and Extensions. Utilization of Microsoft Excel's tool "Solver" was key to completing the analysis.

1.4 Overview

Section 2 defines technical services and discusses the manner through which work is obtained and executed using different types of contracts. Section 3 is a description of human capital and its importance to a Technical Services industry. Economic factors and the different types of costs are discussed in Section 4. Section 5 presents a variety of performance measures whose purpose is to allow managers to judge business success and to understand what those performance measures mean. This basic information across industry and academia is provided for completeness. Section 6 demonstrates the use of two parallel decision models to understand the strategic and tactical value of human capital decisions to ascertain how well the current human capital skill sets meet customer and business requirements. This Section will also discuss how models, processes and

methods are used to relate the impact of human capital on the cost variables discussed in Section 4 that affect the Technical Service company's bottom-line performance measurements discussed in Section 5. Section 7 presents the conclusions reached and recommends directions for future research.

SECTION 2

OVERVIEW OF A TECHNICAL SERVICES INDUSTRY

This chapter examines the nature of technical services and the manner through which work is obtained and executed. This examination is undertaken from the perspective of costs, business philosophy and success. The discussion identifies that people decisions are critical for business success.

2.1 Definition of a Technical Services Company

The government sorts businesses into categories for the purpose of comparing the economic data of similar organizations using the North American Industry Classification System (NAICS). "NAICS was developed jointly by the U.S., Canada and Mexico to provide new comparability in statistics about business activity across North America"(Census Bureau, 2001) in order to permit the consideration of more modern influences. This system promotes the comparison of different types of data that describe various aspects of the U.S. economy. Under the NAICS system, Technical Services fall under code 541. The 1997 NAICS defines code 541 as: "Industries in the Professional, Scientific, and Technical Services subsector group establishments engaged in processes where human capital is the major input. These establishments make available the knowledge and skills of their employees, often on an assignment basis, where an individual or team is responsible for the delivery of services to the client"(Census Bureau, 2001). The unique feature of the professional, scientific and technical services field is that the majority of the output is dependent on worker skills. Neither equipment

nor materials are the major inputs to the product; rather, it is the expertise of the personnel. As stated in the code 541 definition, much of this expertise requires higher education and specific degrees, though not in every case.

These classification codes can then be further broken down into subcategories to better differentiate economic business activities. NAICS code 54133 refines Technical Services down to the Engineering Services level: "This industry comprises establishments primarily engaged in applying physical laws and principles of engineering in the design, development, and utilization of machines, materials, instruments, structures, processes, and systems. The assignments undertaken by these establishments may involve any of the following activities: provision of advice, preparation of feasibility studies, preparation of preliminary and final plans and designs, provision of technical services during the construction or installation phase, inspection and evaluation of engineering projects, and related services" (Census Bureau, 2001). It is through these codes that a Technical Services company may compare itself to similar companies to evaluate its efficiency and competitiveness.

2.2 Philosophy of a Technical Services Industry

The mission of any company is to provide products to consumers. In a Technical Services company, the products are the knowledge, expertise and value-added services represented by its professional employees.

Using these products, the purpose of a Technical Services company is to obtain a profit for its investors by providing customers with engineering, scientific, management, technical and specialized administrative support. The company has a competitive advantage when it is able to provide the required technical expertise, experience and abilities of its employees at a price less than that of the competition. If human capital determines how one company has the advantage over another, "then it is important to build a workforce that has the ability to achieve competitive success and that cannot be readily duplicated by others" (Fitz-enz, 2000).

Since technical support covers a broad range of clientele including all government agencies and branches, this research will focus primarily on the technical services provided to the Department of Defense and in particular to the U.S. Navy. As a cost-saving measure, the Government is moving to place more technical responsibility on its contractors and reserve more of a program management role for its own personnel. Greater portions of the functions previously done internally are being outsourced (given to contractors) for economic reasons, e.g., the contractor can do the work at a price lower than that which it would cost the government to do the work itself; or for technical reasons, e.g., because there is a lack of qualified personnel in the government to perform those tasks. A Technical Services company realizes its growth objectives by successfully competing for the contracts the government awards for the performance of these services. A company competes based on the unique qualifications of the human capital it has built, as well as the efficiency of its cost structure.

2.3 Product versus Services Comparison

Manufacturers strive to provide to consumers a quality product at a reasonable cost. The manufacturing company provides a specific material product and is devoted to the interests or culture of that particular product within its own organization. The factors it must consider are items such as material costs and quality, manufacturing equipment and associated overhead charges. Personnel typically man production lines that generate a high volume of output. Their duties are of low technical difficulty, and machines usually perform the complicated tasks. The company's capital expenditures may be significant based on the quality, capability and precision required of their equipment. Loss or gain of an individual worker usually has little impact on the product provided to the consumer, while loss of a production machine can cause severe economic impacts.

In contrast, a service industry provides the skills and expertise of its people and is devoted to the dissemination of their knowledge. This is reflected by Strassmann (1985) who states: "The organizing principle of an industrial society is nationalism. Its primary resource is capital. The organizing principle of a service society is global cooperation. Its primary resource is knowledge." Industry has pride in what it can physically generate with its resources, whereas services organizations take pride in their ability to generate solutions and provide the human link, in this case, to resolve technical problems.

Technical Services endeavor to provide personnel that the client relies on to accomplish quality work at a reasonable cost. The object is to provide a technically competent individual and to keep costs to the customer/government to a minimum while

generating an acceptable income for the company. These factors define 'best value." It is common business knowledge that value "comes through reduction in expenses as well as through revenue generation, which ultimately lead to profitability and other enterprise goals" (Fitz-enz, 2000). Although part of providing services requires the facilities and equipment necessary to perform the tasks, "people are the only element with the inherent power to generate value. All other variables – cash and its cousin credit, materials, plant and equipment, and energy – offer nothing but inert potentials. By their nature, they add nothing, and they cannot add anything until some human being, be it the lowest-level laborer, the most ingenious professional, or the loftiest executive, leverages that potential by putting it into play" (Fitz-enz, 2000). Technical Services organizations provide professionals and their associated direct costs. In order to provide the customer with the best value, which in the services case means the best people, the areas for cost savings are limited. The available cost savings techniques are mainly attempts to reduce overhead expenses. Examples of the reduction of fixed costs include leased facilities and at times employees may even work at government owned sites, which further reduces capitalized and facility-related costs.

2.4 Costing

Costing is the means of assessing financials into categories. "All business objectives can be reduced to service, quality, or productivity categories. All changes can be measured through some combination of cost, time, volume, errors or defects, and human reactions" (Fitz-enz, 2000). In a Technical Services company, cost is a function of three items:

- direct labor (e.g., personnel, travel and direct charges),
- overhead (fringe benefits, facilities, utilities, etc.),
- and general and administrative (management, human resources, payroll, etc.).

Overhead is charged to the government, generally as a function of direct labor hours. Charges to the government take into account employee related cost reimbursable items, and an applicable fee levied in accordance with the Government Fee Pricing Guidelines. The government pays for the company's overhead as negotiated on every contract and subsequently every individual work task on that contract. Employee fringe benefits/costs are part of the overhead structure, along with typical "cost of doing business" expenses such as office supplies, dues and memberships in professional organizations and other lesser-known costs.

With personnel being the product, the loss of an individual could cause a significant impact on the company's profitability since without the individuals for which the customer is willing to pay, continuance of the existing contract and successful competition for new or renewal contracts is in jeopardy. "The knowledge, skills, and attitudes of the workforce separate the winning companies from the also-rans. It is a complex combination of factors…In actuality, it is the information that the person possesses and his or her ability and willingness to share it that establish value potential" (Fitz-enz, 2000).

As with most businesses where services are provided, the scope of the tasking is established via contracts. There are various types of government contract types, each

with its own purpose. Generally, in dealing with the Department of Defense, technical services are provided by a contract that establishes the cost and fee structure in one of three ways:

- Cost Plus Fixed Fee (CPFF) Contracts where the customer pays for the service with an additional fee,
- Firm Fixed Price (FFP) where the task is bid with the bottom line cost presented,
- and Cost Plus Award Fee (CPAF) where the service is paid for and the fee paid is based on preset criteria.

Contracts establish how the work will be performed and how the costs will be billed, resulting in the reduction of most business uncertainties. Human capital then remains as the biggest and most fragile uncertainty.

2.5 The Effect on Sales of Cutting Cost

A product's price is based on all costs associated with producing that item plus the market fee. A manufacturer may be able to reduce per item costs by buying raw materials at cheaper rates, by purchasing new machinery to produce more products faster, by improving processes to make production more efficient, or any of numerous means for reducing direct or indirect costs associated with production. The more products sold, the greater the profit. Since the product no longer costs as much to produce, its price may be reduced. These savings may then be passed on to the consumer in hopes of gaining a larger market share while simultaneously generating best value for the customer and profit for the company.

For a Services company, cost is based mainly on the salary of the employees and the associated indirect costs. As indicated by the NAICS code 54133, the majority of employees of a Technical Services industry are typically degreed engineers. Therefore, they tend to be costly. Lowering the cost to the customer can be accomplished through lowering of the direct or indirect rates, just as in the product industry. However, lowering the direct rate for a technical service is directly related to a reduction in the engineer's pay. Since engineers are highly knowledgeable, they are also highly marketable. Consequently if their pay is lowered, they find work elsewhere.

Indirect costs have much the same effect as direct costs since the majority of these costs are for the benefit of the employee. If fringe is reduced (incentives, perks, and employee related costs paid by the company for the employee's benefit), the employee will find another employer who will provide them with these benefits. A company's pay and benefits are what entice people to work for it, and keep them from looking for another company that provides a better program. This is asserted by Fitz-enz (2000) where he states that people "are assets that must be cared for, jut like capital equipment. Pay and benefits programs help keep people productive. Money is like a lubricant. If a machine is not well lubricated, it slows down and eventually burns up. If people are not compensated properly, they slow down and eventually retire on the job or leave." With the exception of a more efficient process, it is evident that costs in a Technical Services industry cannot be cut the same as they may be in a products company. So the object then becomes to provide the personnel the customer wants at a cost the customer is

willing to accept (in most cases, lower cost doesn't drive the need; knowledge help by individuals is what is in demand).

When a reduction in cost to the customer is achievable, the question is when it should be done and by how much. On the business side, contract and task costs are predicted, business expenses are estimated with their applicable rates (overhead, general and administrative, etc.), and the obtained money is managed to these predictions. At the end of the fiscal year, the known costs are amortized across all applicable cost objects and the previously estimated rates are made actual.

The object for management in executing financial tasking is to come as close to the predicted rates as possible since major differences could result in major consequences. For example, lower costs could result in lower fees and loss of income on completed tasks. Financials are not closed until the costs are adjudicated with the contracting authority even when the task is completed. A task is managed to a set amount and closed based on predicted rates. If a lower actual overhead or G&A cost is realized and entered into the cost algorithm, money actually gets returned to the government for that task, resulting in a loss of sales and fee. Conversely, the same is true if actual rates turn out to be higher than predicted. The company then has to ask the government for more money. The business debate then becomes whether to recoup those losses from the government and possibly hurt your reputation enough not to be the best value on the follow-on contract, or to "eat" the loss out of profits. Therefore, the time

delay between completing the work and closing the contract magnifies the importance of accurately estimating costs.

2.6 Strategy / Quality

The goal of any company should be to achieve the best Return On Investment (ROI) by providing the best value product that it can. A general philosophy is that most customers do not like dealing with providers who are only in business for the money; instead they want to deal with someone who genuinely cares about meeting their needs. The winning strategy, then, is to provide what the customer wants at a price they are willing to pay.

It is better to provide the services at an acceptable return on investment and maintain the customer base, than to try for a higher return and lose the customer to a lower bidder. "Don't try to maximize profits. American companies focus on profit to provide their stockholders with a better quarterly report and to maximize the executive team's annual bonus. In many cases, maximizing profits in the short run does not provide the best return on investment (ROI). Organizations that focus on building their reputations are going to provide the best long-term ROI" (Harrington, 1991).

Attention to detail falls directly in line with the philosophy that reputation provides the best long-term ROI. "When we improve quality, we naturally reduce production or service costs as a by-product and usually make customers happier in the end. Naturally, this leads to customer retention. Happier customers also buy more and

refer other potential customers. This improves a company's market reputation. In turn, that saves the marketing expense required to obtain new customers, which in turn improves profit margins, and so on" (Fitz-enz, 2000). In addition, quality may also be improved in a Technical Services Industry by hiring better qualified, more experienced, or higher credentialed people. This increases the direct labor pool from which to draw by offering more qualified people, enables a broader range of responses to requests for services, potentially enlarges the field of expertise and its related customer base, and increases the profit margin by obtaining more direct costs at a lower indirect cost per person basis (fixed costs spread over more people lowers the per person cost).

Technical Services is a highly competitive market. The government fee pricing guidelines set the profit margins and allows 5-8% for the low-to-medium risk projects for which most Technical Services compete. On the contracts a Technical Service company wins, they get a fee for performing work for the customer/government. This fee is profit, and is the source of funding that enables growth, research and development, and increased company value/shareholder worth. To be successful, a Technical Services company's strategic goal is straightforward: win the competition for contracts to perform the services, and thus make profit.

Risk when competing for a contract is based on the comparative quality of the competing organizations. The government's criteria is described in a formula that takes into account an evaluation of competitors to determine the one who can provide the best services (ensuring that the remaining bidding companies have shown they can perform

the technical requirements of the task being bid) at the lowest cost – with these criteria known as "best value." Consequently, for the company the object is to meet the contract requirements with the lowest bid. In direct line with this, since fee has a significant role in bidding for a contract, fee is a key player in the bid strategy. If the company currently performs the work being bid and adequately reflects this in their proposal, they are demonstrating the technical aspects of the requirements and can afford to bid a higher fee (on the order of 8%). However, if they are looking to break into a new market, the company will look at taking a lower fee to obtain some new market share (will take a lower profit/fee, around 5%). The company makes less profit per unit sales, but low marginal rates with high volume still result in acceptable profits.

The criteria of whether or not to bid for a contract is how credible the company feels they can be in the line of work they are bidding. They assess their credibility by evaluating what they perceive as their discriminators. Discriminators are the factors that set a company uniquely above its competitors in meeting requirements – the equipment it has or the processes it performs better than the competition. The more discriminators a company has, the more qualified it is, and the better the chance of successfully acquiring a contract.

In a Technical Services industry, another item that must be taken into account is the significant cost of documentation (specifically in dealing with the government). Every detail from the conception through the termination phase of a project requires an

extensive amount of paperwork. The majority of the documentation relates to the following areas:

- justify the concept;
- detail the design and design changes;
- generate and execute a test process;
- and prepare meeting materials and informational packets.

All areas require providing detailed documentation concerning the project, reviewing the documentation, providing comments, and producing multiple iterations until the final document is approved. How to minimize these costs can be a differentiator in the strategic goals of performing this contract; for example, having personnel knowledgeable with this project would enable them to produce the requisite documentation in fewer iterations – therefore, costing less.

2.7 Partnering

On some contracts, one company cannot perform the entire scope, or outside help and experience are required to break into a new market. If that company is not able to hire the personnel it requires to perform those tasks, it looks for other companies that can accomplish those tasks for it. "Top performers are champions of joining with outsiders to enhance performance. They aggressively support partnering and joint venturing. They regularly look outside the enterprise for organizations with which they can leverage resources" (Fitz-enz, 2000). When there are requirements that just one company cannot meet, becoming partners with another company so that the aggregate meets those requirements is necessary (teaming). A working relationship is established that details

the work split, and states which company is the lead contractor (the Prime) and which is responsible through the Prime for other tasking (the Sub-contractor). Determining which company plays which role is debated through the requirements of the contract (general contract, small business set-aside, or woman/minority owned, etc.), which company is better known for the majority of the work to be accomplished, and which company can put across the best combined cost (material and handling charges and fees).

Research has shown that appearance (organization, quality, attitude, etc.) is a key factor in maintaining and growing business. "Customers' perception of our organization drives their buying habits. (...customers) are five times more likely to switch to another supplier because of poor service than because of poor product quality or price issues. Customers will pay up to 30 percent more for an average product if they receive outstanding service from the organization" (Harrington, 1991). This is where the human capital really comes into play. "The customer is always right" is a well known motto by most organizations. This basically means that they are paying for what they want, and if we do not want to give them what they want, they will go get it somewhere else. Finding the right people to meet the needs and the requirements of the customer, and keeping them happy (through political savvy and a personal meshing with the customer), is the drive of the company. If the customers appreciate the personnel giving them support, chances are that when the contract comes up for bid, the incumbent (the prime contractor with their partner companies) will receive higher scores for technical knowledge and performance and be retained as the best value provider.

2.8 Chapter Summary

This chapter has examined the nature of technical services from the perspective of costs, business philosophy and business success. It identified the common theme that people decisions are critical for business success. The next section examines this concept from the viewpoint of the operational decisions that occur in business activities.

SECTION 3

THE IMPORTANCE OF PERSONNEL TO A SERVICES ORGANIZATION

This chapter examines the criticality of people to business success from the viewpoint of day to day business decisions involving the issues of job satisfaction, the effect of personnel turnover, and the use of processes to fully utilize company assets. This discussion identifies that human capital decisions are critical for a Technical Services company to achieve its goals.

3.1 Human Capital

The people in a Technical Services company are the reason that the company is in business; its revenues are derived from its human capital. It is each individual's specific knowledge and dedication that maintain the link between the company and the customer. Attracting, developing and maintaining the right personnel are what will keep that company in business. This takes more than just money and benefits. It also includes ensuring the individual has a sense of self-worth and value-added. Fitz-enz (2000) points out that "beyond pay, people need to have jobs that fit their talents and interests. They need, expect, and demand communication from their supervisors. And they want to know what is expected in the way of performance." A person that is happy in a job and knows he/she is providing what the company wants will most likely stay with that job. For the most part, it takes dissatisfaction for an employee to look elsewhere for fulfillment.

3.2 Develop

Once an employee is with the company, the individual must feel like they have a purpose - that they are contributing to the strategies of the company, and that their work has meaning. The opinion of Fitz-enz (2000) is "the most important issue is how fulfilled people are in their work. No amount of compensation can restore the soul of a person who has spent his or her life in mindless toil."

So what makes an individual feel they are an important cog in the machine and not just a leftover part? "Employees want training and work experience that helps them grow. In a rapidly changing, technologically rich environment, people need their skills continually refreshed. Customers are more demanding than ever; therefore, a poorly trained employee cannot be tolerated. Formal training, informal coaching, and mentoring support employees' needs both psychologically and careerwise" (Fitz-enz, 2000). So training and development is not just for improvement of the employee, but also helps make the company the best value that the customer is looking for, and the entity with whom they want to keep doing business.

3.3 Maintain

Of course, job satisfaction is what keeps an individual employee interested in what they are doing, but they must also be able to pay their bills and have a goal for which to strive (more money, title, etc.) in order for the company to hope to keep them in their positions. Getting an individual hired with a company and trained is important, but how does a company keep an individual once they become the asset the business needs?

"Once the precious human asset is in-house, it must be maintained. This is done principally through pay and benefits – the remuneration system. Nonmonetary reward and recognition is more of a retention and motivational effort than a maintenance program. From a hierarchy-of-needs viewpoint, people seek basic safety and security first from their employers. Paying a fair wage and providing a reasonable degree of security though benefits programs are accepted as de rigueur for maintaining a skilled workforce. After that come the frills" (Fitz-enz. 2000). A fair wage is critical. For example, if a new employee is hired at a rate greater than or equal to a current employee with more experience is earning, the current employee would be justified in wanting a higher salary, or in looking for an employer who did find them worthy of an increase in pay. Once again, if an individual is satisfied, they have no real reason to look elsewhere.

3.4 Turnover

Maintenance of existing employees is paramount for a Technical Services company to remain competitive because employee turnover can be costly. Rarely does a company stay the same size and with the same people. There are times when individuals will not stay with their current company, be it for monetary, title/position, or job satisfaction purposes. Sometimes the company cannot keep up with the employee's desires, or the employee does not meet the standards or expectations of the company. The best case for the company not to stay "as is" is growth, when more personnel are required to perform the tasks, or new personnel are needed for new tasks. "Obviously, the workforce is not static. People come and go every day. Some are replacing terminated personnel, and some are taking newly created positions. It's not a bad idea to

know how many are doing each, because movement is expensive" (Fitz-enz, 2000). This is where human capital plays into the economic value of the company and can affect the bottom-line. Knowing how many people of each skill level and cost are needed (or not) can be utilized to predict the coming period's economic growth or decline.

Much research has been done into the cost of losing an employee. Even so, there are no set figures or formulas for determining the actual cost, only best-guesses. An approach to estimating the cost of turnover as shown in Fitz-enz (2000) is to look at "the cost of termination, replacement, vacancy, and learning curve productivity loss. These four variables generally cost a company the equivalent of at least six months of a nonexempt person's pay and benefits and a minimum of one year's worth for a professional or manager. The combination of pay, benefits, contingents, absence, and turnover yields a total cost of human capital for the organization." Obviously the actual cost is dependent on the type of business, the salary of the employee, and the value of the benefits, but the generalization provides a figure from which to work to make calculations regarding human capital impacts on the economic value of the company. The loss of a professional not only costs the equivalent of at least one year's pay and benefits, but "these calculations do not include effects on customers," and that "unwanted turnover not only costs you today; it leaves you vulnerable in the short run for tomorrow. If you are continually having to break in new people, there is no way that your company can be highly competitive" (Fitz-enz, 2000). Remaining the best value involves retaining the assets with which the customer wants to deal. Losing the "experience" discriminators

for bidding contracts could also result in the loss of current business and not just the individual.

More than likely a company will be able to replace an employee loss with a new person. However, there is still a cost associated with this since it has been shown that the "new employee is seldom as productive as the departing one, so there is a denigration of performance for some period until the new person's productivity at least matches the former's... During that time, there is some productivity or value. The question is how much" (Fitz-enz, 2000). Estimates show that even replacement of an individual can cost up to a year's pay for a professional before productivity is equivalent to the previous employee's departure. These estimates show that maintenance of the existing employees must be stressed for a company to remain competitive in the Technical Services environment.

3.5 Process

A Technical Services organization contributes its human capital to achieve its goals by way of a process. "A process is a series of steps designed to produce an effect. All processes share a common pattern. They consume resources, and they generate a product or a service... The reason we want to study business processes is that an organization is only as effective as its processes. It is referred to as the ability to execute" (Fitz-enz). These processes are the decision paths a company takes in order to accomplish their objectives. They define everything about how a company does its business. These are a business's policies and procedures and include:

- how costs are allocated;
- how employees are hired, maintained and fired;
- and how company assets will be utilized to achieve the company's mission.

The human capital of a Technical Services company uses these processes to achieve its goals and objectives and as the means of running its business.

A well defined set of processes enable an organization to utilize their assets to achieve their objectives efficiently and without ambiguity or a need for interpretation. A Technical Services organization uses its people to achieve its mission and purpose through the use of processes. Fitz-enz (2000) defines processes as "the link between human capital management and the enterprise's strategic goals. Human capital, often called people, is an asset. Through processes, which are activities, assets are put to work. The investment of human and other forms of capital in the process propels it on a course of contributing, or not, to the imperatives of the enterprise. If the imperative is to reduce operating expense, processes can be streamlined, automated, eliminated, or outsourced in support of the imperative." Technical Services measure or analyze the effects of these processes through performance measures such as business ratios, earned value, and cash flow which will be discussed in detail in Section 5. Therefore, processes that are unambiguous and clearly define the steps required to achieve a specific goal are essential for human capital to execute its mission. This business process requirement exemplifies the need for decision models, such as those discussed in section 6, as a starting point for management decisions regarding human capital.

3.6 Chapter Summary

This chapter examined the criticality of people to business success. The importance of job satisfaction, the effect of personnel turnover, and the use of processes to fully utilize company assets were discussed. This discussion identified that it is human capital that a company uses to achieve its goals and that a business process is needed as a starting point for management to make human capital decisions.

SECTION 4

AN OVERVIEW OF COSTS AND COST EVALUATION METHODS

This chapter examines costs and the impact of costs in a Technical Services company. Types of costs will be identified and how to control costs will be presented. This chapter will discuss how control of costs through management decisions can affect a company's economic value.

4.1 Economic Factors

Costs are the financial pluses and minuses that influence the "bottom-line" of a company and impact assets and liabilities on a company's financial statements. In many government oriented Technical Services firms, these business costs are tracked and accounted for with cost pools, which are a grouping of individual costs. The difference between a product-based versus service-based analysis is degree: how much of each direct and indirect charge is attributable to each product/service. In a Technical Services organization, there are direct and indirect charges, which may be recouped by billing the costs back to the contracting authority, and unallowable charges that are deducted from a company's profit.

As was discussed in the previous Section, processes enable an organization to meet its objectives, and can positively or negatively affect the economic value of a company. "Processes that contribute to enterprise goals are at least potentially assets. Those that are purely compliance based are liabilities. Most approaches to process

improvement overlook the nature of processes as real capital. Clearly, a process consumes resources and should be assessed from that standpoint. In short, economic value added is the best measure of process worth" (Fitz-enz, 2000). These economic factors are utilized in the performance measures discussed in Section 5 by management and customers to evaluate the company's value, its processes or potential undertakings.

There are numerous costs associated with doing business. These costs fall into categories or groups dependent on why the cost was incurred. Instead of tracking each cost separately, accounting for individual costs may be accomplished by assigning them to cost objects. This task is performed uniquely by each company at its discretion as defined in their disclosure statement detailing how and why these allocations were performed. Research on cost measurement and analysis defines a cost object as "an activity, output, or item whose cost is to be measured. It can be an organizational division, a function, task, product, service, customer or cost objective" (Willamette, 2001). This research continues by matching (assigning) cost items to cost objects in four ways: "(1) direct matching, (2) averaging (apportioning), (3) allocating, and (4) allocating and then apportioning" (Willamette, 2001). The importance of this assignment is in equitably assessing costs to the products and services that incur them.

Direct matching is for cost items that can be shown to only benefit a single cost object – a department, an activity, a process, a product or a service. Averaging, or apportioning, is performed when a cost item benefits one cost object, but is not used up, and is assessed on the portion used. Allocating occurs when cost items used to benefit

two or more cost objects are allocated to each on an equitable basis. And finally, cost items that benefit two or more cost objects at a time, but are not used up, are both allocated and apportioned dependent on their share. The assignment of cost items to cost objects allows for categories to be generalized and their values utilized by performance measures to analyze the economic value of the company. How and where these costs are incurred impact the efficiency and value of the company.

Cost objects are allocated to higher level categories called direct and indirect charges for the purpose of disclosing how these costs will be charged to the customer. Direct charges are assigned directly to the project they benefit. "Indirect charges (i.e., any cost item not directly associated with a final cost object) are pooled and allocated to all the cost objects that use its services, but not to any others" (Willamette, 2001). For example, many companies have multiple locations and require directors to operate each individual site; the cost of management of that site is allocated to each of the individual contracts at that site, but is not an allowable charge to a contract at another site (whereas corporate management is chargeable to all contracts company wide since maintaining the corporate structure as a whole benefits the entire company and every contract). In the same vein, depreciation may be a corporate function vice location dependent. An example of this is that Technical Services departments may not have a capital budget: they would buy computers or other capital assets as a cost to their locale, and the company would realize the depreciation which would help reduce the overall overhead instead of that of an individual division or department.

Since the product delivered is a service, hours delivered is a means of allocating costs to customers/consumers. Each individual hour would then take into account the direct and indirect charges associated with performing that task. Each individual task would then only have the cost elements directly related to it along with the applicable cost pool allocations attributable to that task.

4.2 Costs

In order to provide a product or a service, there are many associated items and activities that go along with performing that task, and each has an associated cost. Costs are defined as: "The price or imputed value of each resource assigned to an activity that is consumed in the process of producing the products and services of that activity" (Electronic College of Process Innovation, 2001). Groupings of costs associated with a Technical Services industry are:

- Indirect Costs
- Direct Costs
- Unallowable Costs

4.2.1 Indirect Cost

An indirect cost is a "cost that cannot be identified specifically with or traced to a given cost object in an economically feasible way" (Willamette, 2001). These are items and activities that are necessary to provide a product or service, but are not attributable to a single item or activity. There is no strict rule for which items fall under which charge

headings. Indirect Cost allocation is company unique and detailed in the company's disclosure statement for tax and financial statement purposes. Charge headings are:

- Overhead – The local management and "cost of doing business" items that are not attributable to any single cost object. May include fringe, occupancy and office expenses or list them as separate headings.
- General and Administrative Costs (G&A) – "Labor and non-labor costs that cannot be reasonably associated with any single output or group of outputs and are, therefore, allocated over all outputs" (Willamette, 2001).
- Material and Handling

Table 1 provides examples of these categories.

Table 1: Examples of Indirect Costs

Overhead	Fringe	Occupancy and Office Expense	General and Administrative	Material and Handling
Management (Local)	Holiday and vacation Pay	Furniture	Taxes: federal, state, sales, etc	Subcontractors labor, expenses
Incentives: bonus, awards	Educational Assistance	Computers	B&P (Bid and Proposal)	Materials, parts and supplies
Morale & welfare	Sick leave	Facility rent	Business Development	Tools
Training	Admin leave: jury,military,etc	Facility repairs & maintenance	Management (Corporate)	Freight
Dues and memberships	Worker's compensation plan	Utilities (telephone, janitorial, etc.)	Accounting: payroll, billing finance, etc.	Property movers
Subscriptions and pubs	Insurance health, life, etc.	Office supplies	Legal	Property holding costs
Drug testing	Pension plan, savings plan	Building supplies	Human Resources	Storage fees
Advertising	Professional development	Postage and delivery	Employee relocation	
Recruiting	Employee assistance			
Licenses and Fees	Social security, Medicare taxes			
Amortization and Depreciation	Unemployment taxes			

4.2.2 Direct Cost

Direct costs are items and activities that are attributable to a single event: "The cost of resources directly consumed by an activity. Direct costs are assigned activities by direct tracing of units of resources consumed by individual activities" (Willamette, 2001). Examples of direct costs associated with a Technical Services industry are found in Table 2.

Table 2: Examples of Direct Costs

Labor	Travel Expenses	Reproduction	Special Projects
Straight Pay	Meals	Paper	Straight Pay
Overtime Pay	Room Charges	Copier costs	Overtime Pay
Consultants	Transportation	Binders/folders	Project Unique costs
Temporary Labor	Per Diem		

4.2.3 Unallowable Cost

An unallowable cost is an item or activity that is necessary to promote a company but that cannot be charged to the customer as necessary for them to get the product or service they are acquiring. Some examples of unallowable charges for a Technical Services industry are:

- Marketing: memorabilia and costs of activities used for entertainment rather than the promotion of products for export (public relations and advertising costs for

U.S. government products not for export are not allowable) such as alcohol, gifts, models, souvenirs, etc.

- Ceremony costs such as corporate celebrations and new product announcements.
- Costs of promotional material, brochures, magazines and other media that are designed to call favorable attention to the contractor and its activities.
- Costs of souvenirs, models, imprinted clothing, buttons and other mementos provided to customers or to the public.
- Membership costs in civic and community organizations.
- Bad debts and their related collections costs and legal costs.

Generally, if the cost is not specifically required by the contract, or does not arise from requirements of government contracts, then it is not allowable. Allowable and unallowable charges are defined by the government in the Federal Acquisition Regulations (FAR) clauses which are updated on a periodic basis and may be found at numerous locations, including the Internet (FAR, 2001) at http://farsite.hill.af.mil/.

4.3 The Role of Cost

Specific items may be put under different charge headings (cost objects) provided that the way these items are billed is defined and reported in the company's disclosure statement and are within the Federal Acquisition Regulations requirements (example: taxes may be an overhead charge, or may come under General and Administrative). Where these factors are taken into account will vary from company to company and even within the same company over different years. Changes can be instituted at nearly any time. However, whenever the method is changed, it must be re-disclosed and must

receive government concurrence. This allows a company to realize the following advantages:

- tax breaks and profitability factors,
- reorganization expenses,
- and personal preference in forming the cost pool.

Control of these costs, cost objects and pools determines the financial worth of a Technical Services company. Providing technical expertise without driving up the percentage of indirect costs keeps a company profitable and in demand (e.g., more people on the direct labor payroll reduces the overhead percentage per person by amortizing the fixed costs over a larger employee base).

Evaluation of these economic factors leads to the economic value of the company. Since the cost objects take all direct and indirect charges into account, analysis of each cost center/site should provide the bottom-line. The total amount of sales less cost and unallowable costs would be the net profit for the period covered.

A common method for the financial analysis is the comparison of financial ratios between similar companies, or between different time periods for the same company. These ratios are developed using information obtained from a company's annual report. The annual report contains the balance sheets and cash flow sheets. Relating the direct, indirect and unallowable costs defined above to the factors shown in the annual reports and utilized in developing the financial ratios will enable analysis of these variables to

determine which are the most significant. Influence on or control of the most significant variables enables a company to affect its financial picture.

The economic value of a company may be influenced in myriad ways. Management has control over the processes that define how it does business. Management decisions that can have an affect on the economic value of the company include:

- personnel management,
- liability and asset management,
- cost allocation.

Personnel management decisions that affect economic value are those related to influences on unprofitable costs. Examples that influence these unprofitable costs are decisions that reduce the cost per hire and time to start of a new hire and reducing turnover. Any time there is not an employee working on an allowed task equates to a loss of direct sales. The sooner an individual comes to work, or the fewer employees that need to be replaced, the greater the sales and the fewer the expenses.

Liability and asset management is the control of costs to stay close to the predicted/ estimated rates and costs. Management decisions that achieve estimated rates and costs enable achievement of sales and profit predictions without cost overruns when actual rates are too high, or payback and lower profit when rates are too low.

Cost allocation is the assignment or distribution of money to the most profitable areas. Technical Services is a "Cash Cow" in that it has great liquidity (few fixed assets so money is on hand or quickly available to meet financial obligations). Much of the cash paid to perform the service can be diverted to other profitable areas before it has to be accounted for or used.

4.4 Chapter Summary

This chapter has illustrated the many ways that personnel processes, personnel management, and personnel decisions can affect the cost performance of a Technical Services company. As discussed throughout this document and specifically in Section 3, human capital is where a Technical Services company has its investment. Control of costs through management decisions can therefore influence the significant variables and subsequently the ratio analyses, thereby affecting the company's economic value. The next chapter traces cost performance to the evaluation of corporate performance.

SECTION 5

METHODS OF EVALUATING A COMPANY'S VALUE

This chapter presents a variety of performance measures that allow managers and financial analysts to evaluate business success, and to understand what those performance measures mean. It discusses a range of valuation methods such as financial ratios and Activity-Based Costing and relates these tools to the decisions made in human capital management as the means of assessing a company's strengths and weaknesses. It demonstrates that these current analytical tools are impacted positively by effective and efficient human capital decisions.

5.1 Performance Measures

There are many categories of data that investors and managers use to evaluate the performance of companies in general and service industry companies in particular. Performance measures are the analysis tools utilized in evaluating a business to determine its value and how well it is performing economically. This section will provide an overview of a variety of performance measures and associated meanings. Figures utilizing these measures will be used as an input to the modeling and analysis phase to evaluate the impact of human capital on the company's "bottom-line."

5.2 Business Ratios

A Technical Services company is analyzed in much the same way as any other company. The bottom line is determined from the financial reports submitted by the

company and evaluated utilizing the numerous methods and metrics common throughout industry and academia. "Financial analysis using business or financial ratios and norms provides a means of assessing a firm's strengths and weaknesses. Using data from the balance sheet and income statement, various ratios can be calculated, which can then be compared directly to those of competing firms of varying sizes" (Milner, 2001). The comparison of a company's operating results with those of specific competitors or the industry in general helps to identify that company's advantages and disadvantages. The comparison of a company's performance ratios over time points out strengths and helps to identify areas that may require more attention. The use of ratios alone does not provide a complete understanding of the results since there is always room for error or misinterpretation, but it does provide indicators to those performing the analysis.

Financial ratios can help describe the financial condition of an organization and determine whether it is performing to the expectations of the stockholders, allowing them to make inferences about the company's attractiveness as an investment. Ratios are only meant to give an idea of how well the company is performing since much underlying information is not obvious in the numbers obtained from a financial sheet. Increases in debt, decreases in working capital, etc., may be a deterrent to an investor unless research reveals the purchase of another company, or a major expense of Research and Development (R&D) monies to introduce a new product on the market. Ratios commonly used to determine the financial condition of a company are:

- Profitability ratios
- Activity Ratios,

- Solvency and Leverage Ratios,
- Market-Related and Dividend Ratios

Ratio definitions and their meanings are common throughout industry and are briefly described in the following paragraphs. Derivations of these ratios are utilized as examples in the spreadsheets provided in Appendix A.

5.2.1 Profitability Ratios

Profitability ratios compare resources used and activities performed. Profitability ratios include:

- Return on Investment;
- Earnings Per Share;
- Profit Margin.

5.2.1.1 Return on Investment (ROI)

Return on Investment (ROI) relates the use of a company's resources compared to its overall investment. ROI is a term comprising several independent ratios: Return on Assets, Return on Invested Capital, and Return on Equity.

Return on Assets (ROA) relates the net income of the company to its total assets. This shows how well the company has utilized its resources. "The ROA is a test of capital utilization – how much profit (before interest and income tax) a business earned on the total capital used to make the profit" (American Express, 2001). The formula is: ROA = Earnings Before Interest and Taxes / Net Operating Assets.

Return on Invested Capital (ROIC) relates net income of the company to its long-term resources. Deducting current liabilities eliminates current bills. The formula is: ROIC = Net Income / (Total Assets - Current Liabilities).

Return on Equity (ROE) relates the net income to the amount invested by shareholders. The purpose of this ratio is to show what the investment by the owners earned. "The return on equity measures the return earned on the owners' equity in the firm. The higher the rate the better the firm has increased wealth to shareholders. The basic formula is as follows: ROE = Net Profits / Shareholders Equity" (U.S. Business Reporter, 2001).

5.2.1.2. Earnings Per Share (EPS)

Earnings Per Share (EPS) expresses the earnings of a company on a per-share basis. Common Stock Shares (company stock whose value increases through an increase in market price) plus the Preferred Stock (stock in a company which have a defined dividend) or other securities that are converted into common shares are presented as "diluted." Spreading the income of a company over the shares held in that company is a simplified means for shareholders to calculate their proportional share of earnings. EPS is calculated as: EPS = Total Earnings / Number of Shares Outstanding.

5.2.1.3 Profit Margin

Profit Margin is a rate of return on sales. It is very useful when comparing stocks within similar industries. A higher profit margin indicates a more profitable company; a low profit margin can indicate pricing strategy and/or the impact competition has on margins. The profit margin ratio tells how much of each sales dollar is used to cover operating expenses and profit – what portion of sales contributes to the income of the company. It measures the difference between the cost to provide the product and the cost for which it is being sold. Profit margin is an analysis tool that may be use to chart a company's future. The ratio is determined by taking the annual net earnings after taxes divided by revenues, and is usually displayed as a percentage.

5.2.2 Activity Ratios

Activity ratios show how well a company utilizes assets. Activity ratios do not show as much information when dealing with support services as they do for a manufacturing company. Working Capital Turnover is a measure that identifies a company's ability to pay its bills with the funds on hand. It is the most meaningful activity ratio for a service company and is the only one discussed in this report.

5.2.2.1 Working Capital Turnover

Working Capital Turnover measures the speed by which current assets satisfy current liabilities. The difference between the current assets and the current liabilities is a company's net working capital. Net working capital finances receivables, cash in the bank and on hand and also short-term loans and advances. A steadily declining working

capital turnover ratio is an indicator that a company is in trouble. It signifies problems in effectively managing working capital. This ratio is calculated by dividing net sales by net working capital. The higher the ratio, the better the company's ability to manage its receivables, inventory and cash so that it can generate more revenues.

5.2.3 Solvency and Leverage Ratios

Solvency and leverage ratios show a company's ability to meet its financial obligations and indicate the liquidity of the company. Leverage ratios show the extent that debt is used in a company's capital structure; solvency ratios give a picture of a company's ability to generate cash flow and to pay its financial obligations. Solvency and leverage ratios include:

- Current Ratio;
- Acid Test Ratio;
- Debt Ratio.

5.2.3.1 Current Ratio

Current ratio is a test to see how well a company is able to pay its current bills. "This is the standard measure of any business's financial health. You derive this ratio from the figures on your balance sheet. It tells whether a company has enough assets to cover its liabilities" (American Express, 2001). As a general rule, a current ratio of 1.5 or greater means a company has sufficient assets to meet its near-term operating needs. A current ratio that is too high may suggest that a company is keeping its assets instead of using them to grow the business. Some industries have their own norms as far as which

current ratios make sense and which do not. The formula is: Current Ratio = Current Assets / Current Liabilities.

5.2.3.2 Acid Test Ratio

Acid test ratio is a ratio of quick assets (on-hand or short notice cash and cash equivalents) to current liabilities to show the short-term liquidity (ease of changing assets to cash) of a company to pay near-term bills. "This is a tougher measure of liquidity than the current ratio because it excludes inventories when counting assets. It calculates the company's liquid assets in relation to its liabilities. The higher the ratio, the higher the business' level of liquidity, which usually corresponds to its financial health." (American Express, 2001). The desired ratio is 1:1, indicating the company can pay its near-term debt, yet doesn't keep too much cash on hand (reinvesting in growth in the company). The basic formula is: Acid Test Ratio = (Current Assets - Inventories) / Current Liabilities.

5.2.3.3 Debt Ratio

Debt ratio shows how much a company is dependent on shareholder contributions or on liabilities and long-term debt. The higher the debt ratio, the more leveraged the company is and the greater the risk to shareholders (which can pay off in greater returns to the shareholders). The more debt a company has outstanding, the more earnings must go to making the payments on the debt. This limits the amount of capital that can go to growing the business, research and development, or paying dividends to shareholders. The basic formula is: debt divided by net assets.

5.2.4. Market-Related and Dividend Ratios

Market-related and dividend ratios relate market price and shares of stock to the earning potential of the company. These ratios relate the value of a company to the investors and analyzers. Market-related and dividend ratios include:

- Price Earnings Ratio
- Dividend Yield.

5.2.4.1 Price Earnings Ratio

Price earnings ratio relates the earnings of the company to the market price of stocks. This shows basically how much promise a company has, with the greater the multiple indicating the greater the promise. It compares the current price of a stock with its earnings to see if it is over- or under-valued. A ratio of 20-25 is the market average P/E ratio. A higher P/E means that the investors are anticipating growth in the future for a greater return on their investment. The basic formula is: Price Earnings Ratio = Market Price per Share / Earnings Per Share (EPS).

5.2.4.2 Dividend Yield

Dividend yield shows the investor what kind of (dividend) return may be obtained based on the market price of the stock. It tells what percentage of the purchase price the company will return in dividends per share. This is not necessarily an indicator of how well the company is performing. Dividends are paid from company profits. If the company chooses to reinvest its earnings into the company vice paying dividends, it will

have no dividend yield, yet may still be a great performer based on other performance indicators. The ratio is: Dividend Yield = Dividends Per Share / weighted average Market Price Per Share of stock.

5.3 Financial Ratio Analysis

Ratio analysis is a useful management or investment analysis tool because it helps identify positive and negative trends in a company's performance. Analysis is performed by the calculation and comparison of ratios derived from a company's financial statements. The level and historical trends of these ratios can be used to make inferences about a company's financial condition, its operations and attractiveness as an investment. The managers of a company utilize financial ratio analysis to "monitor operations and determine whether or not the company is running efficiently. For example, ratios can indicate whether a business is carrying a dangerous amount of debt, holding too much inventory, or not collecting accounts receivable quickly enough" (American Express, 2001). The monitoring process is performed by utilizing the data from the company's balance sheets and financial reports and inputting it into the ratios previously discussed to assemble a financial picture of that company. This financial picture tells both management and investors a great deal about the performance and future prospects of a company.

Ratios on their own do not always tell the complete story. For example, a comparison to previous years may show trends that are essential to determining if business is healthy or declining. Observing a trend based on previous years can raise

questions as to fundamental direction. An increasing trend may cause an investor to ask: is the company performing well, or is it paying out its earnings to investors trying to get more interest before it goes under? Similarly, a declining trend may cause the investor to ask: is the company performing poorly, or did it just make a major capital purchase, increasing its debt, gearing up for an expansion of its product line? Ratios are performance indicators that may be used by management or investors to assess the financial condition of a company. They are not the final assessment, just a data point to be interpreted (correctly or not) by the user. This is why analysis of a company's financial report is so difficult. The presentation of the data that makes up the answers and how it is compiled is up to the person putting the report together.

5.4 Economic Value Added

In addition to business ratios, financial reports also present investors with other measures of a company's economic value. There are those with the opinion that "Economic Value Added is the financial performance measure that comes closer than any other to capturing the true economic profit of an enterprise. EVA® also is the performance measure most directly linked to the creation of shareholder wealth over time" (Stewart, 2001). It is the difference in value between the total sales and what is required to run the business and can be shown by "EVA = Net Operating Profit After Taxes (NOPAT). Put most simply, EVA is net operating profit minus an appropriate charge for the opportunity cost of all capital invested in an enterprise. As such, EVA is an estimate of true 'economic' profit, or the amount by which earnings exceed or fall

short of the required minimum rate of return that shareholders and lenders could get by investing in other securities of comparable risk" (Stewart, 2001).

The most distinctive and important aspect of EVA, compared to other economic measures, is its capital charge. Under a conventional accounting system, most companies appear profitable that are not really, when evaluated using EVA. "Until a business returns a profit that is greater than its cost of capital, it operates at a loss. Never mind that it pays taxes as if it had a genuine profit" (Stewart, 2001). EVA takes a simple approach to understanding a company's net worth. It starts with operating profits and simply deducts a charge for the capital invested in the company. This can be portrayed for the entire company, or broken down into a business unit, plant and office or even down to an assembly line.

5.5 Cash flow

Cash flow as defined by Lauren Rudd of the Savannah Morning News "is the cash that flows through a company during a fixed interval after taking out all fixed expenses." She goes on to point out that the "most commonly used definition is earnings-after-taxes to which you add back depreciation along with any other "non-cash" expenses. Why do you add back depreciation? Non-cash expenses, such as depreciation, are expenses that have been subtracted out to arrive at net income, but which require no cash outlay." There is also the opinion that "cash flow gives the clearest possible picture of a company's overall health because it measures the ability of a company to generate funds for reinvestment. With ample cash flow a firm has the ability to pay off debt, increase

dividend payments and acquire or develop new products. Cash is financial power" (Rudd, 2001).

Cash flow is a measure of the money going into and out of a business. Most cash inputs to a company come from operations: cash sales and collections of receivables. Other possible sources of cash inputs would include: investment income from interest or dividend income and financing income derived from sales of assets. Cash outlays include inventory purchases, wages, dividends, operating costs (utilities, insurance, maintenance, etc.), interest, deposits and all taxes. "Note, income tax savings from losses are included in the inflow of cash to the business. Positive cash flow refers to more money coming into the business than is going out; negative cash flow refers to the converse situation" (CCH, 2001).

5.5.1 Cash Flow Improvement

The most beneficial way to improve the value of a company is to improve its cash flow. One way a Technical Services company can accomplish this is through its billing of invoices. The object is to bill as frequently as possible. This is a simple matter of cash flow. The more often a company can bill, the more often it gets paid. The quicker cash comes in, the quicker it can be used to pay off outstanding debts, lowering interest payments and increasing cash at hand. "Accelerating cash inflows allows your business to pay its own bills and other obligations on time, or even earlier than required" (CCH, 2001). At the same time, "delaying cash outflows makes it possible for you to maximize the benefits of each dollar in your own cash flow. Seeing the benefit of delaying your

cash outflows is the first step in managing them. The proper management of cash outflows requires tracking and managing business liabilities. Managing cash outflows also requires following one simple, but basic rule 'Pay your bills on time, but never pay your bills before they are due.'" (CCH, 2001).

Taking cash flow and deducting required expenditures such as cash dividends and depreciation results in Free Cash Flow. Free Cash Flow is the cash available to a company to use in any way they want, for example, to pay off debt at an accelerated rate.

5.6 EBITDA

Of the many econometric measures available, EBITDA is the most controversial. EBITDA stands for Earnings Before Interest, Taxes, Depreciation and Amortization. Venture Coach (2001) explains the "theory is that depreciation is a non-cash expense, and thus should be backed out of earnings before measuring a company's earning power. However that ignores the fact that cash actually must be spent on assets in order to run the business. Backing out depreciation without adding in cash expenses is akin to claiming that the business's capital expenditures aren't relevant in measuring its earning potential." This is basically taking a company's operating profit and adding the tangible and intangible taxes and showing it as available money.

EBITDA is of interest to investors that are looking at the "potential" earnings and profitability of a company. "Many publicly traded companies tend to refer to EBITDA as though it represents "cash" earnings, based in part on the fact that "D" and "A" in

EBITDA are non-cash expenses. Nevertheless, it's not the same as real operating cash flow. Let's start with the party line on EBITDA: Capital-intensive companies report EBITDA to give investors a feel for cash flow before debt payments, taxes, depreciation, and amortization charges reduce the income statement to ashes" (Fool.com, 2001). It is an excellent means to get investors interested in a company that may be highly leveraged with capital assets.

Performance measures tell the story the company wants seen. EBITDA shows its investors a modified operating profit. "EBITDA pretends, in effect, that the goodwill and other depreciation charges aren't here, and focuses only on numbers that basically consist of little more than operating income. In other words, EBITDA investing invites you to leave out expenses such as capital investment and maintenance, and concern yourself only with whether a company generates enough cash to pay its debt charges and operating expenses. It's a dangerous strategy, though, because EBITDA numbers don't tell you whether a company is generating enough money to grow in the future" (Byron, 2000). EBITDA is concerned with the ability of a company to pay its near term debts, but is not concerned with showing how a company meets all of its debts.

"Many new-economy businesses spend much of their money on hardware and software infrastructure that's capitalized as an asset on their balance sheet. Using EBITDA lets entrepreneurs and their bankers produce a positive number with the big up-front expenses backed out of the earnings calculation" (Venture Coach, 2001). "The practice is sometimes defended by claiming that a one-time large development expense

shouldn't be used to judge the ongoing attractiveness of a business. But many new-economy businesses have not demonstrated that development is a one-time expense. In fact, technology changes so fast that it is fairly certain that a whole new round of hardware and software purchases will be happening every few years" (Venture Coach, 2001). Performance measures allow companies to show their investors what they want them to see. If a company is highly leveraged in capital expenses, it wants to show that when those expenses are taken care of (capital costs have depreciated, etc.), it will be a profitable investment. The downside being, companies that continually make significant capital investments may not achieve that mark.

The idea behind EBITDA is "to give investors a sense of how much money a young or fast-growing company is generating before it shells it all out to creditors, Uncle Sam, etc. If EBITDA grows over time, it gives investors at least some sense of future potential profitability" (Fool.com, 2001). EBITDA is not very useful when compared with other performance measures, but like many other performance measures is a good indicator of growth or decline when compared to itself over time.

The basic formula to obtain EBITDA is:

Total Sales
- Less cost of sales (Direct)
- Less depreciation, amortization, bank fees and state tax
= Equals Contract Profit
- Less unallowables
- Less bad debt reserve
+ Add state tax
= Equals Operating profit
+ Add depreciation, amortization and bank fees
= Equals EBITDA

5.7 Activity Based Costing (ABC)

Processes are a means of examining the performance measures of a company by dealing with how a company's costs are allocated. "Activity-based costing (ABC) is an information system that maintains and processes data on a firm's activities and products. It identifies the activities performed, traces cost to these activities, and then uses various cost drivers to trace the cost of activities to products" (Acquisition Reform Office, 2000). Process analysis is conducted using an activity-based costing tool and determining if an activity is value added or non-value added. "Activity-based costing is not designed to trigger automatic decisions. It is designed to provide more accurate information about production and support activities and product and services costs so that management can focus its attention on what is most effective and efficient" (Acquisition Reform Office, 2000). Needy (2000) clarifies that ABC focuses on understanding the cause and effect between resources used and costs expended so that overhead can be traced directly to the cost object as opposed to being arbitrarily allocated. So performance measures in a Technical Services company are more than just bottom-line numbers, but also encompass the processes involved in determining how to get those values.

Activity Based Costing focuses on indirect costs (overhead) and makes "indirect" expenses "direct" (Pittsburgh, 2001). ABC can be identified with EBITDA in that it also has shortcomings. ABC can be said to fail to account for capital cost; ignore investment risks; ignore cash flow factors; tend to underestimate object's cost; or allow company capital to be diluted. It is just a means of linking indirect costs to a direct charge. "In

most cases, the ABC analysis terminates after the operating cost (overhead) is traced to the cost objects and added to the direct cost. These results are called "profit before interest and taxes" or "operating profit" (Roztocki, 2001).

ABC costing is an innovative process that is ideally suited to a services organization that is mainly operations based. In this process direct costs are incurred by the operations directly associated with supporting the service. Indirect costs are incurred by support operations. Cost drivers are the activities that affect costs and establish a basis for assigning direct and indirect / overhead costs to the associated service. Activities consume resources and as such they are the source of the cost. Traditional cost systems are based on absorbing or allocating costs. ABC views cost drivers as the activities used to support the service.

"ABC measures process and activity performance, determines the cost of business process outputs, and identifies opportunities to improve process efficiency and effectiveness. Qualitative evaluation and determination alone is totally inadequate as a single measure of improvement. Though quality might determine 'better', it does not contribute to other meaningful decisions such as what is 'cheaper' and 'faster'. It is the integration of these two dimensions that is the critical decision support element of the total process. ABC is the mechanism to integrate these two views" (DoD, ABC Guidebook, 1995). ABC captures organizational costs and administrative expenses and applies them to the defined activity structure. It is a process that enables accounting for all activities associated with providing the required service and feeds the information to

other performance measures by allocating costs to the appropriate categories in the financial spreadsheets to be analyzed by management for their business decisions. As with any other tool, Roztocki (1999) points out that the system by itself will not make improvements, but will provide management with information to direct improvement efforts. Kaplan (1998) provides that service companies will make the best decisions when they combine their ABC analysis with customer requirements to select segments to be targeted for growth and profitability.

5.8 Chapter Summary

This chapter presented a variety of Performance Measures whose purpose is to allow managers to judge business success, and to understand what those performance measures mean. Discussions covered valuation methods such as financial ratios and Activity-Based Costing. The discussion identified financial analysis as the means of assessing a company's strengths and weaknesses. The effective and efficient use of human capital positively impacts these current analytical tools by having management decisions that attribute to the increase of cash flow, implicitly improving a company's financial health.

SECTION 6

ANALYSIS OF HUMAN CAPITAL IMPACT ON THE "BOTTOM-LINE"

Previous chapters have examined the nature of the Technical Service industry, the importance of human capital and how human capital decisions impact corporate valuation and financial performance. The issue is how managers develop a process that integrates these issues. The decision model discussed in this chapter looks at both strategic and tactical decisions, and provides a starting point to a whole systemic view of human capital on meeting company objectives and minimizing costs. The discussion introduces the models used to quantitatively equate human assets to meeting company goals. This section discusses how management may use the proposed models to make work force decisions that minimize costs and contribute to increasing cash flow.

6.1 Analytical Processes

So how does human capital apply to "the bottom-line" of a company's value? This thesis discussed the importance of human capital economic factors that play into the financial workings of a Technical Services company and the performance measures utilized to evaluate the value of a Technical Services company. This section demonstrates the application of human capital to achieve business objectives and the resultant effect on the "bottom line." Assuming a Technical Services company has determined its strategic objectives, an analysis must be performed to ascertain whether the company is prepared to meet those goals. Its current personnel are evaluated, and the impact of acquiring or terminating personnel to meet its objectives is established. To

accomplish these two processes, the following decision science techniques shall be employed:

- Quality Function Deployment (QFD) - establishes relationships between objectives and personnel skill sets.
- Linear Programming (LP) - an optimization tool for maximizing or minimizing the objective function through the use of decision variables. In this context cost is the objective function and the use of an LP model to minimize costs may be used to equate the use of human capital decisions to increase a company's cash flow and financial health.

The influence of human elements on the success or failure of initiatives implemented is not discussed in this thesis and the models presented do not include social aspects to add robustness to the methodologies. Keating, et al. (2001) proposes a Modified Sociotechnical Systems (MoSTS) methodology for holistic analysis of complex technical processes that could facilitate analysis of the impact where human influences may have a significant impact on success. Keating (2001) examines applications of Business Process Reengineering (BPR) and the demonstrated utility of utilizing Sociotechnical Systems (STS) based principles. His work and his research of others (Steininger, 1994; Bolman and Deal 1997; Knights & McCabe, 1998; Evans, et. al., 1999) details the common theme in the analysis of BPR efforts that human elements have significant influences in determining success or failure of reengineering interventions, and the primary strength of STS based methodologies for redesign is their emphasis on human influences in process performance. Incorporation of these other influences that impact managerial decisions

would provide a more holistic approach to providing management with the information they require to make their human capital decisions.

6.2 Quality Function Deployment (QFD)

Quality Function Deployment (QFD) (also known as the House of Quality) is a methodology traditionally employed to quantify customer needs and reflect these requirements into design decisions. QFD is employed through a set of matrices that link customer wants and needs to product and service design metrics that a company is able to track and control. Several detailed texts describe these methods and approaches including Shillito (1994) and Guinta et al. (1993).

Kauffmann (1999) utilized this approach to identify a portfolio tool to prioritize research investment decisions. A variation of this methodology applied to the human capital realm allows the determination of how well a Technical Services company meets its objectives and how well the current skill sets of its employees support these objectives. QFD is applied in a hierarchal top-down process that begins with determining the objectives of the company (the customer requirements) and leads to quantitative measures of market characteristics. In essence, Kauffmann (2000) points out that QFD may be used to map a set of market area specifications (known as "whats") to skill sets (known as "hows") through a flexible set of matrix operations. The resulting product is a quantitative priority value for meeting requirements based on the human capital skill sets. QFD is a model that can be used to structure a Technical Services company's management decisions to meet strategic objectives through the use of human capital.

6.2.1 QFD Objectives

The Quality Function Deployment model in this context is used to relate the strategic areas (objectives) to the current employee skill sets available. The assumption is that management has already determined the strategic areas and has established the overall relative importance (weight) of these areas to meeting the company's goals. Generally, the market identification and weighting is performed through a group decision process such as the Delphi method which is detailed in several texts, including Sahakian (1997).

An example of a market area formulation based on objective importance for a Technical Services company is shown in Table 3. It is an example of where a management team has discussed the areas in which its company is strong and prioritized the importance of each of these areas in meeting the strategic goals of the company.

Table 3: Market Area Formulation

Market Area	Objective Importance	Area Description
Engineering	40%	Provide Technical, systems engineering support
Programming	25%	Develop, analyze, debug computer software, code
Safety	15%	Provide System and Software Safety expertise
IV&V	12%	Provide Independent Verification and Validation
Management	8%	Provide management, contracts and administrative support

6.2.2 QFD Impact on Objectives

The next step in the QFD process involves defining the impact of the employee skill sets on the objectives. To evaluate this impact, a traditional (9, 3, 1) QFD scoring method is utilized and typically developed with a team-based decision process where not just one person determines the impact, but a conglomeration of people make the determination. This is using a qualitative approach to develop a quantitative ranking, but does not take into account the sensitivity and social interaction between skill sets. A (9) indicates high impact of a skill set on an objective, (3) indicates medium, (1) indicates small, and (0) indicates no impact. Any standard or user defined scale may be used, depending on the relative accuracy and definition that is intended to be portrayed. This scale accentuates strong relationships (value of 9) and identifies higher levels of priority. Other scales such as 3, 2, 1 and 5, 3, 1 may be used, but do not make the priorities stand out as well. More information on scoring can be found in Lu et al. (1994). This table will be referred to as the technical impact matrix. Table 4 demonstrates this scoring method.

Table 4: QFD Impact Scoring

Market Area	Importance (weight)	Managers & Administrative	Engineers	Scientists	Programmers	Technicians & Analysts
Engineering	40%	3	9	9	3	3
Programming	25%	0	3	3	9	0
Safety	15%	1	3	3	3	1
IV&V	12%	1	3	3	3	9
Management	8%	9	3	3	1	1

6.2.3 QFD Skill Set Interaction

Determining the interaction between the skill sets themselves is also of great importance. A given skill set may achieve a technical objective but it may also have an influence on another skill set. This skill set interaction may either enhance or detract from the ability to meet program objectives. These interactions are defined by column vectors that describe the impact of a given skill set on the other skill sets. The scoring method employed in the example describes this interaction in terms of a relative rating less than one. (The value "one" describes the impact of the skill set upon itself and it is implicitly assumed that the impact from other skill sets will be less than this value.) The specific numerical values in Table 5 originate from the QFD (9, 3, 1) rating scale used in Table 4. A high interaction results in a score of 9 / (9+3+1) = 9/13 = 0.69, medium interaction results in a score of (3/13) = 0.23, low interaction is valued at (1/13) = 0.077, and no interaction results in a zero.

The model becomes too complicated when adding these social interaction influences on skill sets. The influences are issues for management discretion. This model provides a starting point for those management decisions. There is the possibility of having a negative interaction based on the social system. The negative impact is not considered here but may be an event to consider in a follow-on study.

Table 5: Skill Set Interaction

Market Area	Managers & Administrative	Engineers	Scientists	Programmers	Technicians & Analysts
Managers & Administrative	1	0.69	0.23	0	0.077
Engineers	0.23	1	0.69	0.23	0.23
Scientists	0.23	0.69	1	0.077	0.23
Programmers	0	0.077	0.077	1	0.077
Technicians & Analysts	0.077	0.23	0.23	0.23	1

6.2.4 QFD Impact Assessment

Using the data presented in Tables 4 and 5, the QFD model can develop a range of useful information upon which to base programmatic decisions. The combination of this data is performed by matrix multiplication and results in a quantitative measure of the direct and interaction impact of the skill sets on the market objectives, similar to that of a QFD portfolio model (Kauffmann 1999). To perform this analysis, the general case is to take the direct impact data of Table 4 as a Matrix (A) of m rows representing strategic objectives and n columns representing skill sets. The elements of this matrix may be described as a_{ij} (i=1, 2, ..., m and j = 1, 2, ..., n). The interaction data in Table 5 is then represented as an n x n matrix (B) with elements b_{ij} (i, j = 1, 2, ..., n). The combined impact, including interactions, of skill sets on strategic objectives may then be

defined by the m x n matrix (C). The elements of (C), c_{ij}, describe the complete impact of skill sets on objectives as shown in Table 6.

Table 6: QFD Assessment

Market Area	Objective Importance (weight)	Managers & Administrative	Engineers	Scientists	Programmers	Technicians & Analysts	Row Total	Normalized Row Total
Engineering	40%	**7.4**	**18.2**	**16.8**	**6.5**	**7.6**	56.4	33%
Programming	25%	**1.4**	**5.8**	**5.8**	**9.9**	**2.1**	24.9	14%
Safety	15%	**2.5**	**6.2**	**5.8**	**4.2**	**2.7**	21.3	12%
IV&V	12%	**3.1**	**8.1**	**7.6**	**6.0**	**10.7**	35.4	20%
Management	8%	**10.5**	**11.6**	**7.4**	**2.2**	**3.2**	34.8	20%
Sum	172.8							
	Normalized Impact Values							
Engineering	40%	0.13	0.32	0.30	0.11	0.13		
Programming	25%	0.06	0.23	0.23	0.40	0.08		
Safety	15%	0.12	0.29	0.27	0.20	0.13		
IV&V	12%	0.09	0.23	0.21	0.17	0.30		
Management	8%	0.30	0.33	0.21	0.06	0.09		
Skill Set Importance		0.12	0.28	0.26	0.20	0.14		

The upper portion of Table 6 contains matrix (C) and provides the quantitative measure of both direct and interaction impact of the skill sets on the company objectives.

For example, matrix (C), element c_{11} is the case of the impact of Management on Engineering:

$$C_{11} = 3*1 + 9*.23 + 9*.23 + 3*0 + 3*.077 = 7.4$$

This can be performed in Microsoft Excel utilizing the function MMULT by taking the values from the first row in Matrix (A) times the values from the first column in Matrix (B) to obtain the result for the first row, first column element in Matrix (C). The row total column in the upper portion of Table 6 is a summation of the row impact values. For example, the row total for Engineering is:

$$\sum_{j=1}^{n} c_{ij} = 7.4 + 18.2 + 16.8 + 6.5 + 7.6 = 56.4$$

Dividing the row total by the grand total of all the (C) matrix elements and expressing this value as a decimal or percentage value develops the normalized row total:

$$56.4 / 172.8 = .33 \ (33\%)$$

The row totals provide a quantitative assessment of how the current skill sets support the objectives and are a relative measure to determine if the impact of the skill sets is proportional to the stated importance of the strategic objective. Comparing this value to the strategic objectives weighted value shows if the skill sets under or over support the strategic objectives. For example, from Table 6, Programming has a high significance to the company with a weighted importance of 25%, yet the current skill set under supports this objective by being only 14% important. This information tells the management team that the technical skills do not match up to the stated market priorities. Either cross-training to improve the programming interaction on objectives, or a

redefinition of expectations is required to bring the objectives in line with the employee base. The lower portion of Table 6 assesses the overall importance of the skill set on the objectives as shown in the next section.

6.2.5 QFD Skill Set Importance

The final use of the QFD method for this assessment is to determine the importance of a skill set both to an individual objective and to the overall company. To accomplish this, the upper portion of Table 6 is restated in the lower portion in terms of normalized impact values. Each row element is divided by the row total to obtain the normalized value. For example, element c_{11} (7.4) is divided by the row total for the Engineering objective (56.4), to obtain 0.13. This value indicates that the Management skill set produces 13% of the impact on the Engineering objective. To obtain the relative importance of the skill set to the overall program (T), the importance of each objective is multiplied by the impact of the skill set on that objective and summing these values. In Microsoft Excel, this function is SUMPRODUCT and is a summation of the products of the Strategic Objective's importance times the normalized impact values for each skill set. For example, the importance of the Engineers skill set is determined by:

$$T_{Engineers} = 40\%*.32 + 25\%*.23 + 15\%*.29 + 12\%*.23 + 8\%*.33 = .28$$

Looking at the entire row, Engineers are identified as having the most importance to the company as measured by the direct impact on management decisions.

For sensitivity comparison, trials using scales of 8, 4, 2 and 3, 2, 1 were utilized in Tables 4 and 5. The resulting matrices lowered the importance of programming and the role of

engineers in contrast to the strategic objectives. The 9, 3, 1 scale accentuated the priorities accordingly which added credibility to the selection of this ranking method.

6.3 Linear Programming (LP)

The Quality Function Deployment model tells management where to concentrate its resources to meet the strategic objectives of the company, but not how to accomplish that task in the near term to impact financial performance. Linear Programming (LP) is a tool that can quantitatively identify an advantageous use of a company's resources. From a tactical view, LP may help management decisions required to minimize costs based on near-term contract decisions. Although LP does not reflect all the factors involved in a management decision, it can develop a starting point for evaluation.

Stevenson (1999) describes linear programming as a powerful quantitative tool used by operations managers and other managers to obtain optimal solutions to problems that involve restrictions or limitations, such as the available materials, budgets and labor. Linear programming may be used for many applications in a Technical Services company where the situation involves resource constraints, including:

- Developing financial plans
- Identifying the best set of worker-to-job assignments
- Identifying which contracts are the most beneficial.

6.3.1 Components of a Linear Program (LP)

Most managerial decisions deal with optimizing their resources by either maximizing profit or minimizing loss. Dantzig (1963) explains that if a system exhibits a structure which can be represented by a math model and the objective can be quantified, then a computational method may be made for choosing the best schedule of actions among alternatives. LP models are mathematical approaches to solving these problems. An LP model is comprised of four components:

- Objective.
- Decision variables.
- Constraints.
- Parameters.

6.3.1.1 Objective Function

The obvious reason for solving a math problem is to obtain an answer. In the case of LP, this answer defines an objective, given the specific requirements and constraints. Generally, the objective is classified as a maximization or a minimization. LP algorithms require that a single objective be specified, such as the maximization of profits or the minimization of total costs.

6.3.1.2 Decision Variables

Decision variables represent choices available to the decision maker in quantified terms of either inputs or outputs. For example, some problems require choosing a combination of inputs to minimize total costs, while others require selecting a

combination of outputs to maximize profits or revenues. Decision variables represent the level of activity by the company, e.g., the company will utilize x_1 number of engineers and x_2 scientists to meet the required manning levels on 3 different contracts.

6.3.1.3 Constraints

Constraints are the restrictions that limit the decision makers' options. They are the linear relationships of the decision variables which represent the restrictions of the operating environment, e.g., tasking must be complete in 40 weeks or less. There are three types of constraints:

- Less than or equal to ($\leq$) ,
- Greater than or equal to ($\geq$),
- Equal to (=).

An LP model can consist of one or more constraints. The constraints of a given problem define the set of all possible combinations of decision variables. LP algorithms are designed to select the combination of decision variables that will optimize the objective function.

6.3.1.4 Parameters

An LP model consists of a mathematical statement of the objective and a mathematical statement of each constraint. These statements consist of symbols (e.g., x_1, x_2) that represent the decision variables and numerical values, called parameters. The parameters are fixed values and the model is solved given those values.

6.3.1.5 Assumptions

Stevenson (1999) also states that in order for LP models to be used effectively, certain assumptions must be satisfied. These are:

1. Linearity: the impact of decision variables is linear in constraints and the objective function.
2. Divisibility: non-integer values of decision variables are acceptable.
3. Certainty: values of parameters are known and constant.
4. Non-negativity: negative values of decision variables are unacceptable.

6.3.2 Model Formulation

The important piece of determining how human capital affects the bottom line is the optimal use of these resources to meet contractual needs. Assembling all of the known requirements and constraints is the first step to turn the problem into a model.

The following example is provided to demonstrate the use of LP. From the QFD model, engineering is the Technical Services company's strength but it needs to build up its programming market. The company decides to bid on three contracts that require strong engineering but will enable the company to build its programming beyond its current capabilities. The first contract requires at least 10 engineers, eight programmers and four technicians to work full time, and a total of 260,000 hours over the next five years. The second contract requires at least 30 engineers, 10 scientists, 20 programmers and eight technicians to work full time, and a total of 700,000 hours over the next five years. The third contract requires at least 12 engineers, eight programmers and four

technicians to work full time, and a total of 280,000 hours over the next five years. There are 2000 hours per person, per year for a full time employee. At least one manager and one administrative assistant are required on each contract.

The generic composite cost to the government per category is (direct salary plus overhead plus General and Administrative plus fee):

- Engineer $150,000
- Scientist $160,000
- Programmer $120,000
- Technician $90,000
- Manager $150,000
- Administrative Assistant $50,000

Engineers are the skill set requiring the most personnel. The cost to retrain other categories to meet the requirements far exceeds the cost of laying off surplus personnel and hiring the requisite engineers. In a Technical Services company, most managers have technical degrees and have for the most part come up through the ranks. Assuming generic costs to train other skill sets to meet engineer requirements and generic hiring and lay-off costs to meet the contract requirements (including advertising, bonuses, relocation and separation pay), what is the best combination to minimize cost to achieve the required skill sets?

- Hire an engineer: $10,000; lay off = $25,000
- Hire a scientist: $10,000; retrain to be an engineer: $5,000; lay off = $26,667

- Hire a programmer: $8,000; retrain to be an engineer: $12,000; lay off = $20,000
- Hire a technician: $5,000; retrain to be an engineer: $15,000; lay off = $15,000
- Hire a manager: $10,000; retrain to be an engineer: $5,000; lay off = $25,000
- Hire an administrative assistant: $2,000; retrain to be an engineer: $20,000; lay off = $8,300

Objective: minimization of cost.

The situation has constraints, parameters and an objective. Linear Programming can now be applied to the problem. Organizing the known data results in:

Decision Variables:

- x_1 = Number of Engineers to be utilized
- x_2 = Number of Scientists to be utilized
- x_3 = Number of Programmers to be utilized
- x_4 = Number of Technicians to be utilized
- x_5 = Number of Managers to be utilized
- x_6 = Number of Administrative Assistants to be utilized

Subject to:

- $x_1, x_2, x_3, x_4, x_5, x_6 \geq 0$ (non-negativity)

1,240,000 hours / 5 years / 2,000 hours per year per person = 124 people required.

- At least 10 + 30 + 12 engineers: $x_1 \geq 52$
- At least 10 scientists: $x_2 \geq 10$
- At least 8 + 20 + 8 programmers: $x_3 \geq 36$
- At least 4 + 8 + 4 Technicians: $x_4 \geq 16$

- At least 1 manager per contract: $x_5 \geq 3$
- At least 1 administrative assistant per contract: $x_6 \geq 3$

This provides the detailed listing of the parameters and constraints required to meet the problem identified. This information may now be used to meet the objective.

6.3.3 LP Solution Using Solver

The LP may be solved graphically or, as shown in this example, through the use of a computer program such as in this case, Microsoft Excel's Solver. To solve this LP, the known information is organized in a matrix as shown in Table 7 and the Excel Tool Solver utilized as described.

Table 7: LP Set-up using Solver

	A	B	C	D	E	F	G	H	I	J	K
1		Cost Summary						Constraints			
								Set Target			
2	Position	Annual	Hiring	Firing	Retrain as engineers			Cell =	K28	Min	
								By			
3	Engineer	150000	10000	25000	0			Changing:	C21:E26		
4	Scientist	160000	10000	26600	5000			C21:E26 =		Integer	
5	Programmer	120000	8000	20000	12000			C21:E26 >=		0	
6	Technician	90000	5000	15000	15000			G21:G26 >=		F12:F17	
7	Manager	150000	10000	25000	5000			G27 = 124			
8	Administrative	50000	2000	8300	20000			Solve			
9											
10			Requirements								
			Contract	Contract	Contract						
11	Personnel	Current	1	2	3	Need tot.	Difference				
12	Engineer	35	10	30	12	52	17				
13	Scientist	15		10		10	-5				
14	Programmer	20	8	20	8	36	16				
15	Technician	12	4	8	4	16	4				
16	Manager	5	1	1	1	3	-2				
17	Administrative	3	1	1	1	3	0				
18											
19			Decision variables			Base	Personnel				Cost
20		Base	Hire	Fire	Retrain	Adjusted	Total	Hire	Fire	Retrain	Total
21	Engineer	35	0	0	0	35	35	0	0	0	0
22	Scientist	15	0	0	0	15	15	0	0	0	0
23	Programmer	20	0	0	0	20	20	0	0	0	0
24	Technician	12	0	0	0	12	12	0	0	0	0
25	Manager	5	0	0	0	5	5	0	0	0	0
26	Administrative	3	0	0	0	3	3	0	0	0	0
27					0		90				
28											0

The Excel tool sets up the problem allowing for the objective (minimization of cost) to be achieved. The tool accounts for the parameters and constraints and runs through its iterations until the objective or an answer saying the objective is not achievable is obtained. Solving the LP obtains the results provided in Table 8.

Table 8: LP Results

			Decision variables				Personnel				Cost
19						Base					
20		Base	Hire	Fire	Retrain	Adjusted	Total	Hire	Fire	Retrain	Total
21	Engineer	35	10	0	0	35	52	100000	0	0	100000
22	Scientist	15	0	0	5	10	10	0	0	25000	25000
23	Programmer	20	16	0	0	20	36	128000	0	0	128000
24	Technician	12	4	0	0	12	16	20000	0	0	20000
25	Manager	5	0	0	2	3	3	0	0	10000	10000
26	Administrative	3	4	0	0	3	7	8000	0	0	8000
27					7		124				
28											**291000**

Interpretation of the information provided in Table 8 means the company can best minimize its cost by retraining the extra scientists and managers to be engineers, hiring the required programmers and technicians and supplementing with administrative assistants. Performing this combination results in a cost of $291,000 in order to achieve the required skill sets. This provides a starting point that meets the required constraints, but may not necessarily provide the optimal solution from a business process viewpoint. The tool is an input to the decision makers who must integrate the complete spectrum of decision variables that cannot be mathematically modeled. Management must use this model output information along with known complications, issues, social relationships and other factors to make their decisions. Taking the results obtained through use of the LP and applying it to current assets enables a company to project the affect of obtaining this contract on its financial picture. Changes in cost and sales have a direct impact on

the performance measures discussed earlier. Minimizing costs implicitly increases profit when sales are increased, and thereby positively affects the company's financial health. When profits increase, cash flow is increased by definition.

6.4 Chapter Summary

This chapter examined the strategic and tactical focus of human capital on meeting company objectives and minimizing costs. The discussion introduced the models used to quantitatively equate human assets to meeting company goals. QFD applied to the human capital realm allows management to determine how well a Technical Services company meets its objectives and how well the current skill sets of its employees support these objectives. An LP model utilized to minimize costs may be used to increase the efficiency of human capital decisions to improve a company's cash flow and financial health. This section discussed how management may use the proposed models to make work force decisions that minimize costs and contribute to increasing cash flow and positively affecting financial performance.

SECTION 7

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

7.1 Summary

The research examined understanding and modeling human capital business decisions in a Technical Services industry. It took a systemic approach for management to make human capital business decisions based on what skill sets are required to meet strategic objectives and how these skill sets could be used to impact the financial performance of the company. It also provided an overview of the numerous performance measures that may be utilized to evaluate the financial prospectus of a Technical Services company. Two parallel decision models were offered that may be used to determine the effect of human capital on meeting a company's strategic goals, and how that information could be applied to determine the effect of human capital on the company's financial "bottom line." The research showed how these QFD and LP models may be used by a Technical Services company's management team to integrate these two views into a systemic decision process that integrates organizational issues to make its decisions and how utilization of its human capital affects the value of that company.

7.2 Conclusions

People – human capital – are by far the most significant assets to companies within the Technical Services industry . A company, therefore, has the best chance of leveraging its human capital investments by understanding and building on that resource. Having tools to help model, quantify and understand the impact on the operations and

economic parameters of a Technical Services company by its human capital provides a quantitative approach to business management decisions and alleviates the purely subjective methods of the past. The model presented is a modified approach that helps management and investors to understand the strengths and weaknesses in a Technical Services company. This understanding aids in the determination of where to concentrate a company's skills and resources, and ultimately determines the potential impact on the company's financial picture.

7.3 Recommendations

Human capital is the mainstay of a Technical Services company. Understanding how these resources may be used to evaluate strategic goals and affect a company's financial outlook is of considerable value. A model that quantitatively portrays this information is useful to a management team's decision making process. In the long term, the model structure presented provides the flexibility and may be used to accommodate the analysis of other strategic and mission goals, in addition to those already presented.

Although this thesis may be used as stand-alone material in determining the effect of human capital on a Technical Service company's financial performance, further study to incorporate a Modified Sociotechnical Systems (MoSTS) methodology such as one proposed by Keating et al. (2001) into the model for a holistic analysis, or to develop a model that provides a quantitative integration approach to the LP algorithm based on results of the QFD model would be the next step if further research were to be applied in

this area of study. This would provide management with more information concerning "how to" bring its company in-line to meet its strategic objective weights instead of requiring the current qualitative assessment currently performed.

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APPENDIX A

BUSINESS RATIO FORMULATION

Table 9: Business Ratio Summary Sheet

Ratio Summary Sheet	Fiscal Year	
	1997	1996
Profitability Ratios		
Return on Assets	4.05%	7.31%
Return on Equity	4.05%	7.31%
Return on Invested Capital	6.17%	10.68%
Earnings Per Share	0.67	1.15
Profit Margin	8.96%	15.89%
Activity Ratio		
Working Capital Turnover	1.89	3.88
Solvency and Leverage Ratios		
Current Ratio	1.71	1.75
Acid Test Ratio	2.52	2.71
Debt Ratio	0.00	0.00
Value		
EBITDA		
Market Value		
EVA		

Table 10: Financial Data

Selected information obtained from: Consolidated Balance Sheet; Selected Financial Data; Consolidated Statement of Cash Flows; and Consolidated Statement of Operations	Fiscal Year		
	1997	1996	1995
Inventories	$112,875	$119,558	
Total Current Assets	$488,186	$454,711	
Total Assets	$832,103	$822,900	
Short-term Debt	$46,167	$21,499	
Total Current Liabilities	$285,615	$259,796	
Long-term debt	$114,863	$115,104	
Long-term Liabilities	$103,237	$82,894	
Total Shareholder's Equity	$832,103	$822,900	
Total Sales	$1,460,805	$1,427,252	$1,419,578
Income (loss) from continuing operations	$30,645	$54,480	$54,304
Income from discontinued operations, net of income taxes	$3,047	$5,676	$13,736
Net income (loss)	$33,692	$60,156	$68,040
Basic Weighted-average common shares outstanding	$45,757	$47,298	$51,483
Diluted Weighted-average common shares outstanding	$45,898	$47,472	$51,573
Depreciation and Amortization	$44,612	$40,936	$39,426
Interest	$12,351	$13,526	
Income Taxes	$26,683	$35,678	
Total Cost of Sales	$1,084,691	$1,048,743	

Table 11: Business Ratios

		Fiscal Year		
		1997	1996	1995
Current Ratio	Current Assets / Current Liabilities	1.71	1.75	
Debt to Equity Ratio	Total Liabilities / Owner's Equity	0.00	0.00	
	Total Debt/ Total Assets	31.8%	26.7%	
Dividend Yield	Dividends Per Share / Market Price Per Share (Weighted Avg.)	2.82%		
Return on Assets	Net Income / Assets	4.05%	7.31%	
Return on Equity	Net Income / Share Owners' Equity	4.0%	7.3%	
Return on Invested Capital	Net Income / Total Assets-Current Liabilities	6.17%	10.68%	
Earnings Per Share	Net Income/# Shares Common Stock:			
	Basic EPS for Continuing Operations	0.67	1.15	1.05
	Basic EPS for Discontinued Operations	0.07	0.12	0.27
	Diluted EPS for Continuing Operations	0.67	1.15	1.05
	Diluted EPS for Discontinued Operations	0.07	0.12	0.27
Profit Margin	Net Income / Total Sales-Cost of Sales	8.96%	15.89%	4.79%
Price Earnings Ratio (for Continuing Operations)	Market Price Per Share / Earnings Per Share	29.63		
Working Capital Turnover	Net Sales / Avg.Current Assets-Avg.Current Liabilities	1.89	3.88	
Acid Test	Quick Assets / Current Liabilities	2.52	2.71	

APPENDIX B:

TERMS AND DEFINITIONS

Term	Definition
ACWP	Actual cost for work performed is the amount reported as actually expended in completing the work accomplished within a given time period.
Amortization	Estimated cost of expired usefulness of fixed assets (intangible assets such as leasehold improvements) calculated based on type of item and its estimated useful life. Rates and methodology are based on company policy.
BCWP	Budgeted cost for work performed (BCWP) is the budgeted amount of cost for completed work, plus budgeted for level of effort or apportioned effort activity completed within a given a time period. This is sometimes referred to as "earned value."
BCWS	Budgeted cost for work scheduled (BCWS) is the budgeted amount of cost for work scheduled to be accomplished plus the amount or level of effort or apportioned effort scheduled to be accomplished in a given time period.
Cost	The price or imputed value of each resource assigned to an activity that is consumed in the process of producing the products and services of that activity.
Customer	The recipient of an output product or service. May be internal or external to the organization.
Depreciation	Estimate Cost of expired usefulness of fixed assets (tangible assets such as buildings and equipment) calculated based on type of item and its estimated useful life.
Direct Cost	A cost item that can be identified specifically with a single cost object in an economically feasible manner. A direct cost is applied to the cost object based on the actual content of the resources consumed by the cost object.
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
EV	Earned Value: Forecasting variable used to predict whether the project will finish over or under the budget.
EVA	Earned Value Analysis. Measures financial performance and guides decision making.
Fee	A charge for professional services.
Fringe	Group Health, Worker's Compensation, Group Dental, Group Life, Employee Assistance Program, Pension Plan, Savings Plan, Holiday Pay, Personal Leave Pay
G&A	General and Administrative: costs that cannot be specifically transferred to a cost objective and was a general benefit to all objectives whether direct or indirect.

Term	Definition
Go/No-go	Decision made by the company to either bid on a proposal or not after it has been determined the risk and probability of winning is worth the cost.
Indirect Cost	Costs common to a multiple set of cost objectives and not directly assignable to such objectives in a specific time period, such costs are usually allocated by systematic and consistent techniques to products, processes, services or time periods.
LP	Linear Programming: Mathematical approach to solving a maximization or minimization problem.
MH	Material Handling: Costs associated in procuring products such as procurement, subcontract handling, shipping, receiving, etc.
NOPAT	Net Operating Profit After Taxes.
Overhead	Costs of doing business that are not directly attributable to a single cost object.
Profit	The amount of sales exceeding the cost to perform the service.
QFD	Quality Function Deployment: Method of quantifying customer requirements (what) into service design decisions (how).
Sales	The gross amount of money obtained for providing the service.
Subcontracts	Total costs and fees incurred by another contractor working under your contract.

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