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Comparative and Contributive Effects of Process and Human Performance Improvement Strategies

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COMPARATIVE AND CONTRIBUTIVE EFFECTS OF PROCESS AND HUMAN PERFORMANCE IMPROVEMENT STRATEGIES

by

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Organizational leaders know that the success of their organization depends on the organization's ability to either produce better products or produce equally good products at a lower cost to consumers. Interventions aimed at improving organizational performance stem from two primary perspectives. One perspective emphasizes changing system factors (e.g., equipment and processes) and the other perspective emphasizes changing human performance factors (e.g., performance specifications and behavioral consequences). The current study evaluated the comparative and contributive effects of process improvement techniques (Kock, 1999; Melan, 1992; Rummler & Brache, 1995) and human performance improvement techniques (Daniels, 1989; Gilbert, 1996; Rummler & Brache, 1995), using a simulated work task with 48 college undergraduates as participants. The results indicate a main effect associated with a change in work process (i.e., a supposed streamlining of the work process) and a main effect of a behavioral intervention package. The largest effects were observed when a process change was implemented in combination with a behavioral intervention package. The implications of using a combined approach are discussed and topics for future researchers in this field are presented.

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INTRODUCTION

Background

Organizations in every industry, in every state in the US, and in every country in the world are beginning to face competition from a global marketplace. Decades ago global competition began with the use of mail order catalogs, and has accelerated at an enormous rate over the past decade. The increasingly widespread use of the Internet, combined with incredible improvements in global transportation systems, has made a competitor half-way around the world almost as much of a concern as a competitor located just down the street. Today, more than ever, organizations are under pressure to produce products and services that go above and beyond customer expectations and delight the customer in every regard. However, with global competition playing such a large role, companies must not only delight their customers, but they must also produce products and services in the most efficient manner possible and optimize the use of resources.

There are many resources to optimize in any given organization. Time, materials, and equipment use are often viewed as the most important of these. Time savings can be achieved by decreasing the amount of time a person requires to complete a task (referred to as "value added time," as the person is *adding value* to the product or service while working on it) (Savory & Olson, 2001). Time savings can also be achieved by reducing the amount of time that work-in-progress (WIP) spends waiting to be altered by the next person in the production process (referred to as "non value added time," as there is *no person adding value* to the product or service during this time) (Savory & Olson, 2001).

Benefits of saving time can include reduced labor costs due to increased efficiency, customers that are happy because they receive their products and services on time, and decreased costs resulting from fewer late deliveries (i.e., late deliveries can cost a company money under some contract arrangements). In the realm of new product development, timeliness can help ensure marketshare because the company that is first to get a product to market is often the one that enjoys much of the marketshare for the lifespan of the product. Clearly, saving time has a number of benefits, and organizations have developed numerous ways to save time as a part of their business strategies and processes. Some of these time saving strategies will be explored in the following sections of this paper.

Other resources that are managed in organizations are the use of equipment and materials. Equipment can include the machines (e.g., stamping presses, computers, sewing machines), trucks, forklifts, lighting fixtures, and so on, in an organization, whereas the term "materials" often refers to the raw materials that are transformed into a product or service. These materials are usually directly modified by a person or machine, and thus the potential for interventions to address multiple issues at once is self-evident.

Equipment and materials can be optimized through improved maintenance procedures that might increase the life expectancy of equipment and decrease the amount of materials wasted due to product defects. Upgrades to equipment can also increase productivity. For example, take the case of a graphic designer who works with extremely large graphic files on a computer. Upgrades to the internal components of the designer's computer, such as increasing the amount of memory or processor speed, could allow the designer to work with his or her files (e.g., adding graphic filters or performing the save function) more quickly and efficiently. If the designer frequently interacts with others via the internet, increasing the bandwidth of the connection may also speed up the process, and if additional programs are added to the computer the number of tasks the designer can complete could increase. In addition, such equipment improvements could enable the designer to execute the same commands with greater efficiency by using the correct tool to do the job. The example above illustrates that, in many cases, upgrading equipment can not only improve the quality of outputs, but it can also save the organization time.

The benefits of improving equipment often result in 1) a *reduced amount of rework* required in an operation, 2) a *reduced amount of time required* to complete work tasks, thereby improving efficiency and saving money or increasing production capacity, and 3) *improved quality* of the work outputs, thereby adding more value for the customer. Improving use of equipment and materials not only enables workers to add value to the product or service, but such improvements can also decrease the value added time, as stated above.

With the expansion to a global marketplace and worldwide competition, companies must constantly strive to improve on all aspects of their business operations in order to leverage their ability to compete on various strategic dimensions. Relevant strategic dimensions can vary by industry, the current state of the industry, and the particular product or service in question. For example, a company in the constantly changing technology industry may focus on being first to market as a competitive advantage, whereas a producer of laundry detergent may focus on cutting costs to increase profit margins. Also, given the current state of the industry, a computer manufacturer may try to reduce costs on already popular technology, whereas a laundry detergent producer may try to be the first to market with a new scent or product feature. Strategies must be constantly evaluated and reevaluated within the industry and changing business conditions, but whatever strategy a company chooses, it will need to improve upon the relevant dimensions that affect the effective execution of that strategy in its business. Once those dimensions have been chosen, companies must continuously strive to improve performance on those dimensions. In many cases, this is the only way to succeed in today's marketplace.

Quality Awards and Certifications

Performance improvement has become such a vital component of a company's ability to compete that various quality and performance certifications and awards have been created to recognize excellent business processes and practices. One of the most common certifications, ISO 9000, is awarded by independent auditors who evaluate a company based on standards set forth by the International Organization for Standardization (Corbett & Kirsch, 2001). However, due to the name of the organization setting the standards, and the abbreviation ISO, it is worthwhile to note that the apparent acronym ISO is not really a revised acronym for the International Organization for Standardization, but actually comes from the Greek for 'same' (Corbett & Kirsch, 2001). The Greek translation seems appropriate, as a main goal of the ISO 9000 standard is to establish a consistent set of policies, procedures, and practices while ensuring the quality of output across multiple work sites. Participation in ISO 9000 certification continues to grow each year and at the end of 2001, 510,616 quality management certificates had been issued in 161 countries, which represents an almost 25% increase over the 408,631 certificates that had been issued by the end of 2000 (Anonymous, 2002).

Due to the fact that external auditors award ISO 9000 certificates, some feel that the process of certification is flawed. Dalgleish (2003) feels that some auditors may award certifications that are undeserved, as the client organization is paying the auditors for their services. He also cites a potential unwillingness to revoke ISO 9000 certification, as only .049% of companies failed recertification audits in 2000, and even strong ISO advocates think that is not enough. While Dalgleish (2003) expresses concern with the ISO certification process, others feel that the process has been extremely beneficial in helping to achieve quality and productivity gains (Gerson, 2002; Schoenrock, 2002).

Wackenhut Corp., a $2.8 billion dollar security company is currently seeking ISO 9000 certification at all of its global locations. Wackenhut claims that pursuing and achieving ISO 9000 certification has enabled the company to be more in touch with customer perceptions of service quality than ever before (Schoenrock, 2002). Internally, Wackenhut credits ISO 9000 with improving processes, paper flow, and fostering a team environment in which employees understand the relationship between their daily activities and departmental and organizational success (Schoenrock, 2002).

Alphagraphics, a franchise print shop company, has achieved ISO 9000 certification for nearly 200 sites worldwide. Alphagraphics feels that the time and energy spent achieving ISO 9000 certification has been well worth it (Gerson, 2002). Believing in a data-based approach, the company quantifies the savings that they attribute to achieving the ISO 9000 certification. The company cites a 50% reduction in rework, an 11% increase in the number of jobs completed on time, and a 6% increase to the gross margin of franchise owners who participated in the ISO 9000 certification (Gerson, 2002). Other companies who have achieved ISO 9000 certification include Exxon Mobil, Eastman Kodak, DuPont, Xerox, IBM, 3M, and GE.

However popular, ISO 9000 certification is just one of the many quality recognition programs in existence. The Deming Prize, which was first created in 1951, is given to individuals, companies, or factories for excellence in the systematic application of Total Quality Management (TQM) principles. The prize is named after W. Edwards Deming, who contributed significantly to the promotion of quality concepts in Japanese industry. The Deming Prize is presented each year by the Union of Japanese Scientists and Engineers, and although this prize is typically given to Japanese companies, there is also a category for companies located outside of Japan. The first non-Japanese company to win the prize was

Florida Power & Light (FP&L), in 1989. Obtaining an award such as the Deming Prize is no easy task. Not only must your organization use exemplary processes and techniques, but it must also complete a time-consuming application. The application for the Deming Prize, for example, can be quite lengthy, as evidenced by FP&L's submission which was over 1,000 pages long, and in Japanese (Baila, 1996).

While FP&L did not provide specifics on the time required to compile the 1,000 page application for the Deming Prize, professor Damodar Golhar (personal communication, May, 2002) estimates that it can take as long as two years to prepare an application for similar awards such as the Malcolm Baldridge National Quality Award (MBNQA). The MBNQA is a comprehensive award that includes more than just quality measures. The award differs from the Deming Prize in that it focuses on customers and customer satisfaction, financial performance, management strategies, and human resource factors, while the Deming Prize mainly focuses on production processes and production quality (Anonymous, 2002; Bergstrom, 1996). Depending on the country of origin of a company, its industry, and its reasons for seeking a quality award, it may choose to apply for the Deming Prize, the MBNQA, or both. AT&T for example, has won both awards in the past (Flynn, 1994). However, the MBNQA is also more than just an award, it is actually a government-sponsored program. When it appeared as though foreign manufacturers were producing higher quality products than their American counterparts, the United States government wanted to take some form of action. The result of that action was the MBNQA. The standards for the MBNQA, how the application and review process are conducted, and how the awards are distributed are all set forth by a committee of scholars and professionals appointed by the government (Bergstrom, 1996). Although the MBNQA process culminates with a presidential ceremony each year, it still is somewhat less of an event than the Deming Prize ceremony, which is broadcast on Japanese television and is accompanied by all of the fanfare associated with the Academy Awards for entertainment in the USA (Baila, 1996). The primary benefits of the MBNQA may not actually be in winning the award at all, but in the provision of the specifications needed to win the program. Many who request the application never even apply for the award (likely due to the time required to complete such an application), but still use the standards set forth in the application to conduct a self-assessment of their own operations (Calhoun, 2002). In between the years 1987 and 1996, over a million requests for MBNQA application documents had been filled, approximately 40-50 submissions were received each year, and 24 awards had been presented (Bergstrom, 1996).

Aside from the two most well-known quality awards (the Deming Prize and the MBNQA), there are many others that are worth briefly mentioning here. They include the European Quality Award, the Canadian Quality Award, the Australian Quality Award, and the many other quality awards given by state and local governments. The number of quality awards and certifications, the comprehensiveness of their respective application and review processes, the mass request for their related materials, and the benefits their recipients cite all exemplify the importance of managing organizational quality and the benefits associated with doing so.

Approaches to Performance Improvement / The Rummler and Brache Model

Rummler and Brache (1995) are organizational theorists/practitioners who propose many different models and tools for use in organizational improvement. One of the main themes throughout all of their models is that organizations can be viewed from different perspectives. Rummler and Brache call these perspectives "levels," and determine that there are three main levels of an organization. The three levels, called the organization level, the process level, and the job/performer level, are shown below in Figure 1.

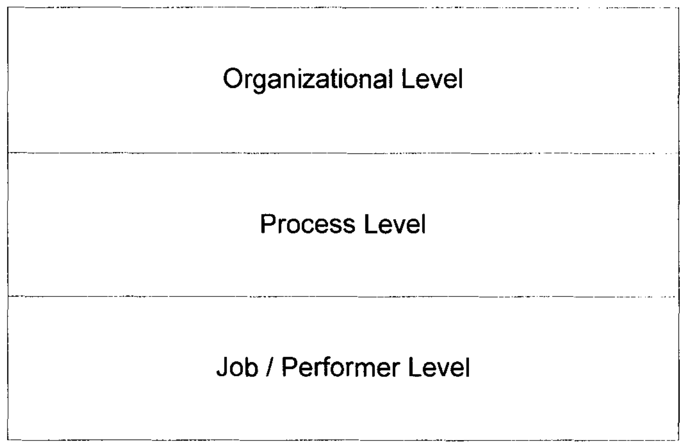


Figure 1. An adaptation of Rummler and Brache's (1995) three levels of performance.

The organization level deals with issues facing the organization as a whole, which include, but are not limited to, acquiring resources, addressing competitor concerns, adapting to the needs of customers, conforming with governmental and industry regulations, and providing a return of some kind to stakeholders. The process level addresses the way the work is completed in the organization. This involves how the organization's products and services are designed, developed, produced, sold, delivered, and supported. This level is also concerned with the order in which specific steps are accomplished, what tools and materials are used, when quality checks are performed, and so on. The job/performer level examines the people who actually do the work. This level seeks to understand the factors affecting human performance in the workplace, and how to diagnose human performance problems so that workers can produce quality products and services in an optimal fashion.

Performance analysts, depending on the project size and scope, may attempt to improve performance at one, two, or all three levels of the organization. Rummler and Brache (1995) present tools for analyzing and improving performance at each of the three levels, as well as tools used to align the three levels. In this case, alignment refers to the degree to which outputs at each level of the organization support the goals at other levels of the organization, so that each level is working towards a common goal or goals in the best possible fashion. While an in-depth analysis of the tools used to improve performance at each of three levels is beyond the scope of this dissertation, the overall three levels framework shown in Figure 1 will be used to organize the variety of performance improvement strategies presented below. At each level, Rummler and Brache's main model of performance for that level will be presented. After presenting the level-specific Rummler and Brache model, several examples of performance improvement strategies relevant to that level will also be explored. At any given level there may be tens or even hundreds of different performance improvement techniques, and so only a select few will be mentioned in order to provide examples of the types of interventions that are used at that level.

Organization Level

Rummler and Brache (Organization Level)

Improvements made at the organization level are focused on improving the performance of the organization, and often deal with factors outside of the organization. Rummler and Brache's (1995) super-system map is a tool used to analyze and improve organization-level performance. The map illustrates the major components affecting performance at the organization level. The super-system map (see Figure 2) depicts a for-profit organization as:

> . . . a processing system (1) that converts various resource inputs (2) into product and service outputs (3), which it provides to receiving systems, or markets (4). It also provides financial value, in the form of equity and dividends to its shareholders (5). The organization is guided by its own internal criteria and feedback (6) but is ultimately

> driven by the feedback from its market (7). The competition (8) is also drawing on those resources and providing its products and services to the market. This entire business scenario is played out in the social, economic, and political environment (9). Looking inside the organization we see functions, or subsystems, which exist to convert the various inputs into products or services (10). These internal functions, or departments, have the same characteristics as the total organization. Finally, the organization has a control mechanism – management (11) – that interprets and reacts to the internal and external feedback, so that the organization keeps in balance with the external environment. (pp. 9-10)

Issues dealing with any of the eleven components can be deemed organization-level issues, and many techniques have been created to improve performance related to these specific components, as well as for the organization as a whole. While it is beyond the scope of this dissertation to list all of the performance improvement techniques aimed at each component of the super-system diagram, a few techniques aimed at a few different areas will be provided below as examples of the performance improvement initiatives designed for this level. A short summary of purchasing and supply chain management (which addresses resource inputs), demand management (which addresses receiving systems), Enterprise Resource Planning (ERP) systems (which help the management function to make decisions), and plant location (one of the many decisions made by the management function) follows.

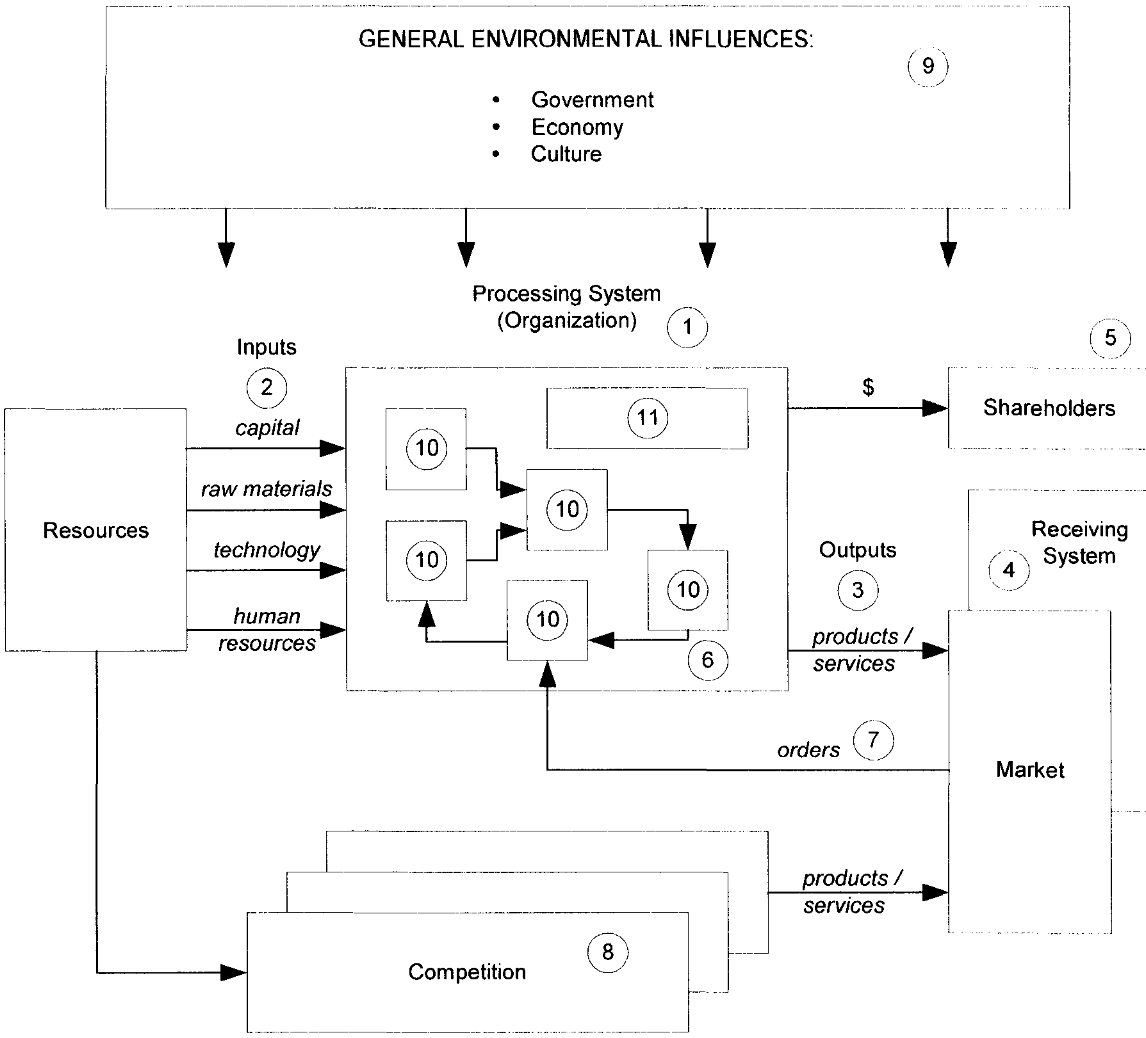


Figure 2. Rummler and Brache's (1995) super-system map. Reprinted by permission of John Wiley & Sons, Inc.

Purchasing and Supply Chain Management

Purchasing and Supply Chain Management (SCM) are key components of any organization, as all organizations require some inputs to produce products and services. Strategies aimed at improving the performance of resource (e.g., materials) acquisition range from the more simple theories of purchasing to the more complex theories of SCM. Purchasing strategies typically relate to the direct transaction (i.e., the purchase) between a buyer and seller, whereas SCM focuses on large scale systems and process oriented issues (e.g., which entity performs quality checks, coordinating deliveries from multiple suppliers, transportation methods, etc.).

A typical industrial buyer spends more than half of every sales dollar on purchased products (Degraeve & Roodhooft, 1999; Lewin & Johnston, 1997; Noordewier, John, & Nevin, 1990; Weeme, 2003). In turn, a one percentage-point savings in purchasing costs can translate into a half-point improvement to the sales margin (Janda & Sheshadri, 2001). Kiser (1976) lists six purchasing strategies intended to save on purchasing costs: negotiation, sourcing, developing and maintaining good relations with suppliers, developing suppliers, protecting the cost structure of the company, and minimizing costs. Each of these strategies relates to the vendor/purchaser relationship and/or the actual terms of a specific purchase. Kiser claims that executing improvement strategies in each of these areas will reduce overall costs and increase the quality of the vendor/supplier relationship. While the actual purchase and purchasing terms can be a potential opportunity for improvement, some believe that the purchase itself occurs too late in the purchasing process to make a significant difference. Arminas (2002) feels that the greatest improvements in purchasing must occur well before the vendor/purchaser interaction and asserts that purchasers need to be involved in setting the organizational strategy in order to create a purchasing strategy that is in proper alignment. While authors and experts in the field of procurement have different views on how to increase procurement performance, they all agree that procurement provides an opportunity for improvement which goes largely unrecognized by many companies.

Supply Chain Management looks beyond the vendor/customer interaction and views the flow of materials from two or three steps up the supply chain (i.e., suppliers) to two or three steps down the supply chain (i.e., customers). A review of the SCM literature revealed several characteristics of the research being conducted in the area. Most authors agree, to some extent, that a supply chain spans multiple organizations (Bacheldor, 2003; Kerrin, 2002; Kopczak & Johnson, 2003), and therefore measuring supply chain performance is not an easy task. Much of the research in the area is qualitative and survey driven, and assesses arguably vague concepts such as "supplier/customer relationship" and "collaboration" (see Kuei, Madu, Lin, & Chow, 2002; Vokurka & Lummus, 2003, for examples). While the measurement of supply chain performance may not be the most exact of sciences, there are some common supply chain problems that are often cited, and similar or compatible strategies that many companies have used to combat those problems. One of the biggest problems that SCM endeavors seek to reduce or eliminate is the "bullwhip effect." The bullwhip effect is the tendency for the sequence of order quantities to have higher variability as one moves upstream (i.e., towards the supply side) in a supply chain (Aviv, 2003; Chase, Aquilano, & Jacobs, 2001). This variability can cause rushed work that may result in decreased quality and/or higher prices for future products once a vendor has to maintain a greater amount of inventory to cope with the increased variability. One way to combat the bullwhip effect is to allow suppliers access to Point of Sale (POS) data (Kopczak & Johnson, 2003). With access to POS data, a supplier or distributor can monitor each customer's or location's inventory of a given product. With this information the supplier or distributor can replenish or ship products only when necessary. On a larger scale, POS data can be used to monitor buying trends and adjust production schedules to match those trends. Beer and alcohol manufacturer Diaego has implemented such a system for its Guinness beer products and expects to save $1.1M in inventory reduction, $600,000 in logistics benefits, and increase sales by $3.3M within the next few years. The company also plans to implement the system with its other product lines (e.g., Johnny Walker and Cuervo) within the next two years (Bacheldor, 2003). Other companies have also executed SCM projects yielding large returns, including Carlson Companies and Verizon Wireless, which trimmed $3M and $6M, respectively, from their temporary employee costs (Anthes, 2003), Harley-Davidson which cut $40M from its materials costs (Vokurka & Lummus, 2003), the Tennessee Valley Authority (TVA) utility, which cut $23.5M in costs (Songini, 2003), and Chrysler, which saved over $2B, not including price reductions, using its Supplier Cost Reduction Effort (SCORE) program (Hartley, Greer, & Park, 2002). Aside from the ever-so-important cost savings and cost reductions (Morgan, 2003), there are several other benefits attributed to SCM programs, including faster product development (Morgan & Monczka, 2003), better customer focus (Mazur, 2003), risk reduction (Buchanan & Perry, 2001), increased technological innovation (Hult, Thomas, Nichols, & Giunipero, 2000), higher quality (Elmuti, 2002), and improved organizational competitiveness (Fisher, 1997; Spekman, Salamond, & Kamauff, 1994; Wisner & Choon, 2000).

While some companies are able to cut costs and document the cost savings, other companies cite fringe benefits from SCM programs, such as a more cohesive supply acquisition process and improved vendor/customer relationships. Little in the literature argues with SCM philosophies or their benefits (see Dickerson, 2003, for an exception), and most companies that use these techniques perceive that significant benefits are being attained by the organization. While translating some of the less tangible benefits into dollars should be an ultimate goal for each application of SCM, it is undoubtedly a large task and might deter a stressed purchasing department. Some of these departments settle for the fringe benefits and hope they are achieving the additional bottom line savings.

Demand Management

Not only must upstream performance be managed (i.e., purchasing of inputs and supplier relationships), but downstream aspects of the organization must also be managed.

Products and services generated by an organization are sold to a consumer market which generates demand for the products. In an optimal situation, the amount of demand that is in effect at any given time should dictate purchasing and production schedules. Taking a proactive role in managing this demand helps the organization to gain better control over other organizational functions (e.g., purchasing and operations scheduling) and helps the organization to execute business operations in a more efficient fashion.

The industry that is probably most adept at demand management is the travel industry. However, the travel industry is more than just airlines, rental cars, resorts, and hotels. It encompasses all means by which people travel from one place to another, and the necessary components of doing so, including roadways, sidewalks, bicycles, public transportation, carpools, forms of energy, and more (Berman, 2002). Strategies used to control demand of travel resources include telecommuting, compressed work weeks, carpool lanes on highways, and lanes that switch direction of travel depending on the time of day. When planning roadways, one of the biggest considerations is determining how many vehicles will be traveling on that roadway, and designing the roadway to meet the demand requirements. Urban areas that are observing an increase in traffic and have little room to expand are emphasizing the use of public transportation and offering incentives (sometimes in the form of dedicated lanes, presumably with less traffic) for vehicles with more than one passenger.

Airlines use demand information to determine which routes to fly and how much to charge for those flights. When an airline sees a decrease in the utilization rate of a particular route, they adjust fares and features on that route to increase utilization. While fare refers to the price of the ticket, features can refer to other bonuses not related to price (e.g., double frequent-flyer miles, free upgrades to a better seat, etc.). In addition, airlines have segmented their consumer market to a degree that they have multiple fares for each flight, depending on the quality of the seat, the meal associated with the seat, the features purchased along with the ticket, and the date the ticket was purchased. In fact, airlines have so many fares for each individual flight, that the ratio in ticket price between the lowest and highest paying passenger on the same plane can be anywhere from 1:8 or 1:10 (Feldman, 2003).

While supply and demand has often been regulated by making price adjustments, there are other ways demand can be managed. One of the essential, yet alone insufficient, means of managing demand is staying in touch with the customer base and having the ability to accurately forecast demand (Jones, 2002). The quicker and more accurately a company is able to detect changes in demand, the more accurately it can accomplish purchasing and operations scheduling functions, as well as adjust price and contract terms, and therefore begin to operate at more optimal levels (Kilgore, 2002). However, demand management is an ongoing cycle, and depending on the industry the strategies for managing demand may need to be reevaluated on a quarterly (e.g., mining) or hourly (e.g., airlines) basis.

Personal Daily Assistant (PDA) maker Palm, Inc., has used demand management strategies to move from a push system (where products are produced and then marketed) to a pull system (where demand is forecasted, or orders are taken, and then the product is produced to match the orders taken). This move has enabled Palm to cut its inventory in half and increase gross margins by more than 50% (Baljko, 2003). Grocery chain Ukrop's has also refined its demand management strategies. The grocery business has long been plagued with the problem of products (e.g., produce, fresh meats, prepared salads) spoiling (referred to in the industry as shrinkage). By improving its demand management Ukrops has been able to reduce shrinkage by 30%, thereby increasing its profit margin on those products (Seideman, 2002).

Both Palm and Ukrops, as well as many other companies, have implemented some type of Enterprise Resource Planning (ERP) and/or Customer Relationship Management (CRM) software to assist them in executing these changes. While these software packages can often run in the hundreds of thousands of dollars, the benefits reported by many companies often total millions of dollars.

ERP Systems

ERP systems are large electronic data warehouses that integrate order management, planning, inventory management, manufacturing, and financial functions, as well as other functions depending upon the industry in which they are utilized (Caruso, 2003). These systems extend beyond the capabilities of demand management alone, and have rapidly become the infrastructure of many large and mid-size corporations. Over the last decade, tens of thousands of large and mid-size companies (See Pui Ng, Gable, & Chan, 2002) worldwide have spent a combined total of over $300B on ERP implementations (James & Wolf, 2000). In addition to the actual implementation costs, average annual ERP maintenance costs are estimated to be approximately 25% of the original implementation costs (Glass & Vessey, 1999).

Although "linked" on the "back-end" (i.e., where the data are stored in a database), most users only interact with one "front-end" (i.e., user interface) component of an ERP system. For example, a production manager may use a component of an ERP system to schedule production, and a materials manager may use the system to purchase materials, while a finance manager can look at the materials being purchased in comparison to the medium-range production schedule and calculate the cost of inventory. While each user might interact with only one component, much of the organization's critical data can be found in one place, thereby reducing the amount of effort required to produce data for other functional units and improving the timeliness with which accurate data can be accessed. ERP systems are highly customizable, and companies can pick and choose the components they want to purchase. Main components of an ERP system may include analytics, human resources, financials, operations, and corporate services, with a wide array of subcomponents available under the heading of each main component (SAP, 2003). As an example, within the realm of operations, a company may choose modules geared towards purchase order management, inventory management, production management, maintenance and quality, delivery management, and sales order management. Due to the way in which an ERP system integrates entire functional units of an organization (e.g., Research & Development, Production, Sales, etc.), and also due to the fact that ERP systems are mainly used by the management function to make decisions, ERP systems are considered to be a strategy aimed at improving organization-level performance.

Five main benefits sought from ERP implementations are competitive advantage (Shang & Seddon, 2000; Weston & Stedman, 1998), globalization (Freedman, 1999; Gable, 1998; Vernadat, 1996), integrated systems (Davenport, 1999; Markus, 2001), best practice business processes (Carlino & Kelly, 1999a,b; Markus, 2000), and cost effectiveness/cost reductions (Butler, 1999; Carlino & Kelly, 1999a,b; Hicks & Stecke, 1995; Norris, Hurley, Hartley, Dunleavy, & Balls, 2000). ERP systems have been used by companies such as Bank, Inc. (one of the world's leading financial services groups), Dell Computer, and Comptec to reduce customer complaints, reduce cycle time by as much as 700%, and increase sales by as much as 45% (Ash & Burn, 2003). While an ERP system assists a company in managing its operations, supply chain, and customers; the data generated by the system must be managed by a human being. ERP systems are tools, they do not automate an organization or eliminate the need for a management function; they simply assist management in making better business decisions.

Plant Location

Managers of organizations are faced with many tasks. While each individual manager is also seated at the job/performer level, management is collectively responsible for setting the direction for the organization, as well as managing and supporting organizational performance. The group of people responsible for making these decisions is referred to as the "management" function in the super-system model of performance depicted in Figure 2.

One of the many decisions the management function must make is where to locate a new plant (i.e., production facility). Optimal plant location depends on many different factors. A comprehensive analysis must be conducted that includes variables such as the location of key organizational resources, major customers, transportation costs, and regulations of the industry or country of location. An organization may determine to locate a plant in a particular location to save money on labor costs (Engardio, Bernstein, Kripalani, Balfour, Grow, & Greene, 2003), or possibly to decrease transportation costs associated with acquiring resources or shipping finished products (Baljko, 2003; Davis, 1971). While some have developed complex mathematical formulas for determining an optimal plant location (Fernandez & Puerto, 2003; Mayer & Wagner, 2002), other decision makers might play into the marketing ploy put on by "place marketers" (Ulaga, Sharma, & Krishnan, 2002). A place marketer's main role is to sell organization decision makers on a particular country, state, or city as a location for their next plant in order to develop the economic area of the place marketer's employer (usually a state or national government).

Many companies have moved their operations overseas to save money. For example, Bank of America has begun to move jobs overseas to India, where work can be completed 80% cheaper than in the USA. For example, in the Philippines, an architect can earn $250 a month, while a Masters level accountant can earn $300 a month. Their U.S. counterparts earn approximately $3,000 and $5,000 a month, respectively. Due to labor savings such as these, Forrest Research, Inc. analyst John McCarthy estimates that 3.3 million white-collar jobs and $136B in wages will be transported overseas to low-cost countries by 2015 (Engardio, Bernstein, Kripalani, Balfour, Grow, & Greene, 2003). However some companies, such as Palm, Inc. have moved their operations overseas for reasons other than labor-cost savings. Palm moved all of its manufacturing to China in an effort to consolidate its operations and decrease lead time. Palm has succeeded in decreasing lead time and has also cut materials transportation costs, mostly because parts no longer have to be shipped from Asia to other places in the world for assembly (Baljko, 2003). For whatever reasons management chooses, the trend of moving dimensions of organizations, or entire organizations, overseas, is sure to continue as strides in information technology make operating in a global environment a somewhat easier task.

Organization Level Summary

Each area of the super-system map is a focal point for a number of well-documented strategies that can be used to improve performance. When dealing with the management function, or any of the functions outside of the processing system, we consider the improvement efforts to be occurring at the organization level. Whether a company has lobbyists who interact with government officials (i.e., officials who affect the regulation of their employer's industry), streamlines its supply chain to interact more efficiently with its vendors, manages consumer demand through strategic contract terms and pricing structures, or promotes offers that attempt to gain more marketshare than their competitors, these strategies address the concerns of the organization as a whole and are therefore considered to be at the organization level. Although there are many areas that can be targeted for improvement, and multiple ways to improve performance in each of those areas, the strategies listed above were presented to provide examples of methods used to improve organizational performance by influencing both internal (e.g., management) and external (e.g., resources, consumers) variables (A more comprehensive list of strategies used to improve organizational performance is presented in the table below). Performance improvement initiatives taking place "inside" the organization that are *not* a part of the management function are considered to be taking place at the process or job/performer levels.

Table 1. A summary of organization-level performance improvement strategies.

Strategy	Selected References	Main Super-system Dimension(s) Addressed
Demand Management	Baljko, 2003	Market, Resources
	Berman, 2002	
	Feldman, 2003	
	Jones, 2002	
	Kilgore, 2002	
	Seideman, 2002	

E-commerce (i.e., Expanding business operations to include customer transactions via the internet or some other electronic means)	Athitakis, 2003 Mathews, 2003 Pan & Lee, 2003 Saranow, 2003 Weinstein, 2003	Market, Competition

ERP Systems	Ash & Burn, 2003 Butler, 1999 Carlino & Kelly, 1999a,b Caruso, 2003 Davenport, 1999 Freedman, 1999 Gable, 1998 Glass & Vessey, 1999 Hicks & Stecke, 1995 James & Wolf, 2000 Lee, Siau, & Hong, 2003 Markus, 2000 Markus, 2001 Norris, Hurley, Hartley, Dunleavy, & Balls, 2000 See Pui Ng, Gable, & Chan, 2002 SAP, 2003 Shang & Seddon, 2000 Vernadat, 1996 Weston & Stedman, 1998	Management, Resources, Market

Financial Administration and Decision Making (e.g., Tax analysis)	Adams, 2002 Anonymous, 2003a Anonymous, 1994 Greenwood & Huffman, 1991 Harden, 2002	Management, Shareholders
Inventory Management (i.e., Storage of materials and completed products)	Archibald, Thomas, Betts & Johnston, 2002 Baumann, 2003 Fuscaldo, 2003 Sullivan, 2003	Management, Resources
Outsourcing (i.e., Hiring an external contractor to produce product components or perform particular services in order to reduce costs or gain some competitive advantage)	Anonymous, 1997 Atkinson, 2003 Challener & Van Arnum, 2003 Chu, 2003 Cox, 1994 Gibson, 1993 Oudkerk, 2002 Sander, 2003 Sawyer, 1999 Schaff, 1998	Management, Resources

Plant Location	Baljko, 2003 Davis, 1971 Engardio, Bernstein, Kripalani, Balfour, Grow, & Greene, 2003 Fernandez & Puerto, 2003 Mayer & Wagner, 2002 Ulaga, Sharma, & Krishnan, 2002	Management, Resources, Market

Purchasing and Supply Chain Management (SCM)	Anthes, 2003 Arminas, 2002 Aviv, 2003 Bacheldor, 2003 Barnes, 1997 Buchanan & Perry, 2001 Chase, Aquilano, & Jacobs, 2001 Degraeve & Roodhooft, 1999 Dickerson, 2003 Elmuti, 2002 Fisher, 1997 Gibbs, 2003 Hartley, Greer, & Park, 2002 Hult, Thomas, Nichols, & Giunipero, 2000 Janda & Sheshadri, 2001 Kerrin, 2002 Kiser, 1976 Kopczak & Johnson, 2003 Kuei, Madu, Lin, & Chow, 2002	Resources, Market

	Lewin & Johnston, 1997 Mazur, 2003 Morgan, 2003 Morgan & Monczka, 2003 Noordewier, John, & Nevin, 1990 Pan & Lee, 2003 Russell, 2003 Songini, 2003 Spekman, Salamond, & Kamauff, 1994 Vokurka & Lummus, 2003 Weeme, 2003 Wisner & Choon, 2000	
Quality Function Deployment (QFD) (i.e., Acquiring consumer requirements and translating them into product design specifications)	Johnson, 2003 Martins & Aspinwall, 2001	Market

Service Guarantees (i.e., Providing guarantees for customer satisfaction to combat the effects of product or service defects that may be observed by the market)	Anonymous, 2001a Boshoff, 2002 Galloro, 2001 Hays & Hill, 2001 Kandampully & Butler, 2001 Lee, 2001 Machalaba, 2000 Sum, Lee, Hays, & Hill, 2002 Wirtz & Kum, 2001	Market, Competition

Process Level

Rummler and Brache (Process Level)

The process level centers on the way work is accomplished in an organization. This level is concerned with steps employees follow and the equipment employees use to accomplish work tasks. Rummler and Brache (1995) contend that the division of organizations into functional units and a strong focus on hierarchical reporting relationships often leads to the maximization of some functional units. The maximization of functional units evidences itself as a maximization in the process metrics (e.g., number of products sold, number of parts produced, etc.) influenced by that functional unit. For example, given the three functional units of Sales, Manufacturing, and Shipping, there exists an opportunity for each of these three functional units to perform "too well" resulting in process problems that sub-optimize the entire process. If Manufacturing produced a large number of products that greatly exceeded the production schedule, the leader of the Manufacturing unit might think he or she has done a fantastic job. However, Sales might not be able to sell the number of products produced, and thus inventory costs will rise. If Sales is able to sell that amount of product, the Shipping unit might not be able to ship as quickly, and may be required to use expedited shipping methods that add cost and decrease the profit margin. When managers of each functional unit focus on maximizing the performance of an individual unit (which is how the contingencies are arranged in many organizations), this is called a "Silo Culture" (Gourishankar, 2003; Rummler & Brache, 1995). They call this type of culture a "silo" culture as the boundaries of functional units on the organizational chart create invisible silos (see Figure 3).

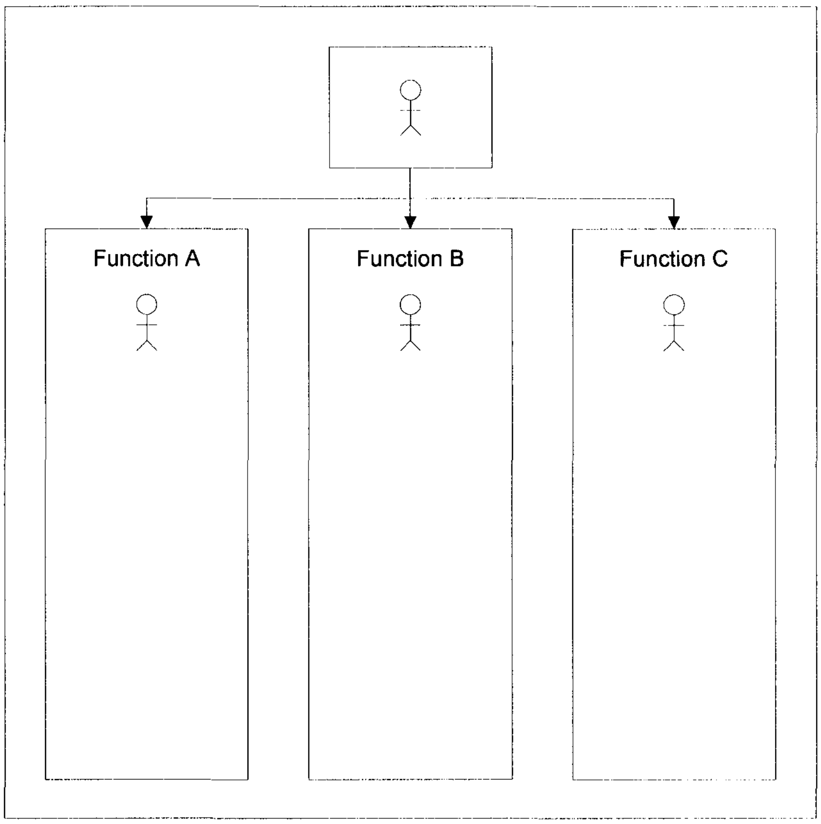


Figure 3. A "Silo" culture. Adapted from Rummler and Brache (1995).

To combat the sub-optimization of a process due to the maximization of one or more functional units, Rummler and Brache (1995) recommend taking a process-centered view (see Figure 4). Taking a process-centered view is beneficial because processes are the ways in which the work is accomplished in an organization. Maintaining a process-centered focus is synonymous with maintaining a focus on the organization's products and services, which is something with which all organizations should be concerned. Such a focus deemphasizes the importance of functional unit performance, and emphasizes the importance of cycle time, reducing costs, increasing quality, and adding value to the customer via improved products and services.

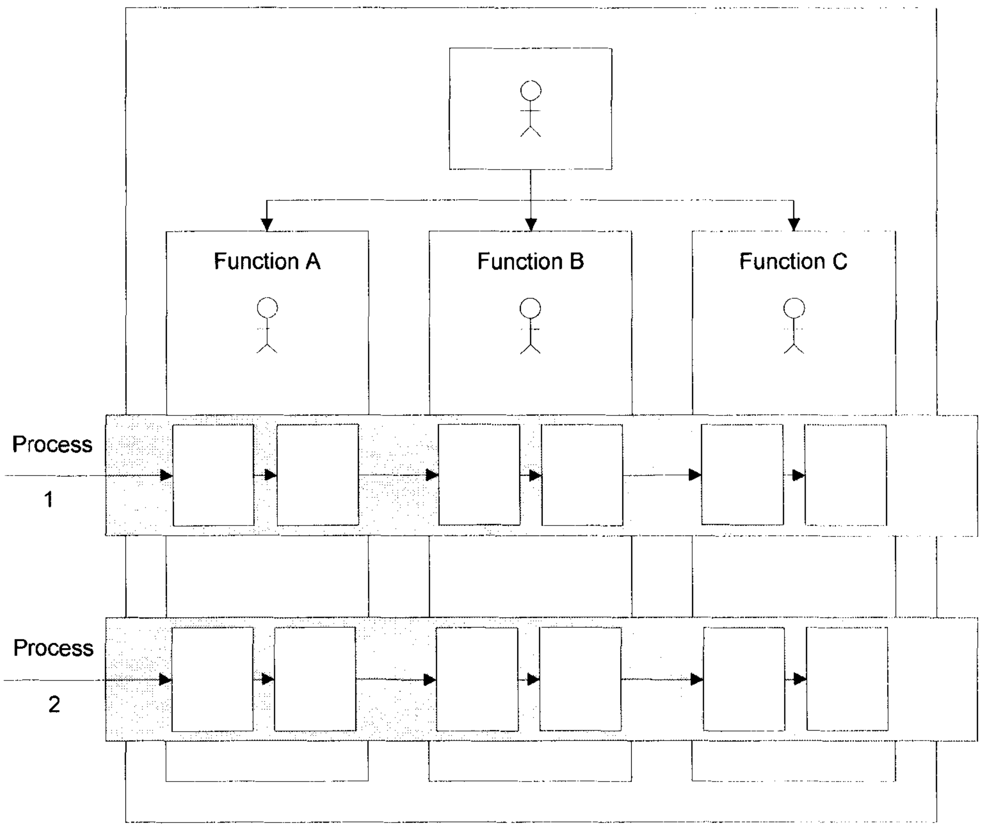


Figure 4. A process-centered view of an organization. Adapted from Rummler and Brache (1995).

In a process-centered organization functional units focus on contributing to the overall health of the process and not maximizing the performance of their own unit. The units recognize that processes span multiple functions and that each unit is expected to perform at a certain level. For this reason, Rummler and Brache (1995) recommend setting goals for processes (e.g., cycle time and rework goals) instead of goals for functional units. While it is common for management to set goals for functional units, these goals are often surpassed and employees are often rewarded for their great achievements. Managers are also often provided with incentives for surpassing these goals, although it may be to the detriment of the entire system. While it is okay to set goals for functional units, those goals should be derived from an analysis of what is required for a functional unit to optimally contribute to a process, and incentives should be based on how close a unit comes to meeting (and not exceeding) its target goals.

The process level is similar to the organization level in that the processes can span many functional units and largely consist of conceptual boundaries. For example, similar to the subjective scope one can place on a supply chain (i.e., how many vendors or customers are included in the chain), one must also make subjective determinations on the scope of a process. Essentially one must decide where a process begins and where a process ends. For example, when improving a production process one must decide whether to look at the process beginning at the point at which a partially completed product enters a specific work area, or the point at which raw materials or components are delivered from a vendor. Likewise, questions such as, "Does the process end when a partially completed work product leaves a particular manufacturing station, when it is completed and boxed, when it is loaded onto a truck, or when it is finally received by the customer?" can be asked. One way of segmenting the previous questions is to define core processes and to use those processes as a template for determining process boundaries. Rummler and Brache (1995) define three core processes, "It" produced, which includes everything from research and development, materials acquisition, and production processes, "It" sold, which involves sales processes, and "It" delivered, which includes transportation and shipping processes, where "It" is considered to be any product or service. While this is but one way to segment processes, defining the scope and amount of change incorporated in a process improvement project can be a determinant in the name given to an initiative.

Views of Process Improvement

Harrington (1998) claims there are three different approaches that comprise business process improvement. The first approach is process reengineering, the second is process redesign, and the third is process benchmarking. Harrington claims that process reengineering should be used when the currently utilized process is so bad that the process improvement professional does not want to contaminate a team's thinking by reviewing the existing process. In process reengineering a team will work together to revamp a process starting with a clean slate, and design the process to operate in an optimal fashion, possibly using new equipment and technology. Process reengineering should be used when cost and cycle time need to be reduced between 60-90 percent (Harrington, 1998).

Process redesign, on the other hand, should be used when the current process needs to be streamlined, possibly by removing elements of bureaucracy, error-proofing the process, or adding information technology tools. Harrington (1998) claims that process redesign can achieve a 30-60 percent reduction in cost and cycle time, while improving quality 100 percent. Process benchmarking, the least radical of the three components, can be used to create a process that utilizes best practices, albeit at some future point in time. In process benchmarking a company with the "best practices" for a particular business process is identified. An improvement team will then study the exemplar's business process and attempt to implement a similar process in the improvement team's own company. Process benchmarking can also reduce cost and cycle time between 30-60 percent and improve quality up to 80 percent (Harrington, 1998). The purpose of Harrington's (1998) classification system is to assist organizations in choosing the right approach to business process improvement. The inherent warning is that choosing the wrong process improvement strategy, or poorly executing the chosen strategy, can cost an organization millions of dollars in wasted resources.

The types of process improvement described by Harrington (1998) are but three options for naming process improvement efforts. Other authors prefer to use the terms "Business Process Design" (Hofacker & Vetschera, 2001; M. Smith, 2003), "Business Process Redesign" (Selander & Cross, 1999), "Business Process Reengineering" (Doumeingts & Browne, 1997; Hammer, 1996; Hammer & Stanton, 1994; Johansson, McHugh, Pendlebury, & Wheeler, 1993; Shin & Jemella, 2002), or simply "Process Improvement" (Babicz, 2002; Colby, 2002; Gardner, 2002; Gilberto, 1993; Harter & Lousberg, 1998; Kock, 1999; Melan, 1992; Upton & Kim, 1998; Zievis, 2003). Whatever name is used, or whatever potential gains are cited, the goals of each of these interventions are the same. The goals of these interventions are to 1) Reduce cost (e.g., decrease labor costs, rework costs, overhead costs, and so on), 2) Decrease cycle time (e.g., decrease time to produce a product), and 3) Increase quality (e.g., increase the number of parts produced to specifications).

Process Improvement Strategies

The goals discussed above are achieved in a number of general ways. For example, cost can be reduced by eliminating unnecessary steps, using different components, decreasing the time required to complete a task, decreasing the amount of floor space/inventory needed for production, and so on. Cycle time can be reduced by improving the flow of information and materials, reducing machine setup time, splitting or sharing tasks, creating parallel production lines, and so on, and quality can be increased by building quality checks into each step in the process or designing processes to be error-proof. Some of these strategies are more heavily utilized in some industries than in others. This is because some strategies are a better fit for the product or service being created, due to the nature of the production processes or the materials used. For example, reducing machine setup time might be a good strategy to reduce cycle time in an industry where machine setup time is a critical factor influencing cycle time (e.g., metal stamping), but might not be an appropriate strategy for an industry such as construction, in which there is little machine setup involved. To meet construction deadlines, establishing processes that improve the flow of information and building resources might be more critical in achieving optimal performance. Again, as with the laundry detergent example provided earlier, the important competitive dimensions and choice of process improvement strategy might also change by industry and over time.

As stated, a number of strategies have been developed to improve process performance in organizations. To provide clarification of what is meant by the process level of performance, and to provide examples of process improvement strategies and the benefits that can be attained by using these strategies, a few of these strategies will be summarized below. A short summary of Process Mapping/Flowcharting, Six Sigma, Lean Manufacturing, and Just-in-Time delivery systems follows.

Process Mapping/Flowcharting

Although many process improvement initiatives use significantly different strategies in their execution, most process improvement efforts begin with the creation of a process map (often referred to as a process flowchart). Many authors have stated that process maps are an extremely important contribution to understanding and controlling business processes and should be considered an essential component of business process improvement projects (Biazzo, 2002; Burr, 1990; Rummler & Brache, 1995; Soliman, 1998). In simple terms, process maps provide a visual representation of the workflow involved with the production of a product or service. As a tool, process mapping involves identifying a customer or business concern, documenting the related process as it is currently accomplished, analyzing the process for deficiencies, and developing and documenting an improved process (Anjard, 1998). As previously discussed, the size of a process can vary depending on the needs and scope of the change initiative. For that reason, the size of a process map can vary as well. Some practitioners in the field of process improvement advocate using maps that are no longer than 15 steps each (Symons & Jacobs, 1997), while others shun the use of the largest chalkboard or whiteboard as they may limit the perceived scope of the project by participants in a process mapping workshop (Burr, 1990). Some practitioners recommend a combined approach in which multiple levels of maps are used, with each map providing an explanation of a single step in a higher level map (Patton, 2002).

Regardless of the size of the process map, most maps are drawn with the same conventional shapes. Three of the most common shapes, and the shapes that appear to be universal throughout all process maps, are squares, diamonds, and arrows (Chase, Aquilano, & Jacobs, 2001; Dewar, 1992). A square shape is used to represent work being done, a diamond shape is used to represent a decision point (i.e., where a decision must be made by an employee), and arrows are used to represent the flow of resources or information (Chase, Aquilano, & Jacobs, 2001; Dewar, 1992, Rummler & Brache, 1995). Process maps are commonly divided into "swim lanes" as well, using thick horizontal lines to create each lane. Swim lanes denote the entities (e.g., functions or people, depending on the scope of map) involved in a process, and a step occurring in a particular entity's swim lane represents the fact that the particular entity is responsible for the execution of that step. Figure 5 provides a general illustration of what a process map could look like. The illustration shows three swim lanes, six process steps, and two decision points. Each decision point has two possible outcomes shown; a "YES" outcome and a "NO" outcome, and arrows are used to connect the process steps in a way that shows a hypothetical flow of materials through the process.

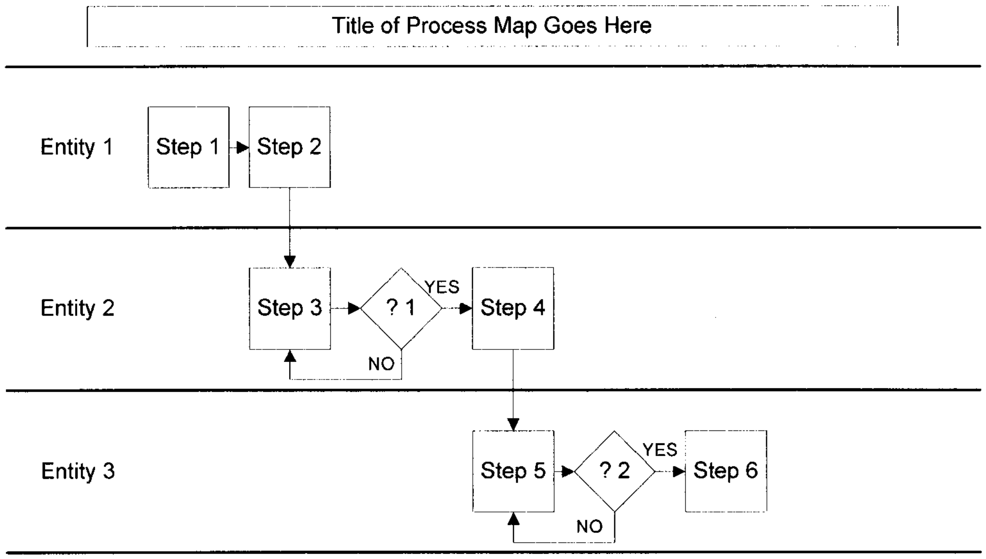


Figure 5. A generic example of a process map.

Although process maps can be created in various ways, they are usually created (or at least validated) by the group of individuals that use the process by conducting a process analysis workshop (for examples see Fulscher & Powell, 1999; Janzen, 1991). Some workshop facilitators prefer to write on seemingly endless rolls of butcher paper taped to the wall, some prefer to use a whiteboard or chalkboard, and others prefer to use Post-It™ notes that can be rearranged on a wall or whiteboard as process changes are discussed. However the original map is created, the final product is often translated into an electronic version to make storing, distributing, referencing, and updating the map an easier task.

Multiple software programs have been designed to create electronic process maps, including Process Model (Sellers, 1996), Team Flow (Heck, 1995), and Visio (Microsoft Corporation, 2003a).

Process mapping can be used to gain a clearer understanding of a process before additional improvement initiatives are undertaken (Symons & Jacobs, 1997), it can be used as a prelude to process simulation modeling (Greenfield & Sanabria, 2002; Sellers, 1996), it can be used symbiotically with other process improvement strategies (Aldowaisan & Gaafar, 1999; Bond, 1999; Collman, 1995), and it can also be considered an improvement strategy on its own (Babicz, 2002; Gourishankar, 2003; Rummler & Brache, 1995; Young, 1991). Process mapping has been used in police departments (Johntson, 2000), construction (Lurz, 1998), insurance (Keller & Jacka, 1999; Rabik, 2001), manufacturing (e.g., bearing production) (Collman, 1995), pharmaceuticals (Greenfield & Sanabria, 2002), safety management (ReVelle, 2003), and health care (Savory & Olson, 2001) to improve the quality of products and services while cutting costs.

Six Sigma

Six Sigma is a process improvement methodology that utilizes statistical tools to reduce process variation, and has gained quite a bit of popularity in the last decade (Bhote, 2002; Pande, Neuman, & Cavanagh, 2000). The term Six Sigma comes from the statistical term sigma, which represents one standard deviation. A "Six Sigma" process is a process that produces a defect rate that is outside of the range of six standard deviations above or below the mean in a normal distribution. Translated into non-statistical terms, a process operating at a six sigma level produces only 3.4 defects per million opportunities. To provide a perspective of the level of quality attained at a six sigma level, Table 1 provides the everyday examples of area, spelling, time, and distance from a magnitude of 1 sigma to 7 sigma.

Table 2. Magnitude of difference between sigma levels. Adapted from Breyfogle, Cupello, and Meadows (2001).

Sigma Level	Area	Spelling	Time	Distance
1	Floor space of the Astrodome	170 misspelled words per page in a book	31.75 years per century	From earth to the moon
2	Floor space of a large supermarket	25 misspelled words per page in a book	4.5 years per century	1.5 times around the world
3	Floor space of a small hardware store	1.5 misspelled words per page in a book	3.5 months per century	Coast-to-coast trip
4	Floor space of a typical living room	1 misspelled word per 30 pages (typical book chapter)	2.5 days per century	45 minutes of freeway driving
5	Size of the bottom of your telephone	1 misspelled word in a set of encyclopedias	30 minutes per century	1 trip to the local gas station
6	Size of a typical diamond	1 misspelled word in all the books in a small library	6 seconds per century	Four steps in any direction
7	Point of a sewing needle	1 misspelled word in all the books in several large libraries	One eye-blink per century	1 inch

But Six Sigma is more than a statistical term. Six Sigma is the name given to the teaching of statistical analyses used for process improvement, and to the methodology and leadership accountabilities taught in order to promote effective use of the statistical tools. Some of the tools taught in the Six Sigma methodology include correlation, linear regression, Pareto charts, one and two-way analysis of variance (ANOVA), box plots, and statistical control charts (Breyfogle, 1999; Stamatis, 2002). These are but a few of the statistical analyses taught, and the Six Sigma methodology doesn't end with a simple or complex statistical course. Possibly the most important element in the re-branding of the Six Sigma statistical tool kit is teaching the methodology with which one should apply the tools (Phillips-Donaldson, 2003). In essence, the Six Sigma methodology emulates the scientific method with its DMAIC (define, measure, analyze, improve, and control) approach to problem solving (Anonymous, 2003b, c; Caldwell, 2002).

Six Sigma was started at Motorola in the mid-1980s and was made popular by General Electric (GE) in the late 1980s and throughout the 1990s. It has been used as a performance improvement tool in industries such as electronics (Willis, 2003), financial services (Bossert, Grayson, Heyward, Kesterson, & Windsor, 2002), chemical manufacturing (Challener, 2002), aerospace (Bossert, Grayson, Heyward, Kesterson, & Windsor, 2002; Velocci, 2002), architecture (Challener, 2002), education (Six sigma schools, 2003), automotive products (Hill & Kearney, 2003; Olexa, 2003), and plastics (Hill & Kearney, 2003); and in organizations from 35 to over 100,000 employees (Connor, 2003).

Six Sigma has also been used to improve organizational functions such as research and development (Johnson & Swisher, 2003), manufacturing (Connor, 2003; Olexa, 2003), purchasing (Hill & Kearney, 2003), and marketing (Hill & Kearney, 2003); and to solve organizational problems such as decreasing cost and reducing time to market (Johnson &

Swisher, 2003), increasing efficiency and decreasing waste (Challener, 2002), reducing touch labor time and inventory levels (Velocci, 2002), and increasing product quality (Olexa, 2003). Similar to processing mapping, these tools can be used for a wide variety of purposes, and evidently are not limited to typical manufacturing settings as some critics have argued (Johnson & Swisher, 2003; Pyzdek, 2001).

These process and product improvements can directly affect an organization's bottom-line. Stockholders want to see the organization use these techniques to increase product quality and save money, thereby increasing the value of their stake in the company. It is now a common occurrence for companies to announce the savings and costs they attribute to Six Sigma programs, and the numbers are quite significant. Motorola estimates that these techniques have saved the company over $11 billion in manufacturing costs (Tennant, 2001) and GE estimates that these techniques save the company approximately $5-$10 billion a year (Pyzdek, 2001). While other companies may not be of the same enormous size as Motorola or GE, it is estimated that a person well trained in Six Sigma can save, on average, over one million dollars a year for his or her corporation (Breyfogle, Cupello, & Meadows, 2001).

Lean Manufacturing

While a main goal of Six Sigma is to reduce process variation, Lean Manufacturing is comprised of a set of tools aimed at reducing multiple types of waste. Many authors state that the two approaches are quite synergistic and can be used together to improve an organization's performance (Bossert, Grayson, Heyward, Kesterson, & Windsor, 2002; Connor, 2003; Hill & Kearney, 2003; Leon, 2002; B. Smith, 2003).

Practitioners utilizing Lean Manufacturing techniques attempt to reduce waste by focusing on activities that add value to the customer and eliminating the activities that don't.

Other areas of focus include quality improvement, cost reduction, and a reduction in rework and inventory levels (Michel, 2002). Essentially, Lean is doing more with less (Connor, 2003; Remich, 2002). The primary goal of a Lean operation is to reduce waste at every opportunity. Waste can include excess inventory, floor space, touch labor time, non-value added time, and material usage, among others. Lean programs often attack problems that are referred to as the "low hanging fruit" (B. Smith, 2003; Stamm, 2003). They tend to be more employee driven in comparison to Six Sigma programs, which are often characterized by a few elite individuals who have received a great deal of training and spend more time conducting analyses and running experiments to troubleshoot the most severe problems (B. Smith, 2003).

While Lean efforts focus on reducing waste, the Lean methodology draws on many individual strategies to accomplish its goals. For example, practitioners implementing Lean programs might try to decrease rework by making processes fail-safe using poke-a-yoke techniques (Adams, 2002), decrease non-value added time by using Single Minute Exchange of Die (Shingo, 1983/1985) techniques to reduce machine setup time (Anonymous, 2003d), or Total Preventive Maintenance (TPM) techniques to reduce machine downtime (Shah & Ward, 2003).

While many consider Lean to be a Japanese manufacturing technique that is also known as the Toyota Production System (Adams, 2002; Bossert, Grayson, Heyward, Kesterson, & Windsor, 2002; Connor, 2003; B. Smith, 2003), there is evidence that Lean techniques (e.g., Just-in-Time delivery, waste elimination, and cellular manufacturing) were first used by Henry Ford in the early 1900s (Bossert, Grayson, Heyward, Kesterson, & Windsor, 2002; Jusko, 2003; Levinson, 2002). Perhaps it is for this reason that the automobile industry has been at the center of the fame associated with Lean techniques, although these techniques have applied to many industries. Lean has been used in the aerospace (Bossert, Grayson, Heyward, Kesterson, & Windsor, 2002; Hill & Kearney, 2003), financial services (Bossert, Grayson, Heyward, Kesterson, & Windsor, 2002), automotive (Hill & Kearney, 2003), plastics (Hill & Kearney, 2003), and manufacturing (B. Smith, 2003) industries, as well as many others; and in organizations from under 100 to over 100,000 employees (Connor, 2003).

The review of the literature revealed it is very difficult to find cost-savings data directly attributable to Lean. Most companies that are reporting cost-savings data are doing so for Six Sigma projects, or combining Lean savings with their Six Sigma savings to report one combined cost-savings estimate (for an example see Hill & Kearney, 2003). While lacking cost-savings data, companies using Lean methodologies report benefits such as reducing lead time, improving productivity and quality, and decreasing scrap and rework (Adams, 2002; Connor, 2003; Remich, 2003; B. Smith, 2003). These benefits are reported as being directly attributable to the use of Lean techniques.

Just-in-Time Systems

One of the key components of a Lean enterprise is a Just-in-Time (JIT) delivery system (Suzaki, 1985). Just-in-Time is a term that can hold multiple meanings, and some authors even equate Lean Manufacturing principles with JIT principles (Duncan, 1988; Golhar, Stamm, & Smith, 1990; Stamm & Golhar, 1991; Wedderburn, 1985). Others limit the term JIT to the Just-in-Time delivery of materials, either from an external supplier or from one workstation (or function) to another within the same company (i.e., similar to the use of the term "continuous product replenishment") (Shmanske, 2003; Vuyk, 2002) . Golhar (personal communication, 2002) has clarified the difference in the use of the term "JIT" by referring to the two viewpoints as "Big JIT," which encompasses similar elements as Lean Manufacturing, and "Little JIT," which refers to the Just-in-Time delivery of materials. To avoid confusion between the two potential uses of the term, this section will focus on the Just-in-Time delivery of materials and the use of the term JIT will be synonymous with Golhar's (personal communication, 2002) use of "Little JIT." While I am differentiating JIT from Lean Manufacturing, it would still be accurate to describe JIT as one of the many techniques applied in a Lean enterprise and a part of the Lean toolkit.

JIT delivery systems assist in the reduction of waste by reducing the amount of floor and inventory space required. Characteristics of JIT systems include the frequent production (and delivery) of small lot sizes within and across organizations (Shmanske, 2003). Deliveries are expected to be on-time, reliable, and contain the exact number of parts that are made to 100% quality. In some cases, suppliers deliver materials to the exact spot on the production line where they will be used instead of a general loading dock. Maintaining minimal amounts of inventory at a given location enables manufacturers to have smaller plants (thereby saving money), and by requiring 100% quality they eliminate the need for internal inspection units (Shmanske, 2003). For example, a gross comparison of Ford and Toyota reveals that the two automakers build two nearly identical engines in two very different plants. At the time of comparison the Ford engine plant was 900,000 square feet, and produced two engines per day per employee. The Toyota plant was 300,000 square feet, and produced nine engines per day per employee (Wedderburn, 1985). While other manufacturing principles and techniques may deserve credit for the enormous difference in productivity, JIT delivery systems deserve most of the credit for achieving this amazing feat in such a small plant.

JIT operations depend on the ability of suppliers to deliver parts exactly on schedule. If a supplier delivers a shipment too early there may not be room to unload the materials. If a supplier delivers a shipment late it can stop an entire production line in its tracks. This problem is only exacerbated in plants that run in an extremely lean fashion. By extremely lean I am referring to plants that carry low levels of safety stock and sometimes receive several shipments each day from a given supplier. The problem of late deliveries became a reality for most JIT suppliers immediately after the terrorist attacks of September 11, 2001. These attacks provided a chilling wake-up call to JIT manufacturing operations. Unable to receive production materials due to a halt of most transportation methods in the days following the attacks, many producers had to stall or idle their production lines (Vinas, 2002). The events of September 11, 2001 gave JIT operations a better idea of the inventory levels they needed to maintain on-site to ensure continuous production in times of impaired shipping capacity. In less extreme and comparatively more typical times, an ongoing strategy used by JIT purchasers is signing tight supplier contracts that can "fine" suppliers for making deliveries that are late or otherwise violate contract terms (Vuyk, 2002). In an attempt to perfect JIT systems and prevent early or late deliveries, many have turned to Electronic Data Interchange (EDI) systems (Banerjee & Golhar, 1993a, b; Vuyk, 2002) The EDI systems communicate inventory stocks between purchasers and suppliers to assist with accurate delivery and inventory management.

JIT delivery systems have been used in many industries above and beyond automotive and manufacturing (e.g., Amasaka, 2002; Noaker, 1992; Wedderburn, 1985). They have also been used in industries such as hotel (Barlow, 2002), beverage (Vuyk, 2002), chemical and petrochemical (JIT spells out good chemistry, 1991), lumber (Kinney & Wempe, 2002), and more. Companies who have embraced JIT include well-known companies such as General Motors, Toyota, Coca-Cola, GTE Sylvania, and Exxon. Due to the limited definition of JIT I am using here, it is difficult to cite cost savings. John Deere has used JIT delivery principles to reduce inventory by $500,000, and Northern Telecom's London plant has been able to reduce inventory from $57M to $22M while also reducing its manufacturing and storage space from 120,000 square feet to 25,000 square feet (Wedderburn, 1985). All other articles reviewed that cited cost savings attributable to JIT programs did so in reference to what Golhar (personal communication, 2002) has labeled "Big JIT" and would not be appropriate to cite here due to the more expansive realm of principles employed.

Process Level Summary

When organization results need to be improved, the primary solution is to improve process performance. Improving internal processes can help to meet the needs of the super-system components (e.g., a greater return on investment for shareholders due to lower production costs; less expensive products that are made to higher quality standards in order to please the consumer market). Each strategy mentioned above can be used to improve process performance, yet they are only a sample of the types of improvements made at the process level. A more complete list of strategies used to improve process performance is presented in the Table 3.

Table 3. A summary of process-level performance improvement strategies.

Strategy	Selected References
Automation	Anonymous, 1988
	Bullerdiek & Hobbs, 1995
	Dasgupta, Sarkar, & Tamankar, 2002
	Goodwin & Bolland, 1988
	Hawkins, 1988
	King, 1993
	Miller, 1993
Design For Manufacturing and Assembly (DFMA)	Ashley, 1995
	Cocco, Callanan, & Bassinger, 1992
	Constance, 1992
	Dewhurst, 1993
	"DFMA Pays Off", 1993
	"Emerging technologies: DFMA", 1993
	Gyorki, 1996
	Leaney & Wittenberg, 1992
	Mecham, 1998
	Otis, 1992
	Raplee, 1999
	Taylor, 1997
	Welter, 1989
	Welter, 1990

Facilities Layout and Transportation Systems	Hazard, 1981
	Hicks & Cowan, 1976
	Lin, Foote, Pulat, Chang, & Cheung, 1996
	Mulcahy, 1993a,b
	Rubin, 1998
	Tompkins, 1977
	Tompkins, 1978
	Waghodekar & Sahu, 1986
	Winarchick & Caldwell, 1997
Fail-Safing	O'Connor, 1999
	Patel, Shaw, & Dale, 2001
	Vasilash, 1995
Group Technology (Cellular Manufacturing)	Adenso-Diaz, Lozano, Racero, & Guerrero, 2001
	Adil & Rajamani, 2000
	Cheng, Goh, & Lee, 2001
	Kannan & Palocsay, 1999
	Pull Production, 2002
	Suresh & Meredith, 1985
	Yasuda & Yin, 2001

Just-in-Time	Amasaka, 2002
	Banerjee & Golhar, 1993a, b
	Barlow, 2002
	Deshpande & Golhar, 1995
	Duncan, 1988
	Golhar & Deshpande, 1993
	Golhar & Stamm, 1993
	Golhar, Stamm, & Smith, 1990
	Kinney & Wempe, 2002
	Noaker, 1992
	Shmanske, 2003
	Stamm & Golhar, 1991
	Suzaki, 1985
	Vinas, 2002
	Vuyk, 2002
	Wedderburn, 1985
Kanban (Pull Production)	Chausse, Landry, Pasin, & Fortier, 2000
	Cubalchini-Travis, 2002
	Djassemi, 2000
	Howell, 1999
	Stundza, 2000

Lean Manufacturing	Adams, 2002
	Anonymous, 2003d
	Bossert, Grayson, Heyward, Kesterson, & Windsor, 2002
	Breyfogle, Cupello, & Meadows, 2001
	Connor, 2003
	Demers, 2002
	Hill & Kearney, 2003
	Jusko, 2003
	Leon, 2002
	Levinson, 2002
	Michel, 2002
	Remich, 2002
	Shah & Ward, 2003
	B. Smith, 2003
	Stamm, 2003

Operations Scheduling (Manufacturing Execution Systems)	Anonymous, 2000
	Anonymous, 2001b, c
	Biegel & Wink, 1989
	Colvin, Bradburn, & Schaefer, 2002
	Davis, 2003
	Dror, 2000
	Hoske, 1998
	Sarker & Li, 2001
	Trebilcock, 2001
	Vijayan, 2000

Process Mapping / Flowcharting	Aldowaisan & Gaafar, 1999
	Anjard, 1998
	Babicz, 2002
	Biazzo, 2002
	Bond, 1999
	Burr, 1990
	Chase, Aquilano, & Jacobs, 2001
	Collman, 1995
	Dewar, 1992
	Fulscher & Powell, 1999
	Gourishankar, 2003
	Greenfield & Sanabria, 2002
	Heck, 1995
	Janzen, 1991
	Johntson, 2000
	Keller & Jacka, 1999
	Lurz, 1998
	Patton, 2002
	Rabik, 2001
	ReVelle, 2003
	Rummler & Brache, 1995
	Savory & Olson, 2001
	Sellers, 1996

	Soliman, 1998
	Symons & Jacobs, 1997
	Young, 1991
Process Selection	Ben-Arich, 1994
	Bock, 1991
	Nau & Chang, 1983
	Plante, 2001
	Stuart, Ammons, & Turbini, 1999

Six Sigma	Anonymous, 2003b, c Bhote, 2002 Bossert, Grayson, Heyward, Kesterson, & Windsor, 2002 Breyfogle, 1999 Breyfogle, Cupello, & Meadows, 2001 Caldwell, 2002 Challener, 2002 Connor, 2003 Hill & Kearney, 2003 Johnson & Swisher, 2003 Olexa, 2003 Pande, Neuman, & Cavanagh, 2000 Phillips-Donaldson, 2003 Pyzdek, 2001 Six sigma schools, 2003 Stamatis, 2002 Tennant, 2001 Velocci, 2002 Willis, 2003

Six Sigma & Lean Manufacturing combined	Anonymous, 2003d
	Bossert, Grayson, Heyward, Kesterson, & Windsor, 2002
	Connor, 2003
	George, 2002
	Hill & Kearney, 2003
	Leon, 2002
	Michel, 2002
	Mills, Wheat, & Carnell, 2001
	B. Smith, 2003
SMED	"The SMED system", 1988
(Single Minute Exchange of Die)	Anonymous, 1998a, b
	Johansen & McGuire, 1986
	Leschke, 1997
	Shingo, 1983/1985
	Strickland, 1997
Statistical Quality Control (SQC)	Frahme, 2002a, b
Statistical Process Control (SPC)	Sternbergh, 2003

Total Quality Management	Boyne & Walker, 2002 Brown, Hitchcock, & Willard, 1994 Chelsom, Reavill, & Wilton, 1998 Claver, Tari & Molina, 2003 Cua, McKone, & Schroeder, 2001 George & Weimerskirch, 1994 Powell, 1995 Pun, 2002 Ross, 1999 Tenner & DeToro, 1992 Zairi, 2002

These strategies, when used alone or in proper combination, can help to solve numerous quality and productivity issues in the workplace. Some are highly technical (e.g., Six Sigma) whereas others rely heavily on workers to diagnose problems and implement changes (e.g., Lean Manufacturing). Some may be used in all work environments (e.g., Process Mapping), whereas others appear to be industry or task specific (e.g., SMED). However, the ultimate goal of each of these strategies is to improve process performance, whether it is measured in productivity, efficiency, machine run time, machine set-up time, cycle time, or some other process metric. This section has focused on strategies aimed at improving performance at the process-level. The following section focuses on strategies aimed at directly improving the performance of employees.

Job/Performer Level

Rummler and Brache (Job/Performer Level)

While a process centered view (see Figure 4) can be valuable in overcoming barriers established by functional "silos," a performance analyst must not forget that there are people "inside" the process (see Figure 6). Strategies aimed at improving process-level performance address logistics and systems issues, whereas strategies at the Job/Performer Level focus more directly on the factors that influence human behavior. This additional perspective is a necessity for effective performance improvement, as employees are the ones that must execute many of the functions in a work process, even in the most automated of working environments.

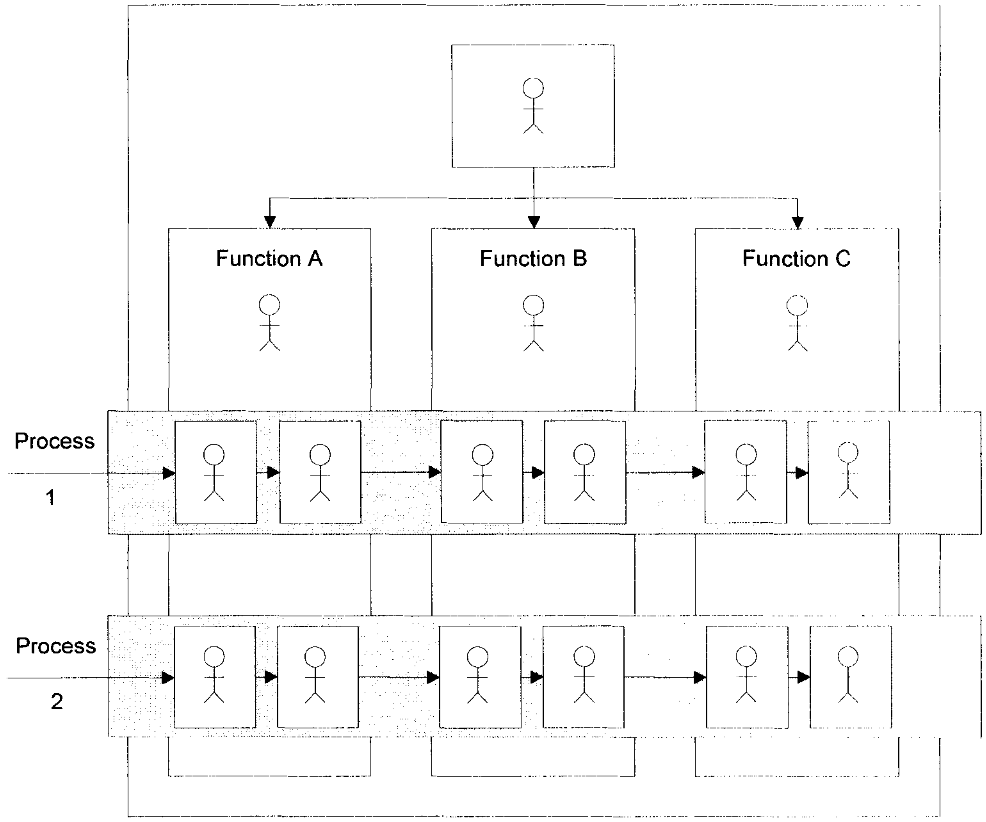


Figure 6. People executing work steps "inside" a work process. Adapted from Rummler and Brache (1995).

Rummler and Brache (1995) have established a systems-oriented model of human performance in the workplace, called the Human Performance System (HPS) (see Figure 7). The HPS specifies six essential components that must be adequately addressed in order to appropriately support human performance in any work environment for any work task. In other words, it is a generic template that can be used as a tool by a performance analyst in any industry for any given position. Rummler and Brache (1995) contend that the six HPS variables are related in a performance system, and that interdependencies exist among all six variables. For this reason, all six of these components must be adequately represented in order for an employee to produce at optimal levels.

The six components of the HPS are: 1) Performance Specifications, which are pre-established standards that comprise the goals of the job (e.g., information about the necessary characteristics of output requirements; work goals), 2) Task support, which is the collection of resources available to employees to assist them in achieving optimal performance (e.g., job aids to guide an employee through process steps; improved work processes), 3) Consequences, which are planned reinforcement contingencies that are dependent upon specified levels of performance (e.g., monetary incentives; other incentives), 4) Feedback, which is information provided to employees on their individual or group performance that can be used to guide future performance (e.g., daily production graphs for each performer or work group; verbally informing employees of how well they are performing in relation to specified criteria), 5) Skills/Knowledge, which consist of the skills and knowledge required to produce products or services that meet the required specifications (e.g., skills assessment; training to teach new skills, new procedures, or how to use new pieces of equipment), and 6) Individual Capacity, which is a person's physical, mental, or emotional capacity to perform at optimal levels (e.g., emotional assessments or counseling; physical supports and prosthetics). Performance analysts can use the HPS template as a tool for diagnosing performance deficiencies and developing comprehensive solutions that address multiple root causes.

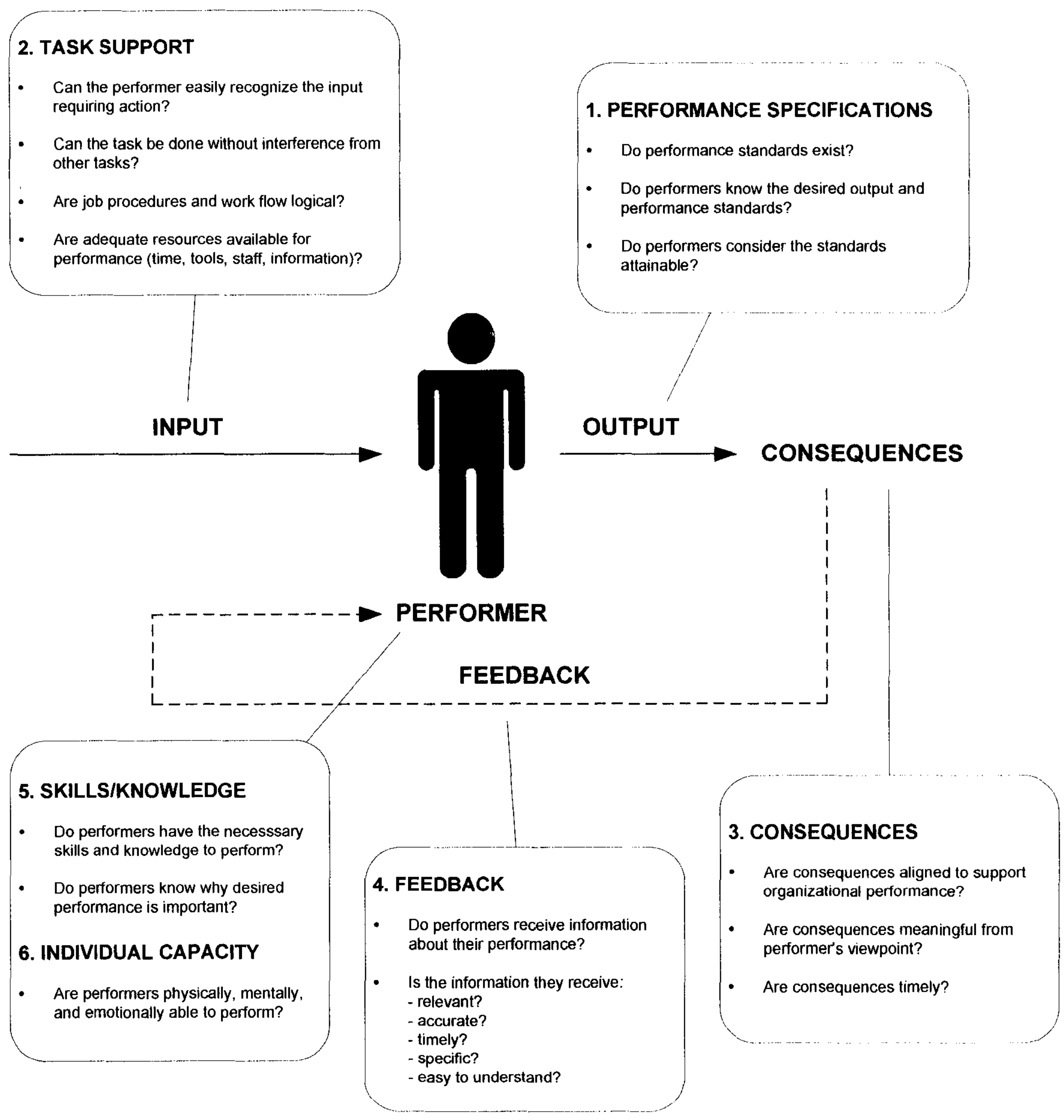


Figure 7. Rummler and Brache's (1995) Human Performance System (HPS) diagram. Reprinted by permission of John Wiley & Sons, Inc.

Although there are many different types of process-level interventions (see Table 3 for a summary), and some are industry or task specific, when implementing a process intervention a HPS analysis should also be conducted for each person (or position) within the work process. The HPS analysis may reveal root causes that indicate why a work process is sub-optimized. It can also be used to determine what performance support, training, consequences, and so on will be required to effectively implement process changes.

Process changes affect how the work is done in an organization, and well-documented processes establish a guideline for how the work should be conducted. However, even workers on an assembly line, engaging in the most-structured of tasks, still exhibit some degree of variability in work behavior, and this can often affect organizational outputs. Any instance of a union slowdown provides a clear example of this fact. Due to employees on the front lines having a large degree of control over quality inspection, productivity, and rework rates; a complete performance analysis will always investigate the factors affecting human performance. Regardless of what level of the organization one is examining, the plans and goals that are set forth at that level become a reality at the Job/Performer Level, which makes the contributions of Applied Behavior Analysis (ABA) (Baer, Wolf, & Risley, 1968) a key component in any performance improvement initiative.

Applied Behavior Analysis

The origin of Rummler and Brache's (1995) HPS was an intellectual collaboration in the early 1960's between Drs. Geary Rummler and Dale Brethower at the University of Michigan. While they were both doctoral students, Dr. Rummler was in University of Michigan's business college whereas Dr. Brethower was in the psychology program. Their combined efforts generated the creation of multiple models that are all aimed at improving organization and human performance. The subset of tools (e.g., the HPS) designed to improve human performance are largely based in the field of ABA (Baer, Wolf, & Risley, 1968).

ABA is an area of Behavioral Science which focuses on improving behaviors and producing clinically significant outcomes. However, whether an outcome is clinically significant is sometimes subjective. To be clinically significant an intervention must not only improve behavior to a considerable degree (i.e., to a degree that is deemed acceptable by a therapist and client, or a performance analyst and client company), but it must also target a socially or organizationally relevant behavior (e.g., smoking cessation or increased productivity). Each person might have a specific behavior that he or she would want him or herself, or someone else, to exhibit in a different fashion. Primarily, it has been the amazing success of behavioral techniques in many domains, and secondarily the degree of idiosyncrasy in selecting a clinically relevant target behavior that has brought the principles of ABA into many different settings.

ABA techniques have been used to increase the safety performance of: Workers in open-pit mines (Fox, Hopkins, & Anger, 1987), roofers (Austin, Kessler, Riccobono, & Bailey, 1996), and bus drivers (Olson & Austin, 2001). They have been used to increase the number of legal body checks administered in a hockey game (Anderson, Crowell, Doman, & Howard, 1988), to increase courtesy among police staff (Wilson, Boni, & Hogg, 1997), to increase the accuracy and timeliness of banquet setups (LaFleur & Hyten, 1995), and to increase the productivity of telephone interviewers (Thurkow, Bailey, & Stamper, 2000) and admissions processors at a large university (Wilk & Redmon, 1998).

Those who use ABA principles to improve performance in organizational settings refer to their craft as Organizational Behavior Management (OBM). OBM techniques (see Austin, 2000; Brethower & Smalley, 1998; Daniels, 1989; Gilbert, 1996; Mager & Pipe, 1970;

Rummler & Brache, 1995) often consist of providing employees with the appropriate training to perform job functions; providing employees with the appropriate tools, equipment, and information to perform a task; providing employees with specifications regarding how the task is to be completed, as well as specifications for the product or service the employee produces; providing appropriate consequences for good and poor performance; and, providing feedback based on the quality, quantity, and timeliness of task performance, and making sure that the feedback is delivered in a timely fashion and in an easily understood format.

An OBM practitioner must be able to diagnose performance deficiencies and design interventions to meet the appropriate needs of the performance context. The HPS diagram can assist a practitioner in conducting a thorough analysis of the performance problem by serving as a troubleshooting guide to diagnose performance contexts to determine where the sources of performance deficiencies exist. The practitioner must then use his or her knowledge of human behavior to design interventions that will support the desired performance and ensure that the HPS components have been adequately addressed. In many cases the specific area of performance (e.g., an area of the HPS) is so complex that an academician or practitioner may spend his or her entire life working to refine the methods associated with a particular area of performance or particular intervention strategy (e.g., feedback or monetary incentive systems). The complex and comprehensive nature of behavioral interventions requires a thorough understanding of all of the factors influencing human performance. A worker's effectiveness might only be thwarted by an ill conceived intervention that was created out of haste and lacking a comprehensive analysis, as opposed the anticipated effectiveness of a well conceived intervention that was based on a comprehensive analysis of all the variables contributing to the performance problem. The construction of these effective interventions requires the performance analyst to base all recommendations for change upon specific root causes identified in the performance analysis and the practitioner's knowledge of human performance in organizational settings. The following sections will define and provide examples of selected intervention strategies; although a performance analyst may decide to use only one strategy, multiple strategies, or a combination of strategies in order to meet the needs of the specific performance deficiency. A discussion of performance specifications, training, consequence manipulation, monetary incentives, and how these (and other) intervention strategies are used in combination to improve human performance follows.

Performance Specifications

Before employees can perform adequately on the job they must know what is expected of them. For example, they should be told the level of quality that is expected of them and how long it should take to complete a task. In short, if the performers are not aware of what they must do or how they must perform, then how can they be expected to perform well? Unfortunately, employees in many organizations are not aware of what they must do or how they should perform. It is not uncommon for workers to enter an organization and receive On-the-Job Training (OJT) from another individual. In the absence of clearly defined standards, trainees acquire a second-hand account of what is important on the job. The person providing the OJT imparts his or her subjective perceptions of what is and is not important to the trainee, most likely without providing a rationale for why a particular metric or suggestion is important.

Permit the hypothetical example of two employees, who I will call "Trainer" and "Learner." Trainer and Learner work in a stamping plant, and although Trainer has always produced quality parts, his production numbers have historically been lower than some of the other workers. Trainer's supervisor is aware of all of the critical elements related to optimal production, but he does not share this information with his employees, nor does he provide the appropriate feedback to his employees. One day the supervisor realizes that Trainer is not producing a sufficient quantity of parts and the supervisor verbally reprimands Trainer and tells Trainer to increase his production. Trainer forms a rule (for discussions of rule control in organizational settings see Malott, 1992; Malott, Malott, & Shimamune, 1992; Malott, Shimamune, & Malott, 1992) that the supervisor on that production line wants a sufficient level of quantity, and does not care very much about quality, since he was not told anything about his level of quality (measured by scrap, rework, bad parts produced, etc.). When Trainer provides OJT to Learner, he tells Learner, "You had better produce a high number of parts. Quality isn't too important, but if you produce a high number of parts you won't be bothered by the supervisor." The hypothetical interaction between Trainer and Learner is but one example of the many ways that the lack of documented performance expectations can lead to the creation of faulty rules about performance requirements, and that those rules can be self-developed or acquired from a supposedly reputable source (e.g., a trainer). The simple solution is to provide each employee with performance specifications.

Each employee should be told what is expected of him or her, in all relevant aspects of his or her job. In the area of timeliness, an employee might need to know what aspects of timeliness are important, and what constitutes "timely." For example, how many minutes from when parts are received should the completed product leave the workstation? Or, how long should it take to perform an analysis of a certain type? If the number of parts produced is important, how many parts are desirable on a given shift, day, or week? Is it okay to over-produce on a given shift? And so on. Without communicating performance specifications the employee will form his or her own rules regarding what is acceptable, and the result will likely be a minimal level of performance (i.e., the employee will produce just enough parts to avoid receiving a reprimand from the supervisor) (Daniels, 1989).

Performance specifications should be provided and always accessible to an employee. These specifications should not be hidden in an employee handbook or stashed away on a corporate intranet. In many work environments the tasks are always changing (along some dimension) to meet the changing needs of business. For example, a stamping plant may prepare a line to press a standard lot of 1,000 car hoods, but the next week it may need to prepare a line to run an emergency order of 250 car hoods. The employees on the line must know that this is an emergency order that needs to be produced in a timely fashion, and they should also be told that the production run is going to consist of 250 units, as the last time they ran this part they produced a standard lot size of 1,000 hoods. As quickly as performance expectations change, the new performance specifications should be effectively communicated to employees. The simple provision of performance specifications can be an inexpensive and effective strategy for improving human performance.

Performance specifications have been used to assist in improving performance in a number of settings. They have been used to help improve doctor utilization time (Gikalov, Baer, & Hannah, 1997), mental health staff performance (Langeland, Johnson, & Mawhinney, 1998), customer service behaviors of police staff (Wilson, Boni, & Hogg, 1997), the quality of banquet set ups (LaFleur & Hyten, 1995), and the timeliness and attendance of factory workers (Landau, 1993).

Brown and Sulzer-Azaroff (1994) successfully used a package intervention that included performance specifications to increase the smiling, greeting, and orienting behaviors of employees at a bank. The performance specifications were conveyed through the provision of feedback to the bank tellers that served as participants. Providing feedback is a form of performance specification (that is admittedly more comprehensive than simply telling employees what behaviors are required) because each instance of feedback serves as an instance of mentioning the desired performances (Sasson & Austin, 2002). Although the study consisted of multiple phases, the phase which included the performance specifications produced the greatest amount of behavior change.

Ludwig and Geller (1999) used an intervention that primarily relied on performance specifications to increase the turn-signal use of pizza deliverers. Using a multiple baseline design, pizza deliverers at two separate restaurants were provided with performance specifications in their paycheck envelopes on two separate occasions that were two weeks apart. The two restaurants were members of the same national franchise, and each note contained the same policy statement: "It is the policy of (name of franchise) that all delivery drivers use their turn signal at every intersection when making a delivery." After the first application of the policy statement drivers at Store A increased their percentage of turn-signal usage from 70% to 78%, and after the second application of the policy statement the drivers increased their turn signal usage to 84%. After the first application of the policy statement at Store B drivers increased their percentage of turn-signal usage from 46% to 51%, and after the second application of the policy statement the drivers increased their turn signal usage to 59%. The results obtained in this study show that interventions aimed at improving performance, that primarily consist of performance specifications, can result in positive effects with little cost and effort.

While an effective means of improving behavior, performance specifications rarely comprise an entire intervention in and of themselves (Sasson & Austin, 2002). Performance specifications are often a part of a larger intervention, and merely comprise one component of an intervention package. This is true of most performance improvement strategies that occur at the Job/Performer level (Sasson & Austin, 2002), and will be discussed in the Job/Performer Level Summary below.

Training

When faced with problems concerning employee performance it is quite common for a manager's first solution to be a training request. To someone who does not specialize in the field of human performance improvement, the solution seems quite logical, "If the person is not performing well, teach the person to perform better." Unfortunately training is not always the proper solution. A good performance analyst knows that proper training is essential, but not sufficient, to attain the desired results. All other areas of the HPS (Rummler & Brache, 1995) must be adequately met as well. Mager and Pipe (1970) have a simple (albeit not very feasible) rule to determine whether training is necessary – Put a gun to the performer's head and ask them to perform the task. If the performer can perform the task to an adequate degree, then the solution to performance improvement lies outside the realm of training. If the performer cannot perform the task, training should be an essential part of the Performance Improvement Plan (PIP) (Daniels, 1989). Many professionals (Daniels, 1989; Gilbert, 1996; Mager & Pipe, 1970; Rummler & Brache, 1995) suggest that although some human performance problems require training as a part of the solution, the majority of problems are solved by improving upon other areas of the HPS (e.g., performance specifications, feedback, and consequences).

When training is utilized as a solution component it should be developed based on the information and skills the employee will need to produce the products and services (Brethower & Smalley, 1998). Brethower and Smalley (1998) propose a training model called "Performance-Based Instruction" (PBI). PBI seeks to train employees to be fluent at producing outputs that meet all performance expectations (e.g., levels of scrap, rework, timeliness, quality, accuracy, etc.) while consuming the fewest possible resources (e.g., employee time, external trainer time, training rooms, etc.). This lean approach to training is grounded in a research-based framework that helps trainees master the "need to know" information (e.g., how to perform the task and what to do if equipment malfunctions) while reducing the "nice to know" information (e.g., company history, founders, information on other branch offices or plants, and so on).

PBI training consists of three phases, 1) Guided Observation (GO), 2) Guided Practice (GP), and 3) Demonstration of Mastery (DM). During the GO phase, learners watch an expert (or experts) perform work tasks and the learners observe and score the expert performance(s) with a checklist. Learners are also encouraged to take notes and ask questions. In the GP phase, learners engage in the task(s) under controlled circumstances. For example, in groups of three, one person could play a customer, one could play an employee, and the third person could take notes on the interaction between the first two trainees and provide feedback to each of them. The three individuals could then take turns in each role until a sufficient number of scenarios had been practiced. This is "learning by doing," and this phase ends when certain performance criteria are met (e.g., standards of quality and accuracy). The final phase, Demonstration of Mastery, can often take place "on the job," except when performing fluently is extremely critical and not even a single mistake can be tolerated (e.g., the position of commercial airline pilot). The DM phase begins when the learner meets all of the standards established for the GP phase. When the learner has met the GP standards he or she will begin to engage in the actual job tasks, which could mean working with customers or actually producing products with raw materials and equipment. The DM phase ends when additional performance criteria are met, usually performance criteria related to fluency such as timeliness and productivity metrics. In summary, PBI is a training methodology that is grounded in science and economics, and can be used to teach almost any task.

Methot, Williams, Cummings, and Bradshaw (1996) used a training program to increase supervisors' and managers' use of objective measures and contingent consequences in a human service setting. Using a multiple baseline design, supervisors and managers participated in a three-hour training session in which experimenters provided instruction on the use of goal-setting, objective performance monitoring, contingent use of consequences, and the provision of performance feedback. After the training was provided desirable behavior changes were observed for all participants, and these changes also resulted in an increase of positive outcomes for nearly of all of the consumers (i.e., consumers at the facility diagnosed with developmental disabilities) that participated in the study.

Hantula, Rajala, Brecher Kellerman, and DeNicolis Bragger (2001) used a training program to increase the safe behavior of employees in two manufacturing organizations. Using a multiple baseline (across organizations) design, line-level supervisors and managers were trained in behavioral safety procedures such as identifying equipment issues, when to request an ergonomic analysis, and how to identify unsafe environmental conditions and work practices. The supervisors and managers were then asked to implement the techniques learned in the training session. Results of the study indicate a decrease in accident and injury rates for both companies, and an annual cost savings of $110,000 for Company One and an annual cost savings of $501,000 for Company Two, over a four year period.

Whether training is Performance-Based Instruction, or some other type of training, the ultimate goal is to teach learners the skills necessary to attain success on the job. People in every industry and every job require some type of training, to learn new skills or possibly just to get acquainted with the policies and procedures of a new employer. For this reason training is a multi-billion dollar industry and the amount of money spent on training continues to grow each year (ASTD, 2002). Those in field of OBM have used training to assist performance improvement interventions aimed at improving delivery driver (Nicol & Hantula, 2001), fast food (Welsh, Bernstein, & Luthans, 1992) and textile worker (Welsh, Luthans, & Sommer, 1993) performance; to improve problem solving and self-management skills (Godat & Brigham, 1999), and supervisor (Methot, Williams, Cummings, & Bradshaw, 1996) and trainer (Fleming, Oliver, & Bolton, 1996) performance. While training can be used to teach a wide variety of skills, many experts assert that the consequences that are available on an ongoing basis are what will determine the maintenance of the skills learned in training. Training is often the first step in an intervention package, and once the appropriate behaviors are learned, they must be supported and reinforced to maintain the desirable performance in the worker's environment. The next section discusses the use of consequences in the workplace to improve and maintain performance.

Consequence Manipulation

Consequence Manipulation (CM) is the arrangement of specified outcomes for specified levels of performance. The manipulation of consequences is a theme that is at the core of many human performance improvement frameworks (e.g., Daniels, 1989; Gilbert, 1996; Rummler & Brache, 1995). Daniels (1989) defines consequences as "the events that follow behaviors and change the probability that they will recur in the future" (p. 23). Daniels (1989) discusses four main types of consequences; Positive Reinforcement, Negative Reinforcement, Punishment, and Extinction. Positive Reinforcement increases behavior by presenting something desirable after the occurrence of the desired behavior. Negative Reinforcement increases behavior by removing something that is undesirable after the occurrence of the desired behavior. Punishment decreases behavior by presenting something that is undesirable after the occurrence of an undesirable behavior, and Extinction decreases behavior by withholding something that is desirable after the occurrence of an undesirable behavior. While Daniels (1989) describes these four terms in greater detail, his book focuses on the use of Positive Reinforcement as the premier technique used to improve human performance. Furthermore, Daniels (1989) argues that Positive Reinforcement is the single most effective tool a manager has for increasing employee performance.

Although positive reinforcers are highly idiosyncratic (and Daniels (1989) recommends many strategies for choosing appropriate reinforcers), some common examples of items used as positive reinforcers are gift certificates, tickets to events or shows, and money. Due to the idiosyncratic nature of consequences (i.e., what functions as a reinforcer for one person may not function as a reinforcer for another person), a consequence analysis should conducted for each problem behavior to determine why the behavior is (or is not) occurring. A consequence analysis consists of listing all of the consequences of a behavior, and evaluating those consequences based on three criteria; 1) perception of the consequence (i.e., as positive or negative), 2) timeliness of the delivery of the consequence (i.e., immediately after the behavior occurs or sometime in the future), and 3) the certainty of the occurrence of the consequence (i.e., it is certain that the consequence will occur after the behavior is emitted or it is uncertain that the consequence will occur after the behavior is emitted). According to Daniels (1989), a positive consequence is one that a person would find desirable, whereas a negative consequence would be perceived as undesirable. An immediate consequence can be classified as occurring within a minute of the person engaging in the behavior, and a future consequence is a consequence that occurs at a later time (e.g., ten minutes, one week, one year, ten years, or more after the behavior). A certain consequence is one that is highly likely or almost guaranteed to occur after a person engages in the behavior, whereas an uncertain consequence might or might not occur if one engages in the behavior. For example, a worker may be failing to engage in the desirable behavior of wearing safety glasses at the appropriate times. One consequence of the worker's behavior is that the worker is at a greater risk of being injured if an accident occurred. This consequence could be classified as Negative, Immediate or Future, and Uncertain, as the worker may or may not have an accident, and it could occur at any moment or in the future. Another consequence of not wearing safety glasses is increased comfort. This consequence could be classified as Positive, Immediate, and Certain. There could be many different consequences listed for any given behavior, and once the consequences are listed and analyzed for the undesired behavior, they should also be listed and analyzed for the desired behavior in a separate analysis (e.g., one analysis for not wearing safety glasses and another analysis for wearing safety glasses). The analyses are then used to design interventions that minimize the number of Negative, Immediate/Future, and Certain/Uncertain consequences and increase the number of Positive, Immediate, and Certain consequences for the desired behavior. Since the ongoing consequences control ongoing behavior, a good performance analyst will alter the ongoing consequences to support the desired performance and to foster maintenance.

Welsh, Bernstein, and Luthans (1992) used Premack's (1959, 1965) model of reinforcement to decrease the number of food preparation and food delivery errors made by employees at a fast food franchise location. Premack's (1959, 1965) model of reinforcement consists of using more probable (i.e., preferred) responses as reinforcers for engaging in less probable (i.e., less preferred) responses. The study utilized a multiple baseline (across participants) design. The participants were provided with the opportunity to work at a workstation (e.g., fryer, grill, front counter, drive-through window, and so on) of their choice on their next shift, as long as they met specific performance criteria on their current shift. The results for all five participants show a decrease in the number of food preparation and food delivery errors committed by each participant. Although no cost savings were cited, one can reasonably assume that fewer errors resulted in less product loss and / or an increase in the quality of the food delivered to customers and the level of customer service received by patrons.

Austin, Kessler, Riccobono, and Bailey (1996) used a package intervention to increase the safety performance of roofing workers. One component of the package intervention was the use of reinforcers for satisfactory safety performance. Each day that the entire work crew achieved a score of 80% safe on two separate checklists (one for the ground and one for the roof) each worker would receive .5 hours paid-time-off to be used at the end of the roofing project. The roofers would also receive small tangible reinforcers (e.g., cold drinks and fruit) on each day that followed a day in which a score of 80% safe (or higher) was attained. Safety performance improved from 51% on the ground during baseline to 90% on the ground during intervention, and from 55% on the roof during baseline to 95% on the roof during intervention.

Additional examples of consequence manipulation in OBM include using praise and monetary incentives to improve therapist performance (Huberman & O'Brien, 1999); free lunches, dinners, and gift certificates for decreasing the number of rejected parts (Jessup & Stahelski, 1999); and verbal praise and individualized "Thank You" notes for increasing the accuracy of copied dictation (Godbey & White, 1992).

Monetary Incentives

Monetary incentives are a type of consequence manipulation, namely the provision of money (a reinforcer) for desired levels of performance. Due to the notion that non-monetary reinforcers are idiosyncratic, it is difficult for researchers to equate the quality of reinforcement received by participants when using non-monetary reinforcers. For example, if two participants in a research study are rewarded with tickets to a Broadway show, one participant (who likes going to the theater) might be highly motivated by the tickets, whereas the other participant (who does not enjoy the theater) might not be motivated by the tickets, and the researchers could expect little behavior change as a result (from only one of the two participants, when both participants received the same exact treatment). In the workplace, a manager who has learned the idiosyncratic reinforcers of his or her employees might improve the effectiveness of a reinforcement system by personalizing reinforcers (Daniels, 1989), however, in a research setting, where the experimenter has very limited contact with participants, personalized reinforcers can be a threat to internal validity. To combat this threat, monetary incentives are often used as reinforcers in OBM research to provide a consistent level of reinforcement to all participants, thereby allowing the experimenter to rule out the quality of reinforcement as a threat to internal validity.

Because money is used to purchase and pay for many things (e.g., soda, fruit, candy, clothes, sources of entertainment, bills, and so on), it becomes associated with all of these items. These associations with various reinforcers (e.g., a soft drink, food, or entertainment) occur under various states of deprivation (e.g., being thirsty, hungry, or bored). Although humans are often subject to different states of deprivation, they are almost always experiencing some form of deprivation that can be alleviated by purchasing some good or service. The fact that money can purchase many of these goods and services at any given time establishes money as a generalized conditioned reinforcer (Daniels, 1989) and a good candidate for providing equal reinforcement to all participants in a research context.

LaFleur and Hyten (1995) used a package intervention to increase the quality and timeliness of banquet setups at a north Texas hotel. One component of that package intervention was an incentive system in which employees could receive a monthly monetary bonus for achieving quality performance. Quality performance was defined as an 85% completion record for all banquet setups that employees had participated in that month, as measured by a completion setup checklist that was used by the banquet manager. All setups were also to be completed 15-minutes before the guests were scheduled to arrive. The study utilized an ABAB reversal design, and performance levels were highest (and least variable) in both of the treatment conditions. Customer satisfaction ratings for room setup quality and customer service were also highest in the two treatment conditions.

LaMere, Dickinson, Henry, Henry, and Poling (1996) used a monetary incentive system to improve the performance of truck drivers. The monetary incentive system used by the researchers is too complex to fully explain here, but in short, the incentive system rewarded drivers for increased productivity and withheld the opportunity to receive the monetary incentive during weeks in which the driver had an accident in which the police or the management deemed the driver was at fault. Results of the study showed an increase in productivity and a decrease in accidents. Drivers also realized an increase in pay due to the monetary incentive system, and the company saved approximately $76,000 in the first 15 months of the intervention (the intervention was in place for nearly four years).

Many researchers have examined the effectiveness of money as a reinforcer (Allison, Silverstein, & Galante, 1992; Honeywell, Dickinson, & Poling, 1997; Honeywell-Johnson & Dickinson, 1999; Matthews & Dickinson; 2000; Mawhinney, Dickinson, & Taylor, 1989) and the results of these studies indicate that monetary rewards are effective at increasing various dimensions of various types of performance. As with Consequence Manipulation, the key to an effective monetary incentive system is the contingent nature upon which the incentives are earned. Incentives that are provided for simply being an employee (e.g., a typical gain sharing program) may promote employee retention, but will do little to improve worker performance. When earning a monetary incentive is contingent upon attaining specified performance criteria the system is much more likely to generate the desired behavior change (Stajkovic & Luthans, 2001).

Strategies Used in Combination

The strategies mentioned above (performance specifications, training, and consequence manipulation), as well as other strategies aimed at influencing areas of the HPS (see Figure 7), are often used in combination. The HPS exemplifies the notion that human performance is a function of many different variables, and that all variables must be sufficiently represented in order to achieve optimal performance. Because human performance occurs in a systemic fashion (Rummler & Brache, 1995; Sasson & Austin, 2002), these strategies are often used together in well conceived intervention packages. The packages are designed to address all of the necessary problems, meet the required performance needs, and make wise use of resources. And while these strategies are rarely used alone, there are some circumstances in which it would be completely feasible and appropriate to use a lone strategy. Such an implementation would be appropriate when an analysis of all variables reveals that only one variable needs improvement, or if changing other variables in addition is not cost effective, and the improvement can likely be achieved by utilizing a single strategy.

Job/Performer Level Summary

Regardless of the process changes made in an organization, behavior of people must be modified to execute those changes effectively. In addition, human behavior can serve as a primary source of performance improvement (as opposed to changing human behavior to support process changes). Human performance can be improved in a number of ways, with a number of different strategies. Many factors influence human performance, and the HPS diagram (see Figure 7) provides a systemic representation of these factors. Often multiple areas of the HPS need to be addressed, and various combinations of interventions (i.e., package interventions) might be appropriate based on the needs of the performer.

OBM techniques have been used in a number of settings (as mentioned above) to influence human performance. Interventions at the Job/Performer Level can be measured in financial terms, however they are also commonly measured in terms of behavior change (e.g., safe work practices) or changes in tangible results (e.g., the number of completed products). These techniques have been shown to produce large amounts of performance improvement and resultant cost savings, with some researchers citing annual cost savings of $55,500 (Sulzer-Azaroff, Loafman, Merante, & Hlavacek, 1990) and others citing annual cost savings as high as $590,000 (Fox, Hopkins, & Anger, 1987). However not all gains at the Job/Performer Level are cited in dollars. Many times behavioral change represents the foundation for achieving other organizational goals. For example, there may not be a direct benefit to using a machine guard on a single occasion, but over the course of time proper safety practices will reduce accident and injury rates, thereby leading to lower workman's compensation and insurance costs for an employer. For this reason many results of behavioral implementations are conveyed in terms of the actual behavior change. The results of some behavioral interventions have been reported as the number of legal body checks delivered in a hockey game (Anderson, Crowell, Doman, & Howard, 1988), the number of college admissions applications processed (Wilk & Redmon, 1998), the number of telephone interviews completed (Thurkow, Bailey, & Stamper, 2000), and the percentage of critical behaviors performed safely at work (Austin, Kessler, Riccobono, & Bailey, 1996; Olson & Austin, 2001). The performance analyst should ensure that these results not only change behavior but also contribute to valuable outcomes, whether or not those outcomes are directly related to cost-savings. In organizational settings, a link to cost-savings is almost always made, which helps the performance analyst gain support for the intervention and to acquire the resources necessary to carry out the intervention. However, any attempts to change behavior should eventually result in the achievement of some overall benefit for the organization.

PURPOSE OF RESEARCH

Interventions at the Process Level are among the more popular used in industry today. Many of these interventions are taught in business and engineering colleges around the world. Although these interventions focus on changing work processes, many of them ignore the performer-related aspects of performance improvement (in terms of targeting employees as a critical component of the performance improvement strategy). Some strategies (e.g., Six Sigma) go so far as to refer to human performance as "white noise" (Pande, Neuman, & Cavanagh, 2000) and advise the performance improver to focus on the process variables and ignore the human performance variables, saying that human behavior is a source of uncontrollable variation that one can do nothing about.

Human performance improvement is a recognized field of its own and is taught in many psychology programs around the world. The Rummler and Brache (1995) framework, consisting of three levels of performance, shows that people achieve the organization's goals, and that the organization's processes are simply the means of doing so. The Process Level is the link between the Organization and Job/Performer Levels, and performance should be managed at all three levels to increase the probability that the organization will be effective (Rummler & Brache, 1995).

While both process improvement and OBM seek to improve performance in organizational settings, and both have been quite successful in their efforts, process improvement changes performance by examining "system" variables, whereas OBM changes performance by examining variables directly affecting performers. Few authors in the process improvement domain discuss human performance variables; whereas many authors in the OBM domain discuss systemic and process variables, albeit in a theoretical and non-empirical fashion (see Austin, 2000; Brethower, 1982, 2002; Gilbert, 1996). Although it is possible that practitioners in each of these fields have, and utilize, knowledge of both domains, my literature review found no empirical studies that have evaluated the effectiveness of both methodologies in comparison to or in conjunction with each other. While logic would state that the strategies used in combination would be more effective than either strategy used alone, I was unable to find any empirical evidence for this claim. An exploration of this question could enlighten practitioners in both domains of performance improvement of the comparative and contributive effects of the two methodologies. The present research not only provides data for the scientific community to evaluate, but it might also lead to increased practitioner cross-training with a resulting increase in practitioner effectiveness.

The purpose of this research was to provide data showing the comparative and contributive effects of process improvement and human performance improvement strategies. It was hypothesized that both process and human performance improvement strategies would be effective in improving performance and that the greatest effects would be attained when the two strategies were used in combination. The results obtained in the current study support this hypothesis. Ultimately, these results might contribute to bridging the gap between two primary methods of performance improvement, as well as provide some indication of participant satisfaction with the two different methods.

METHOD

Overview of Methods

The current study utilized a simulated work task to test the effects of two different processes and a behavioral intervention on task performance. The task was a typing (i.e., document reproduction) task in which participants worked in groups of three to create a nine-page document and was designed to be similar to the way fellow employees might collaborate to create a document at work. Each participant typed three pages of text before passing the work materials on to the next participant. The largest difference between the two processes used to create the final nine-page document was that in one of the processes the participants transferred materials to one another by email, whereas participants in the other process were required to come to Western Michigan University (WMU) and perform manual exchanges through the use of an intermediary (i.e., similar to check-in and check-out system used by a library). Research assistants, in a specified room for 40 hours a week, were the intermediaries. Multiple measures were taken to equate the conditions on task performance in order to study the difference between the two process types. Steps were also taken to maintain an equal number of opportunities (measured in minutes) for each participant to complete the work task and pass the materials on to the next participant.

To test the effects of a behavioral intervention package, a package consisting of performance specifications, additional training, and a monetary incentive system was given to one-half of the participants who used each of the two different work processes. To earn additional money as a performance bonus, participants were required to meet specified criteria. These two criteria were the number of minutes a participant had the work materials in his or her possession (i.e., cycle time required to complete the work task) and the number of typographical errors a participant made during document reproduction (a measure of typing accuracy). The following sections present the details of this experiment.

Participants and Setting

A power analysis for two-factor ANOVA revealed that in order to obtain an effect size equal to, or greater than, one standard deviation, the study would require a total number of 36 participants (nine per condition) to achieve statistical significance at the .05 alpha level with a power of .99. To accommodate the possibility of participant attrition 48 participants were invited to participate in the study. All participants were undergraduates enrolled at WMU. The participant pool consisted of 15 males and 33 females, with an age range of 18 to 55 years. Students were paid $5.00 and given extra class credit for their participation in the study.

The study consisted of three meetings. The three meetings occurred in room 2510 Wood Hall, on the campus of WMU. The actual work task, which was explained to each participant during the second meeting, was completed by each participant at the location of his or her choosing. In total, all three meetings and the completion of the work task required approximately one and a half hours of time.

Participant Recruitment

Participants were recruited from undergraduate psychology classes at WMU. An announcement (see Appendix A) was made during various undergraduate psychology courses until enough participants volunteered. Participants were able to sign-up during class by using a sign-up sheet (see Appendix B), or by contacting the experimenter at a later time using the experimenter's email address (which could be found on the sign-up sheet). All volunteers who agreed to the participation requirements were allowed to participate.

Informed Consent Process

The consent process was initiated as the first item of business at the first meeting between the experimenter and a potential participant. The experimenter read both a script (see Appendix C) that explained the consent process and the consent form (see Appendix D) aloud to the participant. The participant was then given the opportunity to either to sign the form (i.e., agree to participate in the study) or withhold his or her signature (i.e., choose not to participate). Participation in this study did not begin until the participant read and signed the consent form.

Human Subjects Protection

The Human Subjects Institutional Review Board (HSIRB) had approved the current study (see Appendix E for a copy of the approval letter) before any data were collected.

Apparatus

Participants were trained in the use of MS Word and MS Hotmail on a computer located in room 2510 Wood Hall. The computer operated on a Windows 2000 platform, had Microsoft Word 2000 (Microsoft Corporation, 2003b), and was connected to a high speed network via an 11 Mbps USB wireless network adapter. All participants were administered a five-minute typing test, which is described in greater detail below, using the same computer. Participants were able to use WMU computers at any WMU computer lab, or they were able to use a personal computer of their own (e.g., at home, a lap top, or a friend's computer) to complete the work task.

Duration

Each participant was required to meet individually with the experimenter on three occasions. The first occasion was an introductory session, the second occasion was for group assignment, and the third occasion was for interviewing and debriefing. The task itself was to be completed in between the second and third meetings (within some time constraints that are described below).

Work Task

The task consisted of copying a text (approximately 3 double-spaced pages; 5735 characters including spaces) from electronic image files into a Microsoft Word document (electronic image files were used to prevent participants from copying and pasting text as opposed to typing it). One half of the participants were required to come to the experimental room (2510 Wood Hall) to pick up an electronic version of the text to be copied on a standard (1.44 MB) floppy disk. The remaining participants received the necessary files directly via an email account established solely for the purposes of this study. Email accounts were established by using a user name that was based on the study and a sequential number assignment in order to prevent any participant from identifying the work of another participant. All participants had the option of typing the text from either an image file on their computer screen or from a printed version of that image file. Once the text was typed into a Microsoft Word document, one half of the participants (those who picked up the file in person) returned an electronic copy of the file (on a disk provided by experimenters) to the experimental room. The remaining participants (those who received the file via email) sent an electronic copy of the document to another participant and the investigator via email.

Participants were allowed a maximum time limit of 40 hours to complete the experimental requirements. Hours were only counted between 9:00 AM and 5:00 PM, Monday through Friday, to simulate a normal work week. Participants were only allowed to return (or forward via email) the experimental materials within this window of time (9:00 AM – 5:00 PM, Monday through Friday). If a participant did not return the task materials within 40 hours of having the materials available to them, he or she was considered a "Non-complete" participant and was assessed as a person who did not complete the experimental task within the allotted time frame. In this instance, the experimenter manually sent the materials to the next participant (as though they had come from the previous participant) and took all necessary measures to make it appear to the new participant as though there had been no disruption in the process.

Procedures

The procedures of the study involved three one-on-one meetings between the experimenter and each participant. A stratified randomization procedure was established to equate the participants in each condition based on typing and error rate. Participants completed the work task by participating in one of four different work conditions. The details of the three meetings, the group assignment procedure, the work task, and the four work conditions are described below. Dependent variables, independent variables, and integrity measures for both independent and dependent variables are also described below.

Meeting One: Informed Consent and Training

The first meeting began with the informed consent process as described in the Informed Consent Process section above (see Appendices C and D). Once the potential participant agreed to participate, the experimenter began training the participant in Microsoft (MS) Word (Microsoft, 2003b). The experimenter asked the participant to demonstrate five skills in MS Word. The participant was asked to: 1) Setup font as 12-point Times New Roman, 2) Center a line of text, 3) Left-align a section of text, 4) Use the tab key to indent a paragraph, and 5) Double-space a section of text. If the participant was unable to complete these functions the experimenter would have explained how the functions are completed, shown the participant how they are completed by actually performing the functions while the participant observed, and then asked the participant to perform the functions on his or her own. All participants were able to complete all five functions on their own without going through this ancillary process.

Once the participant demonstrated his or her ability to complete all of the necessary functions in MS Word, he or she was asked to take a five-minute typing test. The participant was read instructions for the typing test (see Appendix F) and was provided an opportunity to ask any questions he or she may have had about the typing test. Once any questions were answered, the experimenter then gave the participant three pages of text (see Appendix G) and asked the participant to type at a rate that was comfortable for him or her for the next five minutes. As soon as the participant made his or her first keystroke (or mouse click) the experimenter began timing on a stopwatch. Once five minutes had passed, the experimenter then asked the participant to stop typing, stopped the timer on the stopwatch, and then saved and closed the document.

Once the typing test was completed, the participant was trained in the use of Microsoft (MS) Hotmail (Microsoft Corporation, 2003c). A "Hotmail" email account was established for each participant and consisted of an email address that ensured the anonymity of each participant. All email addresses were of the form dissertationparticipant__@hotmail.com, in which the blank space was filled with successive numbers for successive participants, (e.g., dissertationparticipant1@hotmail.com, dissertationparticipant2@hotmail.com, and so on). The experimenter then taught the participant all of the skills necessary to complete the task should they have been assigned to a group that required the use of MS Hotmail. The experimenter modeled: 1) Going to the MS Hotmail homepage (www.hotmail.com), 2) Logging into the participant's MS Hotmail account (using the current participant's user name and password), 3) Composing an email message that is sent to multiple recipients, 4) Attaching a document to the email, 5) Sending the email, 6) Checking for, and receiving new email, and 7) Downloading attachments from an email message. After the experimenter had modeled these skills, he asked the participant to demonstrate the skills by having the participant follow the same steps the experimenter had just completed.

The experimenter used a job aid (see Appendix H) to maintain the consistency of, and ensure the successful completion of, each introductory session. Each participant was also asked to sign at the bottom of the job aid form to confirm that he or she had been adequately trained to perform all of the functions listed on the form. The final step of Meeting One was to schedule a meeting time for Meeting Two and provide the participant with a reminder form (see Appendix I).

Group Assignment Procedure

In between Meeting One and Meeting Two the experimenter created groups that were equated as evenly as possible based on typing rate and the number of errors committed during the typing test. The typing rate was measured as Words per Minute (WPM). The experimenter calculated the WPM typing rate by using the text typed during the five-minute typing test (completed during Meeting One) and running the "word count" function in MS

Word to determine the number of words completely typed. The experimenter then reviewed the typed words to determine if any errors existed. Each word that contained an error (e.g., misspelling, improper capitalization, and so on), or bordered an error (i.e., touched improper punctuation) resulted in the assessment of one error and the erroneous word being removed from the total number of words completely typed. The final number of words (i.e., the number of words typed correctly) was then divided by five (as participants had five minutes to complete the typing test) to arrive at a single WPM typing rate. Groups were then equated so that each group had as similar a typing rate and error count as possible, on average.

Once participants had been assigned to conditions a one-way (one-factor) analysis of variance (one-way ANOVA) (Hinkle, Wiersma, & Jurs, 1998), was conducted and revealed that there were no statistically significant differences between groups on the WPM typing rate (p = .959) and the number of errors variable (p = .786). Dependent measures obtained from the typing test are presented below (see Table 4) as an average that represents data for a single participant in each condition.

Table 4. Results of the participant typing tests by experimental condition (averaged per participant in each condition).

	Experimental Condition							
	MP		MP+BI		EP		EP+BI	
	WPM	Errors	WPM	Errors	WPM	Errors	WPM	Errors
Average	27	2	28	2	27	3	28	2

Meeting Two: Group Assignment

The purpose of the second meeting was to train each participant in the procedures he or she used to complete the work task, and explain the Behavioral Intervention package to participants that were assigned to a condition that included the Behavioral Intervention package. Participants were assigned to conditions in groups of three using a stratified randomization procedure. If a participant was to be trained in the Electronic Process he or she was trained as participant 1 (Appendix J), participant 2 (Appendix K), or participant 3 (Appendix L). If the participant was to be trained in the Manual Process he or she was trained as participant 1 (Appendix M), participant 2 (Appendix N), or participant 3 (Appendix O). If the participant was also a member of a group that was exposed to the Behavioral Intervention, he or she was also provided instruction on the Behavioral Intervention at this meeting. Participants in the Manual Process were trained in the Behavioral Intervention using Appendix P and participants in the Electronic Process were trained in the Behavioral Intervention using Appendix Q. The experimenter trained participants using the appropriate training script / checklist and a group assignment training checklist (Appendix R). Once the instruction portion of Meeting Two had been completed, participants were asked if they had any questions regarding the work task, and if they fully understood the steps they needed to take to complete the work task. When each participant indicated that he or she was fully prepared to complete the work task, he or she was asked to sign at the bottom of the group assignment training checklist to indicate that he or she had been adequately trained to complete the required tasks. Participants retained all training materials (Appendices J through Q, as applicable) to help guide their performance and to use as a checklist while they completed the requirements of the study. The final step of Meeting Two was scheduling a meeting time for Meeting Three, and providing the participant with a reminder form (see Appendix S). Once the participants were trained in the appropriate work procedures and criteria set forth in the Behavioral Intervention package (if applicable), they were told when the experiment proper would begin. Once the experiment proper began participants were able to check for the availability of their materials as often as they wished.

The construction of the four experimental conditions is shown in Table 5.

Table 5. The construction of the four experimental conditions.

	Manual Process (MP)	**Electronic Process (EP)**
No Behavioral Intervention	Condition 1 (MP)	Condition 3 (EP)
Behavioral Intervention (BI)	Condition 2 (MP+BI)	Condition 4 (EP+BI)

Regardless of the group to which a participant was assigned, participant 1 was to type the text found in Appendix T, participant 2 was to type the text found in Appendix U, and participant 3 was to type the text found in Appendix V. All texts (Appendices T, U, and V) were approximately three pages in length (when in 12-point font and double-spaced) and were exactly 5,735 characters long (including spaces and punctuation). The four experimental conditions are described below.

Condition One: Manual Process (MP)

Participants in Condition One participated in a manual process in which they had to acquire the experimental materials from room 2510 Wood Hall, take the materials to a computer to complete the work task (e.g., type text), and then return the materials to room 2510 Wood Hall. A process map (Rummler & Brache, 1995) depicting the work flow of all participants in this condition (in groups of three) is attached as Appendix W. Each time a participant using this process acquired the task materials, he or she was also provided with a Disk Distribution Sheet that informed the participant of when the disk was placed in his or her possession (see Appendix X). The Disk Distribution Sheet was designed to provide information that is equivalent to the information provided by Hotmail when a participant in the Electronic Process received the task materials via email.

Condition Two: Manual Process and a Behavioral Intervention

Participants in Condition Two completed the task using the same process as the participants in Condition One (see Appendices W and X) but were also exposed to a Behavioral Intervention (see Appendix P) that provided a monetary bonus contingent upon meeting specified levels of performance on two dependent variables.

Condition Three: Electronic Process

Participants in Condition Three participated in an electronic process in which they acquired and sent experimental materials via email. A process map (Rummler & Brache, 1995) depicting the work flow of all participants in this condition (in groups of three) is attached as Appendix Y.

Condition Four: Electronic Process and a Behavioral Intervention

Participants in Condition Four conducted their work using the same process as the participants in Condition Three (see Appendix Y), but were also exposed to a Behavioral Intervention (see Appendix Q) that provided a monetary bonus contingent upon meeting specified levels of performance on two dependent variables.

Meeting Three: Exit Interview and Debriefing

As participants completed their experimental requirements the experimenter met with each participant individually to ask each participant questions regarding his or her participation in the study, and to discuss the purpose of the study. Meeting Three, the date and time of which was scheduled at the end of Meeting Two, was scheduled to take place after each participant finished his or her task requirements. It was only required that the individual participant had completed his or her experimental requirements before the debriefing session was held, as opposed to requiring the entire group (i.e., of three participants) to finish before anyone in that group was debriefed. In order to ensure that the participant had completed his or her experimental requirements before Meeting Three, the final meetings were scheduled based on the assumption that each participant would utilize the maximum amount of time possible to complete the work task. Therefore, for any given group, the final meeting for participant one was scheduled for at least one week after the experiment proper began, at least two weeks after the experiment proper began for participant two, and at least three weeks after the experiment proper began for participant three.

The experimenter began Meeting Three by asking each participant a series of questions regarding his or her participation in the study (Appendix Z). The purpose of the exit interview was to obtain as much information as possible about the equipment the participant used to complete the work task, the participant's level of satisfaction with the work process, and why the participant performed as he or she did. The information gained during exit interviews sought to reveal potential effects of completing the work task using different computers, under different environmental demands (e.g., school and employment schedules), and also the level of social acceptability of the various independent variables.

Once the experimenter asked all of the relevant questions in Appendix Z, participants were debriefed to ensure that they understood the exact nature of the study using a debriefing script (see Appendix AA). Participants were also informed of the purpose of the experiment and why the particular task was chosen. Due to the fact that the study employed a group design, complete information regarding the outcome of the study was not available at the time of debriefing. The experimenter explained this to each participant and extended the offer of meeting with the participant once again to discuss the final results once the study had reached completion. However, each participant was informed of his or her own performance during the debriefing session. For those participants who were exposed to the Behavioral Intervention (Appendix P or Appendix Q), the experimenter informed the participant of his or her results and of the amount of the bonus he or she earned. At this time the experimenter also provided cash payments to each participant for his or her participation in the study and had the participant sign a receipt book acknowledging payment. The experimenter concluded the session by informing the participant that he or she may contact the experimenter at a later date if he or she would like more information on the final results of the study, and by thanking the participant for his or her participation in the study.

Non-complete Participant Procedure

There was one non-complete participant during the course of the experiment. One participant in the Electronic Process with a Behavioral Intervention did not send her completed materials to the experimenter within one week of receiving the materials. The participant was the third member of her group and she received the materials at 10:22 AM on the Tuesday following the beginning of the experiment. A substitute participant was chosen as a replacement for the non-complete participant. After the replacement participant had completed meetings one and two he was informed of the start date of the experiment (just as all previous participants were informed). At exactly 10:22 AM on the Tuesday following the start of the "new" experiment the experimenter sent the replacement participant the exact same materials that were sent to the non-complete participant. The experimenter sent the email from the exact same Hotmail email account that the non-complete participant received the email from, and he also included himself on the email as the participant protocol instructed each participant to do. In short, an identical email was sent at the correct time and was similar in all respects to the email that the non-complete participant was sent. This procedure allowed the experimenter to complete data collection by running one additional participant, as opposed to running another group of three participants, without jeopardizing the experimental protocol.

Independent Variables

Independent Variables / Conditions

The four conditions described above served as independent variables. Each participant was assigned as either participant one, two, or three in one of the four possible conditions. Participants were assigned to conditions based on a stratified randomization procedure, in groups of three, once equated groups had been formed based on typing and error rates.

Independent Variable Integrity

To ensure that all participants were exposed to the same instructional set, scripts were developed for all verbal instructions. Participants were also given detailed task instructions to guide them in completing their work tasks. To ensure that participants had been trained appropriately, each participant was asked to perform all relevant computer functions during the training session (e.g., Meeting One) and was also asked to sign at the bottom of the training forms used during Meeting One (see Appendix H) and Meeting Two (see Appendix R) to testify that he or she had been adequately trained to perform all of the necessary functions.

Dependent Variables

Definition of Dependent Variables

The dependent variables in this study were:

1. Minutes in Possession- the number of minutes that a participant was in possession of the materials required to complete the task, or the completed materials. Only minutes between the hours of 9:00 AM and 5:00 PM Monday through Friday were counted as minutes in possession.
2. Number of Errors- the number of typographical errors produced by incorrect typing of text. Each incorrect instance of the following was considered a typographical error (one error per incorrect character):
    a. Improper capitalization
    b. Improper use of an apostrophe (')
    c. Improper use of quotation marks (" ")
    d. Improper use of parentheses ( )
    e. Improper use of a comma (,)
    f. Improper use of a colon (:)
    g. Improper use of a semicolon (;)
    h. Incorrect spelling
    i. Text that was not 12 point font
    j. Text that was not Times New Roman
    k. Improper spacing (e.g., having two spaces after a word or only having one space after an end punctuation mark, such as a period)
    l. Missing words
    m. Words unnecessarily added

3. Non-completion Rate per Condition- The number of participants who did not return the experimental materials within 40 hours (i.e., one experimental week) of having the materials placed in their possession.

Measurement of Dependent Variables

Dependent variables were collected via manual and electronic means depending on condition assignment. Data were collected using a recording form (see Appendix AB). Further detail regarding the measurement of each dependent variable is provided below.

1. Minutes in Possession: Minutes in possession was measured differently depending upon the group to which the participant was assigned. For participants in the electronic process (e.g., EP and EP+BI), the minutes in possession variable was measured by the experimenter being included on all emails sent by participants. The experimenter could determine when the first participant received his or her materials by sending the materials at the correct time using a designated Hotmail account. By being included on all emails sent between participants (e.g., the material "hand-offs"), the experimenter was able to determine when emails were sent from one participant to another, and thus determine when each participant received the work materials. All of the above relied on the ability of the Hotmail system to deliver email instantly to other Hotmail email accounts. The results of tests conducted to verify this ability are presented in Appendix AC and the results support the ability of Hotmail to perform instant email deliveries, regardless of the number of attachments an email may contain. For participants in the manual processes (e.g., MP and MP+BI), the experimenter (or experimental staff) recorded the actual time that materials were dropped off by each participant in room 2510 Wood Hall. Data were collected using a data recording form (see Appendix AB).

2. Number of Errors: The number of errors was measured manually. Each participant's completed task materials were printed and proofread by the experimental staff, and each incorrect character was counted as one error.
3. Non-completion Rate per Condition: The Non-completion Rate per Condition was measured as the total number of participants who did not return the experimental materials within 40 hours (i.e., one experimental week) of having the materials placed in their possession.

Inter-observer Agreement (IOA)

Research assistants were responsible for the majority of IOA calculations. Instructions were developed to assist the assistants with IOA procedures (see Appendix AD). Inter-observer agreement was calculated for each dependent variable as follows:

1. Minutes in Possession: For the electronic process groups (e.g., EP and EP+BI) minutes in possession was recorded by two independent observers by looking at the computer screen and recording the time an email was sent by a participant. For the manual process groups (e.g., MP and MP+BI) minutes in possession was recorded by two independent observers who recorded the time a participant returned the task materials by looking at the same clock (a clock that was designated for this purpose) when a participant arrived to room 2510 Wood Hall to return the materials. Both observers made a record of this time using the data recording form (see Appendix AB). Due to the fact that the clock used was a digital clock that displayed the time in one-minute increments both observers were required to report the same time, exact to the minute, in order for an instance of agreement to be counted.
2. Number of Errors: The number of errors was measured by two members of the experimental staff using an error recording form (see Appendix AE). Each participant's

completed task materials were printed and proofread by the experimental staff, and each incorrect character was counted as one error. One hundred percent of the work products were proofread by two independent observers and an inter-observer agreement percentage was calculated for each participant's products by dividing agreements by agreements + disagreements and multiplying the resulting quotient by 100. An additional form was designed to assist with the calculation of IOA (see Appendix AF).

3. Non-completion Rate per Condition: The Non-completion Rate per Condition was measured by calculating the total number of participants who did not return the experimental materials within one week of having the materials placed in their possession. This determination was made when the minutes in possession for a given participant exceeded 2,400 minutes. A line on the data collection form (see Appendix AB) that had not been completed (i.e., information written in by the experimental staff) for an individual participant, after the participant had been in possession of the task materials for 2,400 minutes, was observed by two independent observers.

Experimental Design

The current study employed a between-groups design with four conditions and utilized 48 participants. Once all participants had completed the initial training and typing test they were divided into four conditions using a stratified randomization procedure that equated the conditions on the basis of typing and error rate. Equating groups / conditions on the basis of typing / error rate established all four conditions as being equal on task performance and eliminated or reduced the variance associated with different typing / error rates. This also enabled a more sensitive measure of the effects of the two different work processes and the Behavioral Intervention on performance. Once each group (e.g., of three participants) was formed, the group was then randomly assigned to one of the four experimental conditions. Each participant only participated in one experimental condition and only performed the work task one time.

RESULTS

Methods of Analysis

Data were analyzed by calculating descriptive statistics for the performance of participants in each condition for each of the dependent variables. In addition, a two-way (two-factor) analysis of variance (two-way ANOVA) (Hinkle, Wiersma, & Jurs, 1998) was used to test for main effects among independent variables and possible interaction effects. All statistical tests were conducted using an Alpha level of .05. These methods were used for the dependent variables of minutes in possession and number of errors. The number of non-complete participants was so few (N = 1) that statistical analyses proved to be an impractical means of analysis for this variable.

Minutes in Possession

The primary variable of interest was the number of minutes that participants had the task materials in their possession, which is in essence a measure of cycle time. Participants in the Manual Process condition had an average cycle time of 1,869 minutes (SD: 441; range: 936 - 2347), whereas participants in the Manual Process with a Behavioral Intervention had an average cycle time of 856 minutes (SD: 625; range: 174 - 2376). Participants in the Electronic Process condition had an average cycle time of 1,674 minutes (SD: 495; range: 882 - 2243), whereas participants in the Electronic Process with a Behavioral Intervention had an average cycle time of 423 minutes (SD: 368; range: 24 - 1177).

Aside from the means, standard deviations, and ranges of the data presented above, statistical analyses were conducted to determine the differences between groups. A two-way (two-factor) analysis of variance (two-way ANOVA) (Hinkle, Wiersma, & Jurs, 1998) was conducted and revealed a main effect for process type (e.g., electronic vs. manual) (p = .032) and a main effect for Behavioral Intervention (e.g., BI vs. no BI) (p = .000). No interaction effect existed between the two factors (e.g., process type and BI) (p = .406). The results for the minutes in possession variable are depicted below in Figure 8.

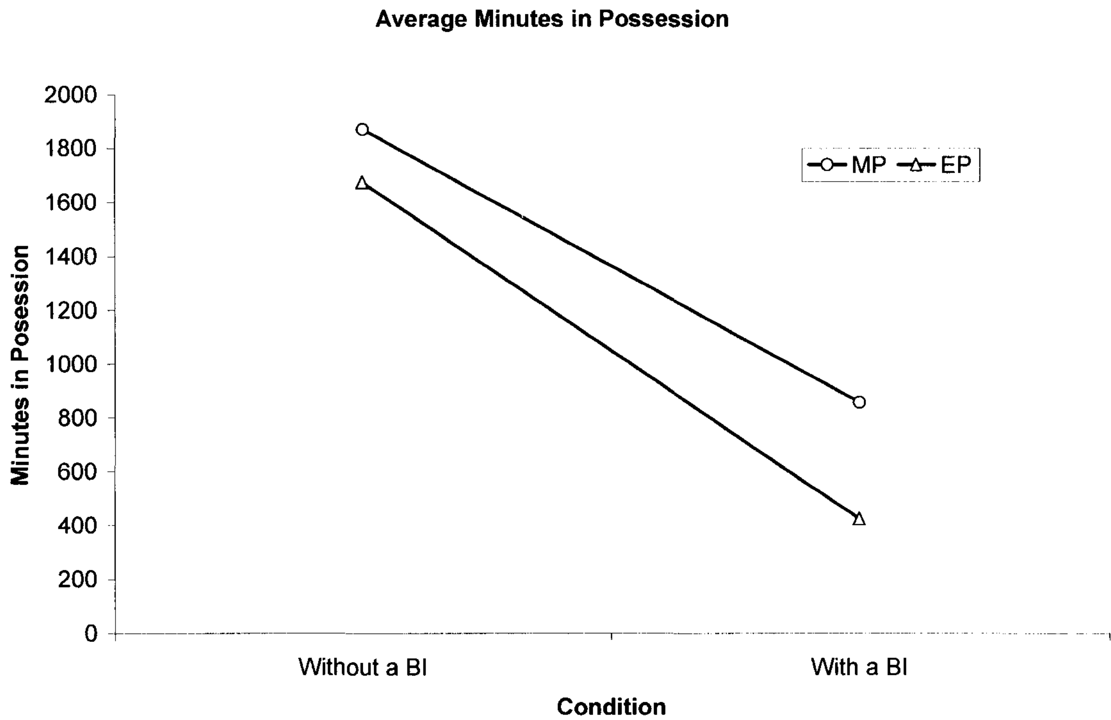


Figure 8. The average minutes in possession for a participant in each experimental condition.

Number of Errors

The average number of errors committed by a participant in each condition was used to serve as a quality measure of task performance. Participants in the Manual Process condition had an average of 258 errors (SD: 737; range: 3 - 2593), whereas participants in the Manual Process with a Behavioral Intervention had an average of 42 errors (SD: 44; range: 0 - 143). Participants in the Electronic Process condition had an average of 38 errors (SD: 42;

range: 1 - 128), whereas participants in the Electronic Process with a Behavioral Intervention had an average of 30 errors (SD: 43; range: 0 - 138).

On the number of errors variable the two-way ANOVA did not reveal a main effect for process type (e.g., electronic vs. manual) ($p = .285$) and did not reveal a main effect for Behavioral Intervention (e.g., BI vs. no BI) ($p = .302$). No interaction effect existed between the two factors (e.g., process type and BI) for the number of errors variable ($p = .337$). The results for the number of errors variable are depicted below in Figure 9.

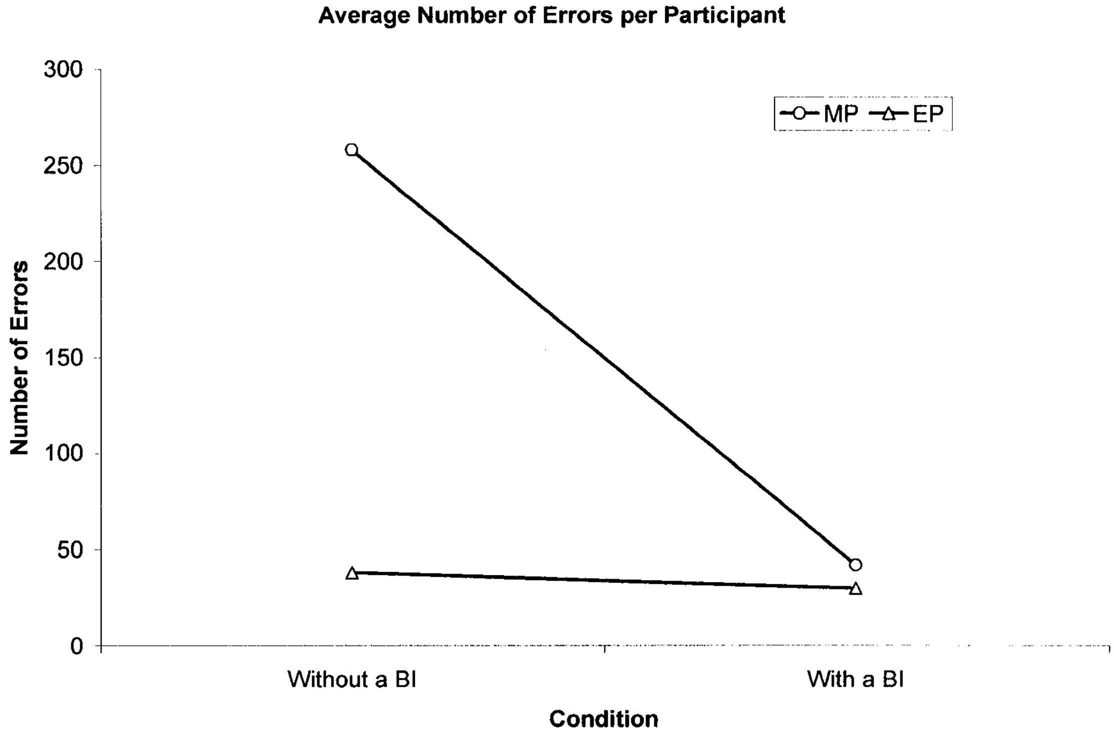


Figure 9. The average number of errors for a participant in each experimental condition.

A follow-up analysis was conducted to determine the number of errors of omission versus the number of errors of commission. Errors of omission were defined as instances of errors in which an error was assessed due to a character that was not typed (e.g., a missing letter or space), whereas errors of commission were defined as instances of errors in which a character had been typed incorrectly (e.g., an extra punctuation mark or a word that was unnecessarily added).

The average number of commission errors for participants in the Manual Process was 6 errors (SD: 7; range: 0 - 23), whereas the average number of commission errors for participants in the Manual Process with a Behavioral Intervention was 12 errors (SD: 16; range: 0 - 59). The average number of commission errors for participants in the Electronic Process was 7 errors (SD: 7; range: 0 - 21), whereas the average number of commission errors for participants in the Electronic Process with a Behavioral Intervention was 6 errors (SD: 8; range: 0 - 28). The average number of omission errors for participants in the Manual Process was 252 errors (SD: 738; range: 0 - 2591), whereas the average number of omission errors for participants in the Manual Process with a Behavioral Intervention was 30 errors (SD: 41; range: 0 - 141). The average number of omission errors for participants in the Electronic Process was 31 errors (SD: 40; range: 0 - 124), whereas the average number of omission errors for participants in the Electronic Process with a Behavioral Intervention was 24 errors (SD: 38; range: 0 - 110). A statistically significant difference between the number of omission and commission errors did not exist in any of the four conditions, although a general trend indicating a higher number of omission errors is apparent in each condition. These results are depicted in Figure 10.

Number of Non-complete Participants

One participant failed to complete the experiment. This participant was the third member of a group exposed to the Electronic Process with a Behavioral Intervention. Due to only one instance of a non-complete participant no graphs were constructed and no additional descriptive or inferential statistics are provided.

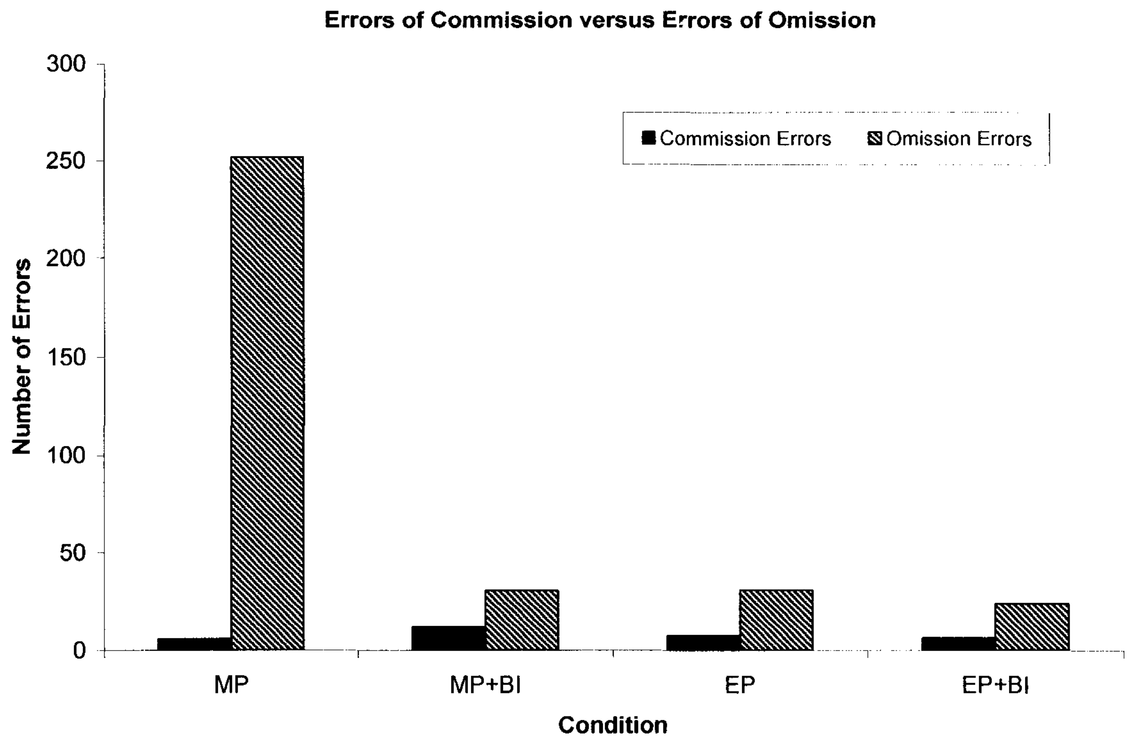


Figure 10. The average number of errors of commission and errors of omission for a participant in each experimental condition.

Participant Order

Both dependent variables were graphed and visually inspected to determine if participant order (i.e., being participant one, two, or three) had an effect on task performance. The visual inspection indicated that participant order had no consistent effects on either of the dependent variables.

Effect Size

Because the inferential statistics reported above merely show the presence or absence of a statistically significant effect, and do not provide information about the magnitude of the effect, effect sizes (measured in standard units, or d) were calculated for the minutes in possession variable (as that was the only variable for which a statistically significant effect was observed). Table 6 provides the magnitude of effect (d) between each pair-wise comparison.

Table 6. Pair-wise comparisons of effect size between experimental conditions.

	Pair-wise Comparisons of Effect Size Between Conditions					
	MP & MP+BI	MP & EP	MP & EP+BI	MP+BI & EP	MP+BI & EP+BI	EP & EP+BI
Effect Size (d)	1.87	0.42	3.56	1.45	0.85	2.87

Inter-observer Agreement Measures

Inter-observer agreement (IOA) measures were collected for all primary dependent variables. For the minutes in possession variable IOA was obtained on 98% of all occasions (47 of 48 possible opportunities) and totaled 100% agreement. For the number of errors variable IOA was obtained on 100% of all occasions (48 of 48 possible opportunities) and totaled 99.94% agreement. For the number of non-complete participants variable IOA was obtained on the single occurrence and totaled 100% agreement.

Participant Exit Interview Responses

During the debriefing session conducted one-on-one between the experimenter and each participant, the experimenter asked a series of questions as an exit interview. Below is a list of the questions asked of each participant at the end of the study and a summary of participant answers by experimental condition. Each question listed is followed by the answers given by participants. As multiple participants often had the same answer, the number of participant(s) who responded with each answer is reported in parenthesis where applicable. Some questions asked were only relevant to participants who participated in particular conditions, and so not all participants were required to answer all of the questions.

Each set of answers is represented with the letter "A" and the numbers "1" through "6" corresponding to the answer number. The responses of participants in each condition will also be noted by using the condition abbreviations (e.g., MP, MP+BI, EP, and EP+BI) prior to each set of responses.

Q1 (Question #1): Is the participant a male or female? MP: (Answer #1) Female (8), (A2) Male (4); MP+BI: (A1) Female (10), (A2) Male (2); EP: (A1) Female (7), (A2) Male (5); EP+BI: (A1) Female (8), (A2) Male (4).

Q2: What is the participant's age? MP: Average age was 24 (range: 19 – 55); MP+BI: Average age was 21 (range: 18 – 23); EP: Average age was 22 (range: 20 – 40); EP+BI: Average age was 21 (range: 20 – 24).

Q3: What environmental factors influenced your decision to acquire, complete, and return the task materials? MP: (A1) Class schedule (11), (A2) Work schedule (5), (A3) Bad weather (2), (A4) The completion deadline (1), (A5) Computer problems (1), (A6) Social commitments (1); MP+BI: (A1) Class schedule (9), (A2) Work schedule (5), (A3) Illness (3), (A4) Social commitments (2), (A5) Bad weather (1), (A6) I knew when the experiment would start (1); EP: (A1) Class schedule (6), (A2) No email at home (2), (A3) I checked email when it was convenient (2), (A4) I knew when the materials would arrive via email (1), (A5) Social commitments (1), (A6) The completion deadline (1); EP+BI: (A1) Class schedule (6), (A2) Work schedule (6), (A3) No answer given (2), (A4) I knew when the materials would arrive via email (1).

Q4: How fast was the processor of the computer you completed the task with? MP: Average speed (in MHz) was 1,060 MHz (range: 448 – 2,400); MP+BI: Average speed was 760 MHz (range: 120 – 1,400); EP: Average speed was 1,760 MHz (range: 500 – 2,500); EP+BI: Average speed was 1,012 MHz (range: 400 – 2,000).

Q5: How much Random Access Memory (RAM) was installed on the computer you completed the task with? MP: Average amount of RAM (in MB) was 207 MB (range: 64 – 523); MP+BI: Average amount of RAM was 144 MB (range: 16 – 384); EP: Average amount of RAM was 250 MB (range: 64 – 522); EP+BI: Average amount of RAM was 313 MB (range: 64 – 512).

Q6: What type of internet connection was used by the computer you completed the task with? EP: (A1) A cable modem connection (5), (A2) A 56 Kbps dial-up connection (3), (A3) A WMU network connection (2), (A4) A Digital Subscriber Line (DSL) connection (2); EP+BI: (A1) A cable modem connection (6), (A2) A WMU network connection (3), (A3) A DSL connection (3).

Q7: Did you complete the task on a computer owned by WMU or on a personal computer? MP: (A1) A personal computer (9), (A2) A WMU computer (3); MP+BI: (A1) A WMU computer (7), (A2) A personal computer (5); EP: (A1) A personal computer (10), (A2) A WMU computer (2); EP+BI: (A1) A personal computer (9), (A2) A WMU computer (3).

Q8: How would you rate yourself in regards to your ability with Microsoft Word, as a beginner, intermediate, or advanced user? MP: (A1) Beginner (1), (A2) Intermediate (5), (A3) Advanced (6); MP+BI: (A1) Intermediate (6), (A2) Advanced (6); EP: (A1) Beginner (1), (A2) Intermediate (8), (A3) Advanced (3); EP+BI: (A1) Intermediate (9), (A2) Advanced (3).

Q9: Do you feel that the training you received was adequate enough for you to complete the required tasks in Microsoft Word? MP: (A1) Yes (12); MP+BI: (A1) Yes (12); EP: (A1) Yes (12); EP+BI: (A1) Yes (12).

Q10: How would you rate yourself in regards to your ability with Microsoft Hotmail, as a beginner, intermediate, or advanced user? EP: (A1) Beginner (1), (A2) Intermediate (8), (A3) Advanced (3); EP+BI: (A1) Beginner (1), (A2) Intermediate (7), (A3) Advanced (4).

Q11: Do you feel that the training you received was adequate enough for you to complete the required tasks in Microsoft Hotmail? EP: (A1) Yes (12); EP+BI: (A1) Yes (12).

Q12: Would you have rather A) Participated in a process in which you had to pick up and drop off your materials at a room in Wood Hall, or B) Preferred to have your documents emailed to a Hotmail account, and then forward the materials to the next participant through Hotmail after you had completed the work task? MP: (A1) Option A (3), (A2) Option B (9); MP+BI: (A1) Option A (5), (A2) Option B (7); EP: (A1) Option B (12); EP+BI: (A1) Option B (12).

Q13: On a scale of 1-5, how satisfied were you with the steps you had to take to complete the work task (the scale was structured so that 1 was a low satisfaction answer and 5 was a high satisfaction answer)? MP: Average satisfaction rating was 4.0 (range: 2 – 5); MP+BI: Average satisfaction rating was 3.9 (range: 3 – 5); EP: Average satisfaction rating was 4.5 (range: 3 – 5); EP+BI: Average satisfaction rating was 4.5 (range: 3 – 5).

Q14: How many times did you check back at room 2510 Wood Hall to see if your experimental materials were available to you? MP: The average number of times a participant checked was 2.2 (range: 1 – 4); MP+BI: The average number of times a participant checked was 1.6 (range: 1 – 4).

Q15: How many times did you check your Hotmail account to see if your experimental materials were available to you? EP: The average number of times a participant checked was 2.5 (range: 1 – 8); EP+BI: The average number of times a participant checked was 2.1 (range: 1 – 6).

Q16: Did you experience any problems with Microsoft Word or Microsoft Hotmail during the course of the study? MP: (A1) No (12); MP+BI: (A1) No (12); EP: (A1) No (12); EP+BI: (A1) No (12).

Q17: How many days a week are you in Wood Hall? MP: The average number of days a person was in Wood Hall was 1.9 (range: 0 – 5); MP+BI: The average number of days a person was in Wood Hall was 1.2 (range: 0 – 3); EP: The average number of days a person was in Wood Hall was 0.3 (range: 0 – 2); EP+BI: The average number of days a person was in Wood Hall was 1.7 (range: 0 – 4).

Q18: Was the time period allotted for completion (one regular work week) too long, too short, or just right? MP: (A1) Just right (9), (A2) Too long (2), (A3) Too short (1); MP+BI: (A1) Just right (6), (A2) Too long (6); EP: (A1) Just right (8), (A2) Too long (4); EP+BI: (A1) Just right (4), (A2) Too long (8).

Q19: What other systems could have been in place to help you return the document even quicker than you did? MP: (A1) No other systems (3), (A2) The use of email (3), (A3) To have been called when the materials arrived (2), (A4) A 24-hour drop box (2), (A5) A shorter deadline (2), (A6) To have been paid money for good performance (2); MP+BI: (A1) No other systems (9), (A2) A 24-hour drop box (2), (A3) To have been called when the materials arrived (1); EP: (A1) No other systems (6), (A2) A shorter deadline (3), (A3) To have been called when the materials arrived (1), (A4) To have been paid money for good performance (1), (A5) To be able to use an Instant Messenger (IM) service that allowed the use of attachments (1); EP+BI: (A1) No other systems (11), (A2) To be able to send emails 24 hours a day (1).

Q20: Could you have performed more efficiently (meaning less time to complete AND return your work) if a monetary contingency was in place (meaning you would get "paid for performance")? MP: (A1) Yes (11), (A2) No, I am not motivated by money (1); EP: (A1) Yes (12).

Q21: Was the amount of money you earned as a performance bonus a sufficient amount of money in comparison to the extra time and accuracy required (if money was earned)? MP+BI: (A1) Not applicable (7), (A2) Yes (4), (A3) No (1); EP+BI: (A1) Not applicable (3), (A2) Yes (9).

Q22: Was the potential to earn $10 (too little / just right / too much) as a monetary incentive given the additional time and accuracy requirements? MP+BI: (A1) Just right (8), (A2) Too little (2), (A3) Too much (2); EP+BI: (A1) Just right (12).

Q23: How would you improve the monetary incentive system? MP+BI: (A1) There are no improvements I would make (9), (A2) I would allow for additional extra-credit in place of additional money (2), (A3) I would offer more money as an incentive (1); EP+BI: (A1) There are no improvements I would make (11), (A2) I would allow participants to send emails 24 hours a day (1).

Q24: If the monetary incentive system did not motivate you, why didn't it? MP+BI: (A1) Not applicable (11), (A2) I only wanted more extra-credit (1); EP+BI: (A1) Not applicable (12).

A two-way ANOVA was conducted using the results of question number 13 above. The results indicated a statistically significant difference that showed a greater preference for the electronic process, regardless of the presence of the behavioral intervention ($p = .021$). There was no main effect of the presence of the behavioral intervention ($p = .854$) and no interaction effect between the two factors (process type and behavioral intervention) on participant satisfaction ($p = .854$). In other words, participants in the electronic process conditions were generally more satisfied with their work process than participants in the manual process conditions, regardless of the presence of a behavioral intervention.

DISCUSSION

Overview

The current study utilized a simulated work task to test the effects of two different processes and a behavioral intervention on task performance. The four groups created by these two factors were intended to provide a reasonable simulation of participants working together to complete a task: 1) Using manual hand-offs (MP), 2) Using manual hand-off while exposed to a behavioral intervention designed to improve performance (MP+BI), 3) Using electronic hand-offs in an effort to improve performance (EP), and 4) Using electronic hand-offs while exposed to a behavioral intervention (EP+BI).

The two different processes were intended to simulate two approaches to work processes that might be used by employees in an organization who are collaborating to produce a single product (e.g., the manual process and the electronic process). The processes were intended to simulate employees working in the same office (e.g., the manual process) and employees who work by telecommuting (e.g., the electronic process). Both processes required the same amount of task-related work, but the manual process involved participants coming to the campus in order to hand-off materials to other group members or to the experimenter, whereas participants in the electronic process were able to perform hand-offs via email. Although I recognize that many other changes could have been proposed (e.g., manipulating the amount of work that was required of participants), the solitary process change was designed to provide an example of a process improvement recommendation that involved environmental factors (e.g., the use of technology and increased accessibility of the task materials) while maintaining the integrity of the work task. This intervention was believed to be similar to a recommendation that would have been provided by a consultant with a business or industrial engineering background provided a situation in which the work task could not be altered.

The behavioral intervention used in this study consisted of performance specifications, additional training, and a monetary incentive system. While other behavioral strategies could have been utilized (e.g., having participants work together on the task or providing feedback on task performance after successive attempts), this intervention was believed to be the most similar to a recommendation that would have been provided by a consultant with a background in Organizational Behavior Management (OBM), while maintaining the integrity of the work task.

Although the current study sought to examine which combination of these performance improvement strategies is most effective at improving performance, the findings and discussion below should be accepted with multiple limitations. Aside from internal strengths and weaknesses of the methodology employed, we should be cautious when attempting to generalize the results of this study; the author is presenting and explaining results obtained in a laboratory setting using specified parameters. Different results might be obtained under different environmental conditions and parameters (e.g., if a different work task was employed, if all participants were given identical laptop computers to use, or if the incentive scale provided a different amount of bonus pay or contained different performance criteria).

Minutes in Possession

The data show a main effect of both IVs on the minutes in possession variable. The general trend is apparent and shows that the electronic process produced shorter cycle times than the manual process, and that the conditions which utilized a Behavioral Intervention (BI) produced shorter cycle times than the processes which did not utilize a BI. These results indicate that the electronic process and the BI are each effective IVs given this set of work tasks and IV parameters. Although both IVs were effective, a larger effect was achieved by the BI factor than the process factor (see Table 6). In addition, the effect size calculations between groups (see Table 6) indicate that the electronic process in combination with the BI had the most powerful effects on cycle time.

The results obtained on this dependent variable are consistent with the results obtained (or claimed) by the literature concerning both IVs. That is, both the process factor (Colby, 2002; Harter & Lousberg, 1998; Selander & Cross, 1999; Shin & Jemella, 2002; Zievis, 2003) and the BI factor (Austin, 2000; Daniels, 1989; Jessup & Stahelski, 1999; LaMere, Dickinson, Henry, Henry, & Poling, 1996; Thurkow, Bailey, & Stamper, 2000) had a positive impact on performance. These results were also in alignment with the outcomes hypothesized by the experimenter.

Number of Errors

For the number of errors variable there were no statistically significant effects of either IV. The lack of statistical significance was due primarily to the similarity of the results obtained in three groups (MP+BI, EP, and EP+BI), and the large standard deviation obtained in a fourth group (MP). The MP group had one outlier (measured as being in excess of 1.5 times the interquartile range above the third quartile) that was the source of the large standard deviation for this group. However, even with the outlier removed no statistically significant effects were found (since the group became similar to the other groups), and so the outlier was left in the data set.

I hypothesized that no statistically significant difference would exist between the groups that differed solely on the variable of process type (e.g., between the MP & EP groups), but that a significant difference would exist between the groups that differed on the BI variable (e.g., between the MP & MP+BI groups). The research in behavior analysis and monetary incentives supports the notion that "you get what you pay for." In other words, if contingencies are established based on timely production, it is likely that timely production will occur, but if contingencies are arranged for timeliness and quality, it is likely that both will occur given that the consequences established are perceived as significant and desirable to the performer. In the conditions without a BI there were no additional positive consequences for completing the work earlier than the 40-hour time limit, and also no contingencies for producing work with a small number of errors. The monetary incentive system that was a part of the BI used in this study provided additional payment for a high level of performance on both the timeliness (minutes in possession) and quality (number of errors) measures.

The results of a two-way ANOVA conducted on the number of errors variable revealed that no statistically significant effects existed for either factor (process or BI). Potential reasons why these results were obtained are: 1) That money did not serve as an incentive for some participants, however only one participant reported that money was not motivating for her and the data on the minutes in possession variable support the effectiveness of monetary incentives as cited in other research studies (for a review see Bucklin & Dickinson, 2001), 2) That not enough money was offered to serve as an incentive, however only two participants reported this to be true and one study has shown incentive amounts of as little as three percent of base pay can be effective in changing performance (Frisch & Dickinson, 1990), and 3) That the task was too difficult to attain any additional bonus pay, however an almost identical number of participants in every condition qualified (or would have qualified) for an incentive (i.e., taking into account participants not exposed to the BI). Furthermore, two participants had perfect papers with zero errors and ten participants qualified (or would have qualified) for the top level of incentive pay which required five or fewer errors. These results suggest that neither the task nor the levels of performance required by the incentive scale were too stringent to attain incentive pay. In fact, these results support research conducted by Jenkins, Gupta, Mitra, and Shaw (1998) in which monetary incentives were shown to be correlated with higher levels of performance on quantity measures but not at all correlated with improvement on quality measures.

Another possible explanation for the lack of statistically significant results on the number of errors variable is that some participants had superior proofreading skills and that these participants were equally distributed amongst the groups. This explanation seems to be plausible for two reasons. One reason is that no measure of proofreading skills was obtained from any participant, and the second reason is that participants were assigned to conditions randomly (using a stratified randomization procedure). Without assessing proofreading skills, and assuming a normal distribution of this skill in the participant pool, one could assume an equal distribution of this skill in all experimental conditions. Future studies that employ similar methodology should consider including some type of skill assessment, and perhaps training, on proofreading skills. The data obtained also show that neither process type, nor the presence of a BI, was effective in promoting proofreading behavior. While the importance of assessing typing rate and the number of errors was apparent, the importance of assessing proofreading ability was overlooked. It was believed that this ability would be equal amongst all participants, and hypothesized that the presence of a BI would simply serve as an impetus to promote these proofreading behaviors.

However, due to a skills deficit or an insufficiently strong IV no statistically significant performance differences were noted between conditions.

Errors of Omission versus Errors of Commission

The analysis of the number of errors of omission (i.e., characters not typed) and the number of errors of commission (i.e., characters typed incorrectly) revealed a general trend in which there were more errors of omission than errors of commission in each condition, however these results were not statistically significant in any of the conditions. No hypotheses were formed about this subset of dependent variables but they were assessed and it was determined that no statistically significant differences existed.

Number of Non-complete Participants

No hypotheses were made regarding the number of non-complete participants, except that none were expected to occur. This dependent variable was created in order to accommodate for the potential situation in which a participant did not pick up the task materials or did not return the task materials within 40 hours of having the materials placed in his or her possession. The creation of this dependent variable was prudent, as one participant did fall into this category. Unfortunately this participant never attended a debriefing session and never returned the experimenter's phone calls. Due to this situation no information was attained on the reason why the participant did not complete the task. The participant who did not complete the task was the third participant in a group that was in the EP+BI condition. Although initially it seems intriguing that the only non-complete participant was a member of the condition with the highest level of performance on one of the dependent variables, it would be a fragile argument to draw any conclusions from a single instance. The fragility of any rationale posed here would only be exacerbated by the fact that the participant never even attended a debriefing meeting and did not respond to any questions about the reason(s) for this outcome. Possible explanations are that the participant: 1) simply forgot about the experiment due to a number of possible factors, 2) was forced to go home for a family emergency for an extended period of time, 3) was hospitalized due to a medical emergency, or 4) any other unsubstantiated, yet plausible possibility.

Participant Exit Interview Responses

Some of the most valuable lessons learned from this study might have been learned during the debriefing sessions. For example, across all conditions the most popular response to Q3 was that a participant's class schedule was an environmental factor that influenced his or her decision to acquire, complete, and return the task materials, which shows some level of consistency between conditions. Responses to Q3 also showed that an influencing factor for groups not exposed to the behavioral intervention was the nearing of the completion deadline. No participants in the conditions exposed to the behavioral intervention cited the completion deadline as an influencing factor. Also, participants in both of the manual process groups cited weather as a factor that influenced their decision to acquire, complete, and return the task materials, whereas no participants in the electronic groups cited this reason as an influential factor. The implication of this set of responses is that the conversion to an electronic process may be more effective in locations with bad weather, or that they may be more effective during times of the year in which bad weather occurs most frequently (e.g., winter and stormy seasons).

In an effort to attain further information about the variables that may have influenced cycle time, participants were asked to provide information concerning the speed, memory capability, and internet connection of the computer they used to complete the work task. Although this information was obtained from many participants, not all participants were able to provide responses. Furthermore, there were no IOA measures attained on this variable, and without any measure of reliability they should be noted with caution. Regardless of the accuracy of the information provided, MS Word places very little strain on a computer in comparison to graphics programs and other memory and processor intensive programs, so computer equipment was likely an insignificant factor on the overall cycle time. The same can be said for the Internet connection speed, which was only asked of participants in the EP and EP+BI groups. The influence of computer and Internet connection factors becomes even less important when one considers the average time in possession for any given condition in comparison to the amount of time it takes a participant to complete the task (i.e., the average time spent completing the task is only a small portion of the average minutes in possession for most conditions).

To assess the effects of skill difference on task completion, participants were asked to rate their ability in each of the programs they used (e.g., either MS Word, MS hotmail, or both programs). There were no apparent relationships which indicated that participants in any of the conditions rated themselves higher on any of the programs than participants in any of the other conditions. This was likely caused by a number of factors, including the randomization procedure, the intensive training, and the fact that the tasks required in MS Word and MS Hotmail were very basic tasks (in comparison to what the programs are capable of). A potentially more important question was to ask the participants if the training they received was adequate enough for them to complete all of the required tasks in the program(s) they used. All participants answered that were adequately trained to perform all of the necessary functions in the programs they were required to use.

During meeting one, participants were informed of the two ways documents are transferred during the experiment (e.g., manually and electronically). They were also told that the purpose of meeting two was for group assignment, and that group assignment would be done randomly. During debriefing participants were asked which method of document transfer (e.g., manual or electronic) they would have preferred if they had been given a choice (as opposed to random assignment). When asked this question, 8 of the 24 participants who used the manual process reported that they would have preferred to use the manual process. They often cited reasons such as, "I don't trust email to deliver my documents," "I don't feel very comfortable with computers," or "I think computers are too impersonal." Using the stratified randomization procedure employed in this study one would expect an equal number of people in each condition to prefer using each type of process. However, 24 of the 24 participants who used the electronic process said they would have preferred to use the electronic process. It is possible that an equal number of participants who used each process type would have had sentiments similar to those participants who used the manual process, however after transmitting documents electronically they were provided with evidence of the success of using the electronic method. They may have also experienced some of the other benefits of electronic transmission (e.g., not having to go outside during bad weather) when participating in an EP condition. This question would have contained more validity if it had been asked to participants who had actually participated in both processes, but the protocol did not allow for participants to participate in more than one process so this was not a possibility. If nothing else, this discrepancy and the reasons cited for preferring a manual process indicate the need to manage change in order to gain acceptance and the indoctrination of workplace changes when process improvements of this type are made.

At the end of the study, participants were asked to rate their satisfaction with the process they used to complete the work task. Answers to this question were analyzed by conducting a two-way ANOVA. The results indicated a statistically significant difference that showed greater satisfaction in the electronic process groups, regardless of the presence of the behavioral intervention ($p = .021$). There was no main effect of the presence of the behavioral intervention ($p = .854$) on participant satisfaction (there was also no interaction effect as a result of the combination of a difference in process type and the presence of a behavioral intervention ($p = .854$)). In other words, participants in the two EP conditions were generally more satisfied with their work process than participants in the manual process conditions, regardless of the presence of a behavioral intervention. However, due to the significantly restricted range of possible answers (participants responded on a 1-5 likert-type rating scale) these results should be evaluated with caution.

Participants were also asked how many days a week they came to Wood Hall. The purpose of asking this question was to determine if coming to Wood Hall more frequently contributed to shorter cycle times in the manual process conditions, however this information was asked of all participants (i.e., even those who participated in the electronic process conditions). The data do not indicate that coming to Wood Hall more frequently was a contributor to shorter cycle times, as the MP condition had a longer cycle time than the MP+BI condition, when in fact participants in the MP condition reported themselves as coming to Wood Hall even more frequently than those participants in the MP+BI condition. Although the question was limited to how many days a week a participant came to Wood Hall, perhaps a more valuable question would have been to ask how many days a week a participant came to the WMU campus. The variables controlling the behavior of checking for the availability of a disk are likely more related to presence on campus than presence in Wood Hall. The underlying explanation is that the response effort of coming to campus is much greater than that of walking to Wood Hall once a participant was already on campus.

Not all participants were taking a class in Wood Hall during their participation in the experiment, but many were nearby at various times throughout each week, thereby resulting in a lower response effort of checking for the availability of the disk than if they were not on campus at all.

Exit interview question 19 asked participants what other systems could have been in place that would have helped them to return the document even more quickly than they did. Although the use of email was considered to be one example of a process improvement, answers to this question revealed other manipulations that could have been made that would have constituted a form of process improvement. Answers in this category included receiving a phone call when the materials had arrived, to be allowed to send emails 24 hours a day (for participants in the electronic processes), a 24-hour drop-box for materials (for participants in the manual processes), and the use of an Instant Messenger (IM) system that would accommodate attachments. All of these process changes are feasible low-cost improvements that might have reduced cycle times even further had they been incorporated into this study. Human performance oriented changes that were recommended were the provision of money for good performance (a response from participants that were not in a BI condition) and a shorter deadline (which might also be considered a process change). Changes such as these could be incorporated into future studies in various combinations in order to test for the most effective combination of intervention strategies.

One area of interest was the effectiveness of the monetary incentive system (MIS), which comprised a large majority of the BI. The data indicated that some participants were motivated by the MIS while other, although fewer, participants were not. Participants who were not exposed to the MIS were asked if they could have performed more efficiently if a monetary contingency was in place. Twenty-three of the twenty-four respondents answered that they could have performed more efficiently, while one respondent who answered "No" replied that she was not motivated by money. These answers suggest that the MIS (and therefore the BI) would have been effective with almost all participants had all participants been exposed to the BI (as one would expect in a work setting which employed this type of intervention). Another participant who was exposed to the MIS also reported not being motivated by money, but that she would have been motivated by the opportunity to earn additional extra class credit.

Money is considered to be a generalized conditioned reinforcer (Daniels, 1989). A generalized conditioned reinforcer is created by pairing a stimulus with many different reinforcers under various states of deprivation. For example, money can be used to purchase a drink when someone is thirsty, purchase food when someone is hungry, or pay the rent when a person needs a place to live. Given that most people have at least one or more states of deprivation in effect at any given time, and that many of those states of deprivation can be alleviated with money, money becomes a simple and equitable means of delivering reinforcement to participants in an experiment.

However, in order to affect performance a reinforcer must also be viewed as being of a significant value. For example, Daniels (1989) states that although money is a positive reinforcer to practically everyone, the amounts a manager can give are usually so small that they are not reinforcing. When asked if the amount of money being offered as a performance bonus was too much, too little, or just right, all twelve of the EP+BI participants indicated that it was an appropriate amount of money, while only eight of the MP+BI participants indicated that the amount of money was appropriate. Two of the remaining participants in the MP+BI group indicated that too much money was offered while the final two participants indicated that too little money was offered. One would expect the MIS to serve as an effective consequence for good performance if the performer perceived the amount of money offered to be sufficient, but as explained, not all participants deemed the amount of performance bonus to be sufficient. Furthermore, although multiple participants reported not being motivated by money, when asked why the MIS was not motivating (if it was not motivating), the only participant who responded that she was not motivated by the MIS cited the reason that she only wanted additional extra-credit, and was not concerned with additional payment.

These participant answers concerning the value of the reinforcers provided were examined from two perspectives. One perspective is that of Abraham Maslow (1943, 1948, 1951, 1965, 1971). Maslow's (1943, 1965, 1971) theory of human motivation consisted of a set of levels that people progress through in a predetermined fashion from "lower" levels to "higher" levels. At the lower levels people are motivated by basic needs such as food, water, shelter, and safety. At the higher levels people are motivated by concepts such as social acceptance, self-esteem, love, self-actualization, and self-transcendence, which can be interpreted as reaching one's full potential in a given area (e.g., academic success). As people progress through these levels (i.e., the needs are met at each level), the rewards available at that level are no longer motivating for that person. In this framework of motivation people will progress through the levels until they reach the top level, which is called self-transcendence. Once a person has reached the top level he or she will simply continue to strive towards higher levels of self-transcendence. From Maslow's perspective, we can view these results as people seeking higher levels of rewards that were not offered in this experiment. Some participants were not motivated by money, which can be interpreted as them having their lower (and more monetary) needs met. These participants might have been better motivated to perform if there were other rewards that could have helped them achieve their goals of acceptance, esteem, self-actualization, or self-transcendence.

From a behavioral perspective, one might view these results from a reinforcer selection standpoint. Behavior analysis has long acknowledged that people are motivated by different reinforcers and that a person (e.g., a manager at work) should create reinforcers on an individual level whenever possible (e.g., movie tickets for one person, a cash bonus for another, etc.) (Daniels, 1989). When one assumes the behavioral perspective, it becomes apparent that minor adjustments could have been made that might have resulted in a reinforcing contingency for all participants. As indicated by the answers to Q23 ("How would you improve the monetary incentive system?"), all participants might have been motivated to perform better by simply offering additional extra class credit in place of money, or by offering even more money to participants (i.e., an amount greater than $10). It is possible that providing a greater amount of money and other reinforcer options would have been sufficient to motivate all participants to perform optimally in the experiment, which carries the implications that such manipulations could also motivate optimal performance in an organizational setting.

Strengths of the Study

The current study had multiple strengths in terms of the measures taken to assure internal validity. These strengths included participant training based on the methods of Performance-Based Instruction (Brethower & Smalley, 1998) to ensure that all participants could complete the necessary functions. They also included having all participants use the same computer to complete the typing test to ensure that no differences in the dependent variables of the typing test were due to equipment differences. Once the participants had completed the typing test, a stratified randomization procedure was used to equate the participants in each condition based on typing and error rate. As a result of this procedure there were no statistically significant differences between groups on the WPM typing rate (p = .959) or the number of errors variable (p = .786) (calculated using a one-way ANOVA for each variable). Equating groups / conditions on the basis of typing / error rate established all four conditions as being equal on task performance and eliminated or reduced the variance associated with different typing / error rates. This enabled a more sensitive measure of the effects of the two different work processes and the Behavioral Intervention on performance.

To ensure that all participants were exposed to the same instructional set, scripts were developed for all verbal instructions and participants were also given detailed task instructions to guide them in completing their work tasks. Once participants had completed the work task, IOA was obtained for nearly all instances (98% of instances) of the minutes in possession variable and on all instances of the number of errors variable. Furthermore, the IOA percentages calculated were very high (almost 100%) for both variables.

Weaknesses of the Study

While this experiment was strong in terms of internal validity, the laboratory setting in which it was conducted, and the procedures used in group research, provide an avenue for one to criticize the study on the basis of external validity. For example, to generalize to an entire population a researcher often includes an equal number of males and females in the participant pool, whereas the participant pool in this study consisted of 15 males and 33 females. However one may argue that task performance was likely a more important variable than participant gender.

Another weakness of the study is that participants used different computers to complete the work task. As discussed earlier in this paper, it is unlikely that this variable had much influence on the overall cycle time of a single participant, but this does represent a minor threat to internal validity.

In terms of the process factor, only a single process improvement strategy was utilized. It is possible that a different process improvement strategy (or that a combination of strategies) would have been more effective in reducing the cycle time or improving quality (e.g., streamlining the work task itself by requiring participants to type less). Furthermore it is likely that a more comprehensive approach to process improvement (e.g., more than one process change) would be utilized in an applied setting, suggesting a deficiency in the external validity of the current study.

In terms of the behavioral intervention, the criteria for timeliness and quality were derived from pilot participant data; however the criteria were set by the experimenter using pilot data and deduction, not mathematical formulas. The amount of monetary incentive paired with each criterion level was also formulated in this manner due to the absence of any published precedent. The somewhat arbitrary manner in which the performance criteria were established is another weakness of the study that should be considered.

Despite the apparent weaknesses to internal and external validity, future researchers and practitioners should consider these results with caution. Unless an exact replication were conducted, the results of this experiment might vary greatly dependent upon the task used, the procedure change(s) implemented, the criteria for attaining a performance bonus, and the types of reinforcers provided (e.g., money and / or extra class credit). While the effects of these manipulations remain unknown, their possibilities provide interesting avenues for future researchers.

Suggestions for Future Research

In general, suggestions for future research primarily rest in the area of examining various ways of combining process improvement strategies with human performance improvement strategies to achieve optimal performance in organizations. While only one process improvement method was examined in the current study, human performance variables should be examined in regards to their interaction with other types of process improvement strategies that are being used in organizations today (see Table 3). As well, other human performance improvement strategies could be tested in comparison and in combination with process improvement strategies in a way that more accurately simulates how they would be used in an organization. For example, in the current study participants engaged in the work task only one time, whereas employees in organizations often engage in the same task multiple times. This fact suggests that future researchers may want to create protocols that include repeated measurements, which will more accurately simulate a work setting and also allow the study of additional human performance improvement strategies (e.g., performance feedback).

More directly related to the current study, however, future researchers might want to replicate the procedures used with manipulations similar to those discussed (e.g., multiple process changes and various levels of incentive pay). It is believed that this protocol is a sound method of measuring cycle time and quality (which are two organizationally relevant variables) in a laboratory setting and future researchers may want to utilize these methods with multiple variations in order to answer other organizationally relevant research questions. Most importantly is that the research in this field continue and that it constantly be guided by the needs of organizations and the practitioners who work in and with those organizations.

CONCLUSION

This study can be viewed from two main perspectives, a practitioner's perspective and a researcher's perspective. From a practitioner's perspective, a practitioner who solely utilizes process improvement techniques will be provided with knowledge and data explaining the use of, and benefits of incorporating human performance improvement strategies into their work. The same can be said about a solely behavioral practitioner who gains practical knowledge of how to utilize process improvement techniques. However, the more realistic scenario is that of a competent practitioner, who might view the information contained in these pages as common sense. After years of effectively combining process and human performance oriented improvement techniques to solve a variety of organizational problems, the results presented here might be of little value in terms of designing and implementing performance improvement interventions. As the author perceives this to be a likely circumstance, he has placed the larger value in the researcher's perspective (as opposed to the practitioner's perspective).

From a researcher's perspective this study has opened the door to a new field of research, namely the interaction of process and human performer oriented changes. Throughout the extensive literature review conducted the author was able to identify multiple examples of process improvement, yet only one that was conducted in an experimental manner (Wagner, 2000). Unfortunately that experimental example was an unpublished doctoral dissertation and was not released to the scientific community. The literature review also revealed multiple, highly scientific examples of human performance improvement from reputable peer-reviewed journals. However, not one experimental study was found that examined the individual and combined contributions of both of these performance improvement strategies. When a gap such as this is identified it is often for one of two reasons: 1) the subject manner is of little importance or value, or 2) no one has developed a protocol for researching the experimental question. Given the prevalence of these two performance improvement strategies, and the frequency with which they are used in combination in the workplace, the latter reason appears to be much more plausible. Another reason for the lack of integration is that each of these areas is a highly specialized field in terms of the research topics and questions addressed by researchers. From a research perspective I understand the value of advancing and refining research endeavors within any field, however practitioners are combining these methods in what might be less than optimal interventions, in part due to the lack of research and publications on the interaction of these methods.

I believe the current study has provided one way of analyzing the comparative and contributive effects of two different performance improvement strategies, but more importantly provides a demonstration that these types of manipulations are possible to conduct in an experimental manner. To begin to bridge these two areas of research would create an entirely new field of research, and provide more immediately applicable and relevant information to practitioners who are already using these strategies to improve organizational performance.

Appendix A

Oral Recruitment Script

Oral Recruitment Script

(To be read by the experimenter in Psychology classes to recruit participants.)

Hi, my name is Joe Sasson. I am a doctoral student working with Dr. John Austin, and I am recruiting students to participate in a psychology experiment here at WMU. Participation requires use of both Microsoft Word and the web based email system "Hotmail," however ***all*** participants will be trained in the aspects of these programs that they will need to know. Participation in this experiment consists of copying a document by typing it into Microsoft Word, and returning the document to me via email, or by returning it to me in Wood Hall. This is a very simple experiment.

The experiment will require you to meet with me on three occasions. The first occasion will be for training purposes, the second occasion will be to inform you of the experimental procedures, and the third occasion will be for debriefing and payment if a payment option is chosen. However, the first task at the very first meeting will be to provide you with a deeper explanation of the study and to provide you with an opportunity to decide whether or not you would like to participate in the study. Participants will have the option to earn ***either*** extra credit points from your teacher, or to receive $5 for participating. Some participants will have the ability to earn an extra $10 for superior performance, however these students will be chosen at random, and you can not automatically expect to be one of those students when signing up to participate in this study. Participation in this study is expected to require approximately one hour of your time. The training session will be approximately 15 minutes, and a session to inform you of the experimental procedures will be approximately 5-10 minutes. It will require approximately 20-30 minutes for you to complete the work task, and approximately 10-15 minutes to participate in a debriefing session.

The work task will need to be completed on a computer with Microsoft Word, and can be completed on either a personal computer, or one owned by WMU. You will also need to have internet access and be able to log into a "Hotmail" email account. Again, all of you have this capability by being students at WMU, which automatically grants you access to WMU's computer labs as a part of your student assessment fee.

If you have any questions regarding participation that I did not answer, please email me with any questions. My email address is on the sign-up sheet that is coming around the room. If you would like to participate in this study please sign the form going around the room and I will contact you via email in the very near future. Please sign the form if you are interested in participating in this study, as signing the form will **NOT** automatically commit you to participating in this study. Signing the form will simply express your interest in participating. Please print all information legibly on the form. If all of the spaces on the form are already filled up by the time it reaches you, please fill in the required information on the back side of the form.

Thank you for your time.

Appendix B

Participant Sign-Up Form

Participant Sign-Up Form

Primary Investigator: Dr. John Austin

Student Investigator: Joseph R. Sasson
Email Address: joe.sasson@wmich.edu

Teacher's Name: ________________

Class: ____________ Date: __________

First Name	Last Name	Email Address	Phone Number

Appendix C

Script for Administering Informed Consent

SCRIPT FOR CONSENT PROCESS

To be read aloud by the experimenter at the beginning of the first meeting with the potential participant

"Before you begin participation in this study you must carefully read a consent form. I will read over the consent form with you. If you have any questions concerning the information we go over, please feel free to ask them. After you have read the consent form, you may either sign it or choose not to participate by not signing. If you choose not to sign, you will not be penalized in any way."

[Hand the participant a consent form and read it aloud to them]

Then ask, "Do you have any questions regarding the consent form? Please sign on copy of the consent form for my records, and keep the other copy for your records."

Appendix D

Consent Form

WESTERN MICHIGAN UNIVERSITY
DEPARTMENT OF PSYCHOLOGY

John Austin, PhD, Principal Investigator
Joseph R. Sasson, MA, Student Investigator

Comparative and Contributive Effects of Process and Human Performance Improvement Strategies

Purpose. You are invited to participate in a research study that will evaluate performance characteristics under a series of different conditions. The intent of this study is to determine the effectiveness of different performance improvement strategies.

Duration. You are asked to participate in 3 sessions, approximately 20 minutes in length, over 4 weeks, although you may withdraw from the study at any time without penalty.

Explanation of Study Procedures. As a participant in this study you will be asked to 1) take a typing test to determine the number of words you type per minute, 2) copy a text approximately three double-spaced pages in length (when in 12-point font), and 3) answer questions about your participation in the study. You will have the option of copying the text on any computer you choose, either a personal computer, or a computer at WMU.

Compensation. You may choose between either (1) extra credit points or (2) $5.00 per hour of participation in this study. Your extra credit points or money earned will not be penalized or forfeited should you choose to withdraw from the study. The study will require one hour of participation time, and therefore the payment option will result in a payment of $5.00. We would also like to remind you that there are other options for extra-credit available in your course, and that participation in this study does not prevent you from taking advantage of those options.

Benefits. Aside from extra credit points or $5.00, you will receive some training in two software programs (Hotmail and Microsoft Word). After the completion of your participation in this study you will be allowed to use your Hotmail email account for personal purposes. Data gained from your participation in the study may benefit the general scientific community by providing information on the effectiveness of various performance improvement methods.

Risks and Protections. The nature of the task is one that requires little physical exertion, and should not expose you to risks greater than those presented by your everyday activities. During session you may experience minor fatigue. You should conduct all experimental requirements at a pace that is comfortable for you, and if you ever experience fatigue you are encouraged to take a break.

As in all research, there may be unforeseen risks to the participant. If an accidental injury occurs, appropriate emergency procedures will be taken; however, no compensation or additional treatment will be made available to you except as otherwise stated in this consent form.

Confidentiality. All of the information collected from you and about your performance is confidential. That means that your name will not appear in any publications or presentations of the data collected. Both group and individual data may appear in publications and presentations of this research. However, each student will be assigned a code number when his or her data are entered into an electronic database for analysis purposes.

Any presentations or publications will use code numbers to label individual data. Any forms with identifying information will be retained by Joe Sasson over the course of the study and entered into the database using code numbers. Joe Sasson will keep a separate master list with the names of participants and the corresponding code numbers. Once the data are collected and analyzed, the master list will be destroyed. Data gathered from the study will be kept in a locked cabinet in the primary investigator's office for at least three years. After three years time the data will be destroyed.

Joe Sasson and Dr. John Austin are prepared to meet personally with any student who wishes to discuss any aspect of this research project and answer questions about the way data may be or are presented. As mentioned above, any information that could identify individuals will be removed from data used in any publications or presentations.

Voluntary participation. Your participation in this study is completely voluntary. You are free to withdraw at any time without penalty, and you will receive extra credit or cash payment for the amount of time you participated. Your participation in this study, or your withdrawal from it, will not affect your grades in any course. At the end of the study, the experimenter will answer any questions you have and explain how your data helped us learn more about performance in a manufacturing setting.

Who to contact with questions. If you have any questions about this study you may call Joe Sasson at 353-1687. In addition, Dr. John Austin, my faculty advisor, can be reached at 387-4495. You may also contact the Chair, Human Subjects Institutional Review Board at 387-8293 or the vice President for Research, 387-8298 if questions or problems arise during the course of the study.

Your signature below indicates that you read the above information and agree to participate in the study.

______________________________________ ________________
Participant Signature Date

Consent obtained by: ________________________ ________________
Initials of researcher Date

Please keep the attached copy of this form for your records.

This consent document has been approved for use for one year by the Human Subjects Institutional Review Board (HSIRB) as indicated by the stamped date and signature of the board chair in the upper right corner. Subjects should not sign this document if the corner does not show a stamped date and signature.

Appendix E

Human Subjects Institutional Review Board (HSIRB) Approval Letter

Date: June 6, 2003

To: John Austin, Principal Investigator
Joseph Sasson, Student Investigator for dissertation

From: Mary Lagerwey, Chair

Re: HSIRB Project Number 03-05-07

This letter will serve as confirmation that your research project entitled "Comparative and Contributive Effects of Process and Human Performance Improvement Strategies" has been **approved** under the **full** category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note that you may **only** conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: May 21, 2004

Appendix F

Typing Test Instructions

Typing Test Oral Instruction Script

(To be read by the experimenter at the beginning of the typing test.)

You are now going to be asked to copy a text from three pieces of paper. You are to copy what you see on the paper in its exact form. Please pay special attention to punctuation and spelling, as misspelled words or words touching improper punctuation will not be counted towards your total. You will be given five minutes to complete this task. Please type at a rate that is normal for you, and continue to type until the five minutes is up. At the end of the five minutes the experimenter will ask you to stop typing. Please stop typing immediately when you are asked to do so.

Some guidelines for you to follow in copying the text are to:

1. Make sure to use 12 point Times New Roman font throughout the document.
2. Note that the title line is centered, and paragraphs are left-aligned and are indented with one tab space.

You may type however you feel comfortable; either "two-finger typing" or "touch-typing" is okay.

When I finish reading this script, I will hand you this piece of paper, which contains everything I have said, so that you will have all of this information while you complete the task.

Do you have any questions concerning this task at this time?

(The experimenter will then answer any questions the participant has, and once the participant has had all of his or her questions answered the typing test will begin.)

Appendix G

Text to be Typed for the Typing Test

Typing Test

Since its inception, the field of applied behavior analysis has faced the challenge of extrapolating basic experimental research findings to the behavior of individuals at home, school, work, and in their community. Over the years, practitioners and applied researchers have addressed increasingly complex behavioral issues and, in doing so, have become less reliant on basic experimental findings to affect and explain change. The failure to relate practice back to theory has led to much controversy and criticism of the applied behavior analysis community. There are, however, several applied practitioners and researchers who do strive to explain their findings in the context of phenomena often seen (and predicted and controlled) in the laboratory. Unfortunately, this too has led to criticism regarding the appropriateness of some of these extrapolations (Poling, Dickinson, Austin, & Normand, 2000).

Much has already been said about Ludwig and Geller's use of behavior analytic terminology in safety research (Austin & Wilson, 2001; Baer, 2001). Over the past few years, Ludwig and Geller have utilized behavior analytic terms derived from the experimental analysis of behavior, typically, utilizing nonverbal, nonhuman subjects, to interpret results from their safety research, involving verbal, human subjects (1991, 1997, 2000). Their use of such terminology has often spawned responses from many recognized experts in the behavior analytic and OBM community. Most of the responses have focused on the authors' use of the terms response generalization, response maintenance, and counter control. In the recently published JOBM, Ludwig (2001) adds the term concurrent schedules to the growing list of behavior analytic terminology used in behavioral safety research.

The purpose of the current paper is to respond to Ludwig's (2001) use of several terms taken from basic experimental research and to address the inherent danger in extrapolating from the work done with nonverbal organisms in controlled settings to the work done with verbal humans in everyday settings. While we appreciate the author's attempt to forge a link between experimental and applied work, the accuracy and appropriateness of the link is questionable. Rather than expanding the scientific foundation of behavior analysis, we fear that the misuse of such terms threatens to weaken the link between this foundation and OBM. Although the terms exist and are used in other areas of applied behavior analysis, we must exercise caution when extrapolating from the laboratory to the applied realm, even if doing so means that we are criticized once again for being "technological to a fault."

Ludwig (2001) recognized that response generalization is a term that has brought much confusion to the realm of Organizational Behavior Management (OBM). In general, this can be attributed to various published definitions of response generalization (e.g., Keller & Schoenfeld, 1950) and generalization (e.g., Stokes & Baer, 1977), which leave room for multiple interpretations of causation. Additional definitions that do incorporate causal variables (e.g., Kazdin, 2001; Martin & Pear, 1992) omit an explanation of the underlying behavioral principles responsible for such generalization, and have continued to contribute to the confusion. Many of the definitions seek to label a behavior pattern that has been observed. They are a description of what can be seen once data have been graphed, but they do not infer any source of causality. Ludwig and Geller have used the term response generalization to explain the effects achieved in various behavior based safety studies (see Ludwig & Geller, 2000). They have also attempted to explain the causality behind these response generalization patterns, but have often done so inconsistently. Explanations have ranged from employee involvement (Ludwig & Geller, 2000), to concurrent schedules of reinforcement (Ludwig, 2001), and to rule-governed behavior (Ludwig & Geller, 2000). Unfortunately, few authors have recognized all of the possible reasons for observing patterns of response generalization, and many have used whatever explanation seems appropriate to the current conditions of a particular study.

Austin and Wilson (2001) preferred the term "response-response" relationships in place of "response generalization" citing that response generalization is merely one of six possible types of behavioral covariation and should not be used as an all-encompassing term. The five additional causes of behavioral covariation cited by Austin and Wilson (2001) are: 1) Responses which are physiologically related, 2) Target behaviors which occasion related responses, 3) Target behaviors which reinforce related responses, 4) Target and related responses which are maintained by the same reinforcing stimulus, and 5) Covariation through participation in verbal relations.

While these five causes may not be exhaustive, each of these terms indicates its own set of causal variables, and at least provides researchers with potential causes of response-response relationships that may be tested and pursued as lines of research. Future research and theoretical writings conducted in this area may benefit the science of applied behavior analysis by simply defining the effects observed and the potential causal variables affecting each response, as opposed to selecting and twisting behavioral principles to conform to a given situation.

Appendix H

Introduction Session Script/Checklist

Initial Meeting Training Checklist

Participant Name: ______________________________

☐ Train the participant in Microsoft Word
- ☐ Train the participant to use set up a font as 12 point Times New Roman
- ☐ Train the participant to center a line of text
- ☐ Train the participant to use left-align a section of text
- ☐ Train the participant to use the tab key to indent a paragraph
- ☐ Train the participant to double-space a section of text

☐ Conduct a typing test
- ☐ ________WPM

☐ Train the participant in the Hotmail email system
Hotmail email address: dissertationparticipant @hotmail.com
Hotmail user password: password

- ☐ Train the participant to compose email and attach documents
- ☐ Make sure the person knows how to send email to multiple users
- ☐ Train the participant to receive email and download attachments

☐ Attest to the following statement if you agree.

I feel that I have been adequately trained to execute all of the above functions, and that I can execute all of those functions if called upon to do so.

____
Participant Signature

☐ Next Meeting Date: __________ Time: ______________

☐ Participant given Meeting Two Confirmation Form

Appendix I

Meeting Two Reminder Form

Meeting Two Confirmation Form

Participant Name: ______________________________

My email address for the purposes of this study is:

Hotmail email address: dissertationparticipant_____@hotmail.com
Hotmail user password: _password____

☐ My second meeting with the experimenter or experimental staff is to be held on:

Date: __________ Time: ______________

*If you must change or reschedule this meeting time please contact Joe Sasson via email at jrsasson@earthlink.net or via telephone at (269) 352-8873 as soon as possible.

Appendix J

Electronic Process- Participant One Instructions

Task Instructions for Participant EP 1

Condition: EP Group Number: ________ Participant Number: 1

As a participant in this study you are to complete the following items in the order described below. When you have completed each item please check the box next to the item to indicate its completion. Please make sure that all items have been completed before emailing your work to the experimenter and to the next participant.

Please complete the following items in the order they are presented below. If you have any questions regarding the tasks, or have difficulty using **MS Word** or **Hotmail**, please send an email to jrsasson@earthlink.net or call Joe Sasson at (269) 352-8873 between the hours of 9:00 AM and 5:00 PM ***ONLY***.

☐ The experiment will begin at 9:00 AM on Monday ____________________. At this time the materials will be made available to you. You will be able to receive these materials and begin the work task by checking your hotmail email account. You must complete the following tasks and forward the email to the next participant and the experimenter by Friday, ____________________ at 5:00 PM.

☐ Log into your email account at www.hotmail.com
Your username is: dissertationparticipant @hotmail.com
Your password is: password

☐ At the beginning of the experiment you will receive an email with four files attached to it. The email will have a blank word document (called "FINAL PRODUCT") which you will use as a place to type a specified amount of text. The email will also have three additional documents called "Participant 1", "Participant 2", and "Participant 3".

☐ When you receive the email your first task will be to download the files to any location you choose on your computer (although the desktop is recommended for added ease in locating the files once you have downloaded them). Do this by logging into your hotmail account and opening the email mentioned above. Under the "attachments" list in the email, click on the first attachment. Once hotmail has conducted its own virus scan, click on the "download" button, and choose a location to store the document on your computer (i.e., the desktop). Do this for each of the attachments listed.

☐ ***NOTE:*** Only use Microsoft Word to complete the following steps. If you attempt to use another word processing program such as Microsoft Works, Wordpad, or Notepad, it is very likely that you will corrupt the files you have received. To avoid this problem only use Microsoft Word.

☐ Your next task is to copy the text from "Participant 1" into the document "FINAL PRODUCT." Since the text in "Participant 1" is actually a picture file, you will have to retype the text manually. You may print out the text and copy it from your printed copy, or you may copy it from the screen, whichever is easiest for you.

☐ Please read and take the following precautions when typing your text: 1) Please be sure to copy the text exactly as it appears in the document. This includes commas, parenthesis, quotations marks, periods, capitalization, etc. 2) When you are typing the text, if you decide to get up and take a break or if you decide to begin working on a separate project, ***please close the "FINAL PRODUCT" document window. You do not want this document open unless you are actually working with it.***

☐ Make sure the text is typed using the additional guidelines listed here: 1) 12 pt. Times New Roman Font, 2) Double-spaced, and 3) Using two spaces after each period.

☐ **Please note** that the text on the printed version might not line-up exactly with the text on the screen (i.e., lines might end with different words; paragraphs might end on different lines, and so on). This is okay. The font size is larger than 12-point font in the sample, and the margins might also be different. This will not be counted against you and is no reason for concern.

☐ When you have completed typing the text from "Participant 1" into "FINAL PRODUCT" save the "FINAL PRODUCT" document using the same file name.

☐ If it is between the hours of 9AM and 5PM, Monday through Friday, you may forward the materials to the next participant using your Hotmail account, in which case you should move on to the next step. If it is NOT between 9AM and 5PM Monday through Friday please wait until the next available time within those time constraints, and then move on to the next step.

☐ Please note, IT IS VERY IMPORTANT that you only send this email between 9AM and 5PM Monday through Friday. Hotmail will put a "time and date stamp" on your email that comes from Hotmail's computers, not yours, so adjusting your system clock in an attempt to make the email appear as though it was sent at a different time will not work.

☐ Log into your email account at www.hotmail.com
(username and password are listed above)

☐ Once you are logged in to your account, click on the "compose" tab. In the subject line of the new email please type "Psychology Experiment Materials". In the body of the email type "Here are the materials to complete the psychology experiment you are participating in." In the "To" field, please type the email address dissertationparticipant   @hotmail.com AND in the "CC" field please type the email address jrsasson@earthlink.net.

☐ Now attach the documents. Click on the button that says "Add/Edit Attachments". Under step one use the "Browse" button to locate the files on your disk (wherever you had saved them previously- i.e., the desktop was recommended). Select the document "Participant 2" and click attach. Repeat the same process and select the document "Participant 3" and click attach. Repeat the process one last time and select the document "FINAL PRODUCT" and click attach.

☐ Once all three documents appear in the attachment list in step two, click OK.

☐ After clicking "OK" in the previous step you will return to your original message. Now click "send" to send the email.

☐ You have a maximum time limit of one week to complete all of the steps above. The time limit of one week begins when you receive the email in your Hotmail inbox, and ends when you send the email to the next participant and experimenter.

☐For your own records, please record the following:

1. The number of times you checked email waiting for this document to appear. ______
2. The speed of the computer you completed the task on _________(MHz).
3. The amount of Random Access Memory (RAM) of the computer you completed the task on ___________MB.
4. The computer I completed the task on (was / was not) owned by WMU. (circle one)
5. The internet connection speed with which I accessed Hotmail to send and receive the necessary documents was (check one of the five choices): 56K ___ ISDN ___ DSL ___ Cable Modem ___ WMU Network (i.e., library, dorm, or wireless) ___

*** NOTE:** To help attain the information sought in numbers 2 and 3 above, go to the START menu on your computer, go to SETTINGS (if necessary), and then go to the CONTROL PANEL. In the CONTROL PANEL, go to PERFORMANCE AND MAINTENANCE (if necessary) and click on SYSTEM. Once you have clicked on SYSTEM, click on the GENERAL tab, and the computer's speed (in MHz) and amount of RAM (in MB's) should be displayed.

☐Bring this sheet with you to your debriefing session.

Appendix K

Electronic Process- Participant Two Instructions

Task Instructions for Participant EP 2

Condition: EP Group Number: ______ Participant Number: 2

As a participant in this study you are to complete the following items in the order described below. When you have completed each item please check the box next to the item to indicate its completion. Please make sure that all items have been completed before emailing your work to the experimenter and to the next participant.

Please complete the following items in the order they are presented below. If you have any questions regarding the tasks, or have difficulty using **MS Word** or **Hotmail**, please send an email to jrsasson@earthlink.net or call Joe Sasson at (269) 352-8873 between the hours of 9:00 AM and 5:00 PM ***ONLY***.

☐ The experiment will begin at 9:00 AM on Monday ______________. At this time the materials will made available to participant 1. We are unable to inform you of when *your* materials will be available, and so you will be required to check your hotmail email account to see when the materials arrive. You must complete the following tasks and forward the email to the next participant and the experimenter within one week *from when you received the email in your inbox.*

☐ Log into your email account at www.hotmail.com
Your username is: dissertationparticipant @hotmail.com
Your password is: password

☐ You will receive an email from another participant with three files attached to the email. The email will have a document called "FINAL PRODUCT" which you will use as a place to type a specified amount of text (Note: Some text will already be typed in this document. You are to add to it.). The email will also have two additional documents called "Participant 2", and "Participant 3".

☐ When you receive the email your first task will be to download the files to any location you choose on your computer (although the desktop is recommended for added ease in locating the files once you have downloaded them). Do this by logging into your hotmail account and opening the email mentioned above. Under the "attachments" list in the email, click on the first attachment. Once hotmail has conducted its own virus scan, click on the "download" button, and choose a location to store the document on your computer (i.e., the desktop). Do this for each of the attachments listed.

☐ ***NOTE:*** Only use Microsoft Word to complete the following steps. If you attempt to use another word processing program such as Microsoft Works, Wordpad, or Notepad, it is very likely that you will corrupt the files you have received. To avoid this problem only use Microsoft Word.

☐ Your next task is to copy the text from "Participant 2" into the document "FINAL PRODUCT." Since the text in "Participant 2" is actually a picture file, you will have to retype the text manually. You may print out the text and copy it from your printed copy, or you may copy it from the screen, whichever is easiest for you.

☐ Please read and take the following precautions when typing your text: 1) Please be sure to copy the text exactly as it appears in the document. This includes commas, parenthesis, quotations marks, periods, capitalization, etc. 2) When you are typing the text, if you decide to get up and take a break or if you decide to begin working on a separate project, ***please close the "FINAL PRODUCT" document window. You do not want this document open unless you are actually working with it.***

☐ Make sure the text is typed using the additional guidelines listed here: 1) 12 pt. Times New Roman Font, 2) Double-spaced, and 3) Using two spaces after each period.

☐ **Please note** that the text on the printed version might not line-up exactly with the text on the screen (i.e., lines might end with different words; paragraphs might end on different lines, and so on). This is okay. The font size is larger than 12-point font in the sample, and the margins might also be different. This will not be counted against you and is no reason for concern.

☐ When you have completed typing the text from "Participant 2" into "FINAL PRODUCT" save the document using the same file name.

☐ If it is between the hours of 9AM and 5PM, Monday through Friday, you may forward the materials to the next participant using your Hotmail account, in which case you should move on to the next step. If it is NOT between 9AM and 5PM Monday through Friday please wait until the next available time within those time constraints, and then move on to the next step.

☐ Please note, IT IS VERY IMPORTANT that you only send this email between 9AM and 5PM Monday through Friday. Hotmail will put a "time and date stamp" on your email that comes from Hotmail's computers, not yours, so adjusting your system clock in an attempt to make the email appear as though it was sent at a different time will not work.

☐ Log into your email account at www.hotmail.com
(username and password are listed above)

☐ Once you are logged in to your account, click on the "compose" tab. In the subject line of the new email please type "Psychology Experiment Materials". In the body of the email type "Here are the materials to complete the psychology experiment you are participating in". In the "To" field, please type the email address dissertationparticipant @hotmail.com AND in the "CC" field please type the email address jrsasson@earthlink.net.

☐ Now attach the documents. Click on the button that says "Add/Edit Attachments". Under step one use the "Browse" button to locate the files on your disk (wherever you had saved them previously- i.e., the desktop was recommended). Select the document "Participant 3" and click attach. Repeat the same process and select the document "FINAL PRODUCT" and click attach.

☐ Once both documents appear in the attachment list in step two, click OK.

☐ After clicking "OK" in the previous step you will return to your original message. Now click "send" to send the email.

☐ You have a maximum time limit of one week to complete all of the steps above. The time limit of one week begins when you receive the email in your Hotmail inbox, and ends when you send the email to the next participant and experimenter.

☐ For your own records, please record the following:

1. The number of times you checked email waiting for this document to appear. ______

2. The speed of the computer you completed the task on _________(MHz).

3. The amount of Random Access Memory (RAM) of the computer you completed the task on ___________MB.

4. The computer I completed the task on (was / was not) owned by WMU. (circle one)

5. The internet connection speed with which I accessed Hotmail to send and receive the necessary documents was (check one of the five choices): 56K ___ ISDN ___ DSL ___ Cable Modem ___ WMU Network (i.e., library, dorm, or wireless) ___

* **NOTE:** To help attain the information sought in numbers 2 and 3 above, go to the START menu on your computer, go to SETTINGS (if necessary), and then go to the CONTROL PANEL. In the CONTROL PANEL, go to PERFORMANCE AND MAINTENANCE (if necessary) and click on SYSTEM. Once you have clicked on SYSTEM, click on the GENERAL tab, and the computer's speed (in MHz) and amount of RAM (in MB's) should be displayed.

☐ Bring this sheet with you to your debriefing session.

Appendix L

Electronic Process- Participant Three Instructions

Task Instructions for Participant EP 3

Condition: EP Group Number: ________ Participant Number: 3

As a participant in this study you are to complete the following items in the order described below. When you have completed each item please check the box next to the item to indicate its completion. Please make sure that all items have been completed before emailing your work to the experimenter and to the next participant.

Please complete the following items in the order they are presented below. If you have any questions regarding the tasks, or have difficulty using **MS Word** or **Hotmail**, please send an email to jrsasson@earthlink.net or call Joe Sasson at (269) 352-8873 between the hours of 9:00 AM and 5:00 PM ***ONLY***.

☐ The experiment will begin at 9:00 AM on Monday ____________________. At this time the materials will made available to participant 1. We are unable to inform you of when *your* materials will be available, and so you will be required to check your hotmail email account to see when the materials arrive. You must complete the following tasks and forward the email to the experimenter within one week *from when you received the email in your inbox.*

☐ Log into your email account at www.hotmail.com
Your username is: dissertationparticipant @hotmail.com
Your password is: password

☐ You will receive an email from another participant with two files attached to the email. The email will have a document called "FINAL PRODUCT" which you will use as a place to type a specified amount of text (Note: Some text will already be typed in this document. You are to add to it.). The email will also have one additional document attached, called "Participant 3".

☐ When you receive the email your first task will be to download the files to any location you choose on your computer (although the desktop is recommended for added ease in locating the files once you have downloaded them). Do this by logging into your hotmail account and opening the email mentioned above. Under the "attachments" list in the email, click on the first attachment. Once hotmail has conducted its own virus scan, click on the "download" button, and choose a location to store the document on your computer (i.e., the desktop). Do this for each of the attachments listed.

☐ ***NOTE:*** Only use Microsoft Word to complete the following steps. If you attempt to use another word processing program such as Microsoft Works, Wordpad, or Notepad, it is very likely that you will corrupt the files you have received. To avoid this problem only use Microsoft Word.

☐ Your next task is to copy the text from "Participant 3" into the document "FINAL PRODUCT". Since the text in "Participant 3" is actually a picture file, you will have to retype the text manually. You may print out the text and copy it from your printed copy, or you may copy it from the screen, whichever is easiest for you.

☐ Please read and take the following precautions when typing your text: 1) Please be sure to copy the text exactly as it appears in the document. This includes commas, parenthesis, quotations marks, periods, capitalization, etc. 2) When you are typing the text, if you decide to get up and take a break or if you decide to begin working on a separate project, ***please close the "FINAL PRODUCT" document window. You do not want this document open unless you are actually working with it.***

☐ Make sure the text is typed using the additional guidelines listed here: 1) 12 pt. Times New Roman Font, 2) Double-spaced, and 3) Using two spaces after each period.

☐ **Please note** that the text on the printed version might not line-up exactly with the text on the screen (i.e., lines might end with different words; paragraphs might end on different lines, and so on). This is okay. The font size is larger than 12-point font in the sample, and the margins might also be different. This will not be counted against you and is no reason for concern.

☐ When you have completed typing the text from "Participant 3" into "FINAL PRODUCT" save the document using the same file name.

☐ If it is between the hours of 9AM and 5PM, Monday through Friday, you may forward the materials to the experimenter using your Hotmail account, in which case you should move on to the next step. If it is NOT between 9AM and 5PM Monday through Friday please wait until the next available time within those time constraints, and then move on to the next step.

☐ Please note, IT IS VERY IMPORTANT that you only send this email between 9AM and 5PM Monday through Friday. Hotmail will put a "time and date stamp" on your email that comes from Hotmail's computers, not yours, so adjusting your system clock in an attempt to make the email appear as though it was sent at a different time will not work.

☐ Log into your email account at www.hotmail.com
(username and password are listed above)

☐ Once you are logged in to your account, click on the "compose" tab. In the subject line of the new email please type "Completed Psychology Experiment Materials". In the body of the email type "This groups experimental materials are completed and attached". In the "To" field, please type the email address jrsasson@earthlink.net.

☐ Now attach a document. Click on the button that says "Add/Edit Attachments". Under step one use the "Browse" button to locate the file on your disk (wherever you had saved them previously- i.e., the desktop was recommended). Select the document "FINAL PRODUCT" and click attach.

☐ Once the document appears in the attachment list in step two, click OK.

☐ After clicking "OK" in the previous step you will return to your original message. Now click "send" to send the email.

☐ You have a maximum time limit of one week to complete all of the steps above. The time limit of one week begins when you receive the email in your Hotmail inbox, and ends when you send the email to the experimenter.

☐ For your own records, please record the following:

1. The number of times you checked email waiting for this document to appear. ______
2. The speed of the computer you completed the task on _________(MHz).
3. The amount of Random Access Memory (RAM) of the computer you completed the task on ___________MB.
4. The computer I completed the task on (was / was not) owned by WMU. (circle one)
5. The internet connection speed with which I accessed Hotmail to send and receive the necessary documents was (check one of the five choices): 56K ___ ISDN ___ DSL ___ Cable Modem ___ WMU Network (i.e., library, dorm, or wireless) ___

* **NOTE:** To help attain the information sought in numbers 2 and 3 above, go to the START menu on your computer, go to SETTINGS (if necessary), and then go to the CONTROL PANEL. In the CONTROL PANEL, go to PERFORMANCE AND MAINTENANCE (if necessary) and click on SYSTEM. Once you have clicked on SYSTEM, click on the GENERAL tab, and the computer's speed (in MHz) and amount of RAM (in MB's) should be displayed.

☐ Bring this sheet with you to your debriefing session.

Appendix M

Manual Process- Participant One Instructions

Task Instructions for Participant MP 1

Condition: __MP_______ Group Number: ________ Participant Number: __1___

As a participant in this study you are to complete the following items in the order described below. When you have completed each item please check the box next to the item to indicate its completion. Please make sure that all items have been completed before turning in your work.

☐ The experiment will begin at 9:00 AM on Monday ____________________. At this time the materials will be made available to you. You will be able to pick up your materials anytime after the experiment begins in room 2510/2530 Wood Hall. You must complete the following tasks and return the disk to room 2510/2530 Wood Hall by Friday, _______________ at 5:00 PM.

☐ You must check in room 2510 or 2530 Wood Hall to receive a diskette with multiple files on it. The diskette will have a blank word document (called "FINAL PRODUCT") which you will use as a place to type a specified amount of text. The document will also have three additional documents called "Participant 1", "Participant 2", and "Participant 3".

☐ ***NOTE:*** Only use Microsoft Word to complete the following steps. If you attempt to use another word processing program such as Microsoft Works, Wordpad, or Notepad, it is very likely that you will corrupt the files you have received. To avoid this problem only use Microsoft Word.

☐ When you receive the diskette your task is to copy the text from "Participant 1" into the document "FINAL PRODUCT". Since the text in "Participant 1" is actually a picture file, you will have to retype the text manually. You may print out the text and copy it from your printed copy, or you may copy it from the screen, whichever is easiest for you.

☐ Please read and take the following precautions when typing your text: 1) Please be sure to copy the text exactly as it appears in the document. This includes commas, parenthesis, quotations marks, periods, capitalization, etc. 2) When you are typing the text, if you decide to get up and take a break or if you decide to begin working on a separate project, ***please close the "FINAL PRODUCT" document window. You do not want this document open unless you are actually working with it.***

☐ Make sure the text is typed using the additional guidelines listed here: 1) 12 pt. Times New Roman Font, 2) Double-spaced, and 3) Using two spaces after each period.

☐ **Please note** that the text on the printed version might not line-up exactly with the text on the screen (i.e., lines might end with different words; paragraphs might end on different lines, and so on). This is okay. The font size is larger than 12-point font in the sample, and the margins might also be different. This will not be counted against you and is no reason for concern.

☐ When you have completed typing the text from "Participant 1" into "FINAL PRODUCT" save the document to the disk and return the disk to the laboratory

(2510/2530 Wood Hall). You can only drop off the disk in 2510/2530 Wood Hall between the hours of 9 AM and 5 PM, Monday through Friday.

☐ You have a maximum time limit of one week to complete all of the steps above. The time limit of one week begins when the task materials are ready for you to pick up, and ends when you return the task materials.

☐For your own records, please record the following:

1. The number of times you checked in rooms 2510/2530 Wood Hall to see if the diskette was available. ______
2. The speed of the computer you completed the task on _________(MHz).
3. The amount of Random Access Memory (RAM) of the computer you completed the task on ___________MB.
4. The computer I completed the task on (was / was not) owned by WMU. (circle one)

*** NOTE:** To help attain the information sought in numbers 2 and 3 above, go to the START menu on your computer, go to SETTINGS (if necessary), and then go to the CONTROL PANEL. In the CONTROL PANEL, go to PERFORMANCE AND MAINTENANCE (if necessary) and click on SYSTEM. Once you have clicked on SYSTEM, click on the GENERAL tab, and the computer's speed (in MHz) and amount of RAM (in MB's) should be displayed.

☐Bring this sheet with you to your debriefing session.

Appendix N

Manual Process- Participant Two Instructions

Task Instructions for Participant MP 2

Condition: MP Group Number: ________ Participant Number: 2

As a participant in this study you are to complete the following items in the order described below. When you have completed each item please check the box next to the item to indicate its completion. Please make sure that all items have been completed before turning in your work.

☐ The experiment will begin at 9:00 AM on Monday ____________________. At this time the materials will be made available to participant 1. We are unable to inform you of when *your* materials will be available, and so you will be required to check back in room 2510/2530 Wood Hall. You must complete the following tasks and return the disk to room 2510/2530 Wood Hall within one week from *when the disk was available* for pickup. The experimenter or experimental staff will inform you of when the deadline is.

☐ You must check in room 2510 or 2530 Wood Hall to receive a diskette with three files on it. The diskette will have a Word document (called "FINAL PRODUCT") which you will use as a place to type a specified amount of text (Note: Some text will already be typed in this document. You are to add to it.). The disk will also have two additional documents called "Participant 2" and "Participant 3".

☐ ***NOTE:*** Only use Microsoft Word to complete the following steps. If you attempt to use another word processing program such as Microsoft Works, Wordpad, or Notepad, it is very likely that you will corrupt the files you have received. To avoid this problem only use Microsoft Word.

☐ When you receive the diskette your task is to copy the text from "Participant 2" into the document "FINAL PRODUCT". Since the text in "Participant 2" is actually a picture file, you will have to retype the text manually. You may print out the text and copy it from your printed copy, or you may copy it from the screen, whichever is easiest for you.

☐ Please read and take the following precautions when typing your text: 1) Please be sure to copy the text exactly as it appears in the document. This includes commas, parenthesis, quotations marks, periods, capitalization, etc. 2) When you are typing the text, if you decide to get up and take a break or if you decide to begin working on a separate project, ***please close the "FINAL PRODUCT" document window. You do not want this document open unless you are actually working with it.***

☐ Make sure the text is typed using the additional guidelines listed here: 1) 12 pt. Times New Roman Font, 2) Double-spaced, and 3) Using two spaces after each period.

☐ **Please note** that the text on the printed version might not line-up exactly with the text on the screen (i.e., lines might end with different words; paragraphs might end on different lines, and so on). This is okay. The font size is larger than 12-point font in the sample, and the margins might also be different. This will not be counted against you and is no reason for concern.

☐ When you have completed typing the text from "Participant 2" into "FINAL PRODUCT" save the document to the disk and return the disk to the laboratory (2530 Wood Hall). You can only drop off the disk in 2510/2530 Wood Hall between the hours of 9 AM and 5 PM, Monday through Friday.

☐ You have a maximum time limit of one week to complete all of the steps above. The time limit of one week begins when the task materials are ready for you to pick up, and ends when you return the task materials.

☐ For your own records, please record the following:

1. The number of times you checked in rooms 2510/2530 Wood Hall to see if the diskette was available. _______

2. The speed of the computer you completed the task on __________(MHz).

3. The amount of Random Access Memory (RAM) of the computer you completed the task on ____________MB.

4. The computer I completed the task on (was / was not) owned by WMU. (circle one)

*** NOTE:** To help attain the information sought in numbers 2 and 3 above, go to the START menu on your computer, go to SETTINGS (if necessary), and then go to the CONTROL PANEL. In the CONTROL PANEL, go to PERFORMANCE AND MAINTENANCE (if necessary) and click on SYSTEM. Once you have clicked on SYSTEM, click on the GENERAL tab, and the computer's speed (in MHz) and amount of RAM (in MB's) should be displayed.

☐ Bring this sheet with you to your debriefing session.

Appendix O

Manual Process- Participant Three Instructions

Task Instructions for Participant MP 3

Condition: MP Group Number: ________ Participant Number: 3

As a participant in this study you are to complete the following items in the order described below. When you have completed each item please check the box next to the item to indicate its completion. Please make sure that all items have been completed before turning in your work.

☐ The experiment will begin at 9:00 AM on Monday ____________________. At this time the materials will be made available to participant 1. We are unable to inform you of when *your* materials will be available, and so you will be required to check back in room 2510/2530 Wood Hall. You must complete the following tasks and return the disk to room 2510/2530 Wood Hall within one week from *when the disk was available* for pickup. The experimenter or experimental staff will inform you of when the deadline is.

☐ You must check in room 2510 or 2530 Wood Hall to receive a diskette with two files on it. The diskette will have a word document (called "FINAL PRODUCT") which you will use as a place to type a specified amount of text (Note: Some text will already be typed in this document. You are to add to it.). The disk will also have one additional document called "Participant 3".

☐ ***NOTE:*** Only use Microsoft Word to complete the following steps. If you attempt to use another word processing program such as Microsoft Works, Wordpad, or Notepad, it is very likely that you will corrupt the files you have received. To avoid this problem only use Microsoft Word.

☐ When you receive the diskette your task is to copy the text from "Participant 3" into the document "FINAL PRODUCT". Since the text in "Participant 3" is actually a picture file, you will have to retype the text manually. You may print out the text and copy it from your printed copy, or you may copy it from the screen, whichever is easiest for you.

☐ Please read and take the following precautions when typing your text: 1) Please be sure to copy the text exactly as it appears in the document. This includes commas, parenthesis, quotations marks, periods, capitalization, etc. 2) When you are typing the text, if you decide to get up and take a break or if you decide to begin working on a separate project, ***please close the "FINAL PRODUCT" document window. You do not want this document open unless you are actually working with it.***

☐ Make sure the text is typed using the additional guidelines listed here: 1) 12 pt. Times New Roman Font, 2) Double-spaced, and 3) Using two spaces after each period.

☐ **Please note** that the text on the printed version might not line-up exactly with the text on the screen (i.e., lines might end with different words; paragraphs might end on different lines, and so on). This is okay. The font size is larger than 12-point font in the sample, and the margins might also be different. This will not be counted against you and is no reason for concern.

☐ When you have completed typing the text from "Participant 3" into "FINAL PRODUCT" save the document to the disk and return the disk to the laboratory (2510/2530 Wood Hall). You can only drop off the disk in 2510/2530 Wood Hall between the hours of 9 AM and 5 PM, Monday through Friday.

☐ You have a maximum time limit of one week to complete all of the steps above. The time limit of one week begins when the task materials are ready for you to pick up, and ends when you return the task materials.

☐For your own records, please record the following:

1. The number of times you checked in rooms 2510/2530 Wood Hall to see if the diskette was available. ______

2. The speed of the computer you completed the task on _________(MHz).

3. The amount of Random Access Memory (RAM) of the computer you completed the task on ___________MB.

4. The computer I completed the task on (was / was not) owned by WMU. (circle one)

* **NOTE:** To help attain the information sought in numbers 2 and 3 above, go to the START menu on your computer, go to SETTINGS (if necessary), and then go to the CONTROL PANEL. In the CONTROL PANEL, go to PERFORMANCE AND MAINTENANCE (if necessary) and click on SYSTEM. Once you have clicked on SYSTEM, click on the GENERAL tab, and the computer's speed (in MHz) and amount of RAM (in MB's) should be displayed.

☐Bring this sheet with you to your debriefing session.

Appendix P

Manual Process- Behavioral Intervention

Behavioral Intervention Sheet - MP

Participant Name: ____________________________
Condition: _MP+BI__ Group Number: ______ Participant Number: __________

You have been chosen to participate in an incentive program as a part of this experiment. You will be rewarded financially for completing the assigned tasks according to the following pay scale:

NOTE Although you are working in a "virtual group", your payment is based solely on your own performance.

Dollars Earned	**Maximum Duplication Errors**	**Maximum Hours in Possession**
$10	5	8
$8	10	16
$6	15	24
$4	20	32
$2	25	40

Requirements for Each Pay Level:

To meet any given pay level, you must meet BOTH requirements found in the "Duplication Errors" and "Hours in Possession" columns.

According to this pay scale, if you returned the completed materials on disk to the laboratory (2510/2530 Wood Hall) with fewer than 5 duplication errors within 8 hours from when they were dropped off by the prior participant, you would earn $10. If you returned the materials within 8 hours, but had 20 duplication errors, you would earn $4. If you returned the materials within 24 hours, and had only 3 duplication errors, you would earn $6. You would not be eligible for an incentive bonus if you had more than 25 duplication errors. Also, if you violate any of the work instructions provided you will be ineligible for a bonus.

Duplication Errors

Duplication errors are any errors of the following type:
☐ Improper capitalization
☐ Improper use of an apostrophe (')
☐ Improper use of quotation marks (" ")
☐ Improper use of parenthesis ( )
☐ Improper use of a comma (,)
☐ Improper use of a colon (:)
☐ Improper use of a semicolon (;)
☐ Incorrect spelling
☐ Text that is not 12 point font
☐ Text that is not Times New Roman
☐ Improper spacing (i.e., having two spaces after a word or only having one space after an end punctuation mark, such as a period)

☐ Missing words
☐ Words unnecessarily added

Hours in Possession

"Hours in Possession" is defined as the amount of time that passes between the time that the experimental materials are placed in your possession and the time that you return the completed materials. Materials are considered to be in your possession ***at the time the experiment is said to begin*** (if you are participant one), ***or the time at which the previous participant dropped off the materials*** (if you are participant two or three). You will be informed of the time that the materials were placed in your possession when you pick up the materials.

Hours are measured from 9 AM to 5 PM. For example, if the participant before you dropped off the experimental materials at 9:00 AM on a Monday, you would have to complete the task and return the completed materials to the experimenter (or experimental staff) by 5:00 PM on the same day (any later than 5 PM would be more than 8 hours) to be eligible for the $10 bonus. If the participant before you dropped off the experimental materials at 4 PM on a Tuesday you would have to complete the task and return the completed materials to the experimenter (or experimental staff) by 4 PM on the following day (in this example it would be Wednesday) to be eligible for the $10 bonus.

Helpful Tips:

To help you get the monetary bonus follow these suggested tips:

- Check in the laboratory (rooms 2510/2530 Wood Hall) as often as possible (at least once a day) so that you will get the materials as soon as possible.
- If possible have another person proofread your writing when you are finished.
- Return the materials to the experimenter (or experimental staff) as soon as you are finished.

Once you have completed your assignment the experimenter will have to proofread your document for errors. You will be informed of the amount of bonus pay you have earned at your debriefing session, at which time you will also be provided payment for your participation and your excellent performance.

Appendix Q

Electronic Process- Behavioral Intervention

Behavioral Intervention Sheet - EP

Participant Name: ___________________________
Condition: _EP+BI__ Group Number: ______ Participant Number: __________

You have been chosen to participate in an incentive program as a part of this experiment. You will be rewarded financially for completing the assigned tasks according to the following pay scale:

NOTE Although you are working in a "virtual group", your payment is based solely on your own performance.

Dollars Earned	Maximum Duplication Errors	Maximum Hours in Possession
$10	5	8
$8	10	16
$6	15	24
$4	20	32
$2	25	40

Requirements for Each Pay Level:

To meet any given pay level, you must meet BOTH requirements found in the "Duplication Errors" and "Hours in Possession" columns.

According to this pay scale, if you sent the completed materials to the next participant and/or experimenter via email (jrsasson@earthlink.net) with 5 or fewer duplication errors, within 8 hours from when they were sent by the experimenter or prior participant, you will earn $10. If you sent the materials via email within 8 hours, but had 20 duplication errors, you would earn $4. If you sent the materials within 24 hours, and had only 3 duplication errors, you would earn $6. You would not be eligible for an incentive bonus if you had more than 25 duplication errors. Also, if you violate any of the work instructions provided you will be ineligible for a bonus.

Duplication Errors

Duplication errors are any errors of the following type:
- ☐ Improper capitalization
- ☐ Improper use of an apostrophe (')
- ☐ Improper use of quotation marks (" ")
- ☐ Improper use of parenthesis ( )
- ☐ Improper use of a comma (,)
- ☐ Improper use of a colon (:)
- ☐ Improper use of a semicolon (;)
- ☐ Incorrect spelling
- ☐ Text that is not 12 point font
- ☐ Text that is not Times New Roman

☐ Improper spacing (i.e., having two spaces after a word or only having one space after an end punctuation mark, such as a period)
☐ Missing words
☐ Words unnecessarily added

Hours in Possession

"Hours in Possession" is defined as the amount of time that passes between the time that the experimental materials are placed in your possession (sent to you via email) and the time that you send the completed materials to the next participant (or experimenter) via email. Materials are considered to be in your possession ***at the time they were sent by the experimenter*** (if you are participant one), ***or at the time they were sent by the previous participant*** (if you are participant two or three). This time is shown in your Hotmail "Inbox" and in the message header when you open the email.

Hours are measured from 9 AM to 5 PM. For example, if the participant before you sent you the materials via email at 9:00AM on a Monday, you would have to complete the task and send the completed materials to the experimenter (and the next participant, if applicable) by 5 PM on the same day (any later than 5 PM would be more than 8 hours) to be eligible for the $10 bonus. If the participant before you sent you the materials at 4 PM on a Tuesday, you would have to complete the task and send the completed materials to the experimenter (and the next participant, if applicable) by 4 PM on the following day (in this example it would be Wednesday) to be eligible for the $10 bonus.

Helpful Tips:

To help you get the monetary bonus follow these suggested tips:

- Carry your new hotmail user name and password with you at all times.
- Check your email as often as possible (at least once a day) so that you will get the materials as soon as possible.
- If possible, have another person proofread your writing when you are finished.
- Send the materials to the experimenter (and the next participant if applicable) as soon as you are finished.

Just as a reminder, your hotmail (www.hotmail.com) username and password are:

Your username is: __dissertationparticipant______@hotmail.com__
Your password is: _password___

Once you have completed your assignment the experimenter will have to proofread your document for errors. You will be informed of the amount of bonus pay you have earned at your debriefing session, at which time you will also be provided payment for your participation and your excellent performance.

Appendix R

Group Assignment Session Script/Checklist

Group Assignment Training Checklist

Participant Name: ________________________________
Condition: __________________________
Group Number: ______________________
Participant Number: __________________

☐ Read the appropriate work flow to the participant
  ☐ Review the checklist of items that should be reviewed before a task is completed
  ☐ Ask the participant if they have any questions about what they are to do

☐ Review Behavioral Intervention Package (if applicable)

☐ As a reminder, this participant's Hotmail username and password are:

Hotmail email address: dissertationparticipant_____@hotmail.com
Hotmail user password: password

☐ Attest to the following statement if you agree.

I feel that I have been adequately trained to execute all of the above functions.

____
Participant Signature

☐ Next Meeting Date: __________ Time: ______________

☐ Participant given Meeting Three Confirmation Form

Appendix S

Meeting Three Reminder Form

Meeting Three Confirmation Form

Participant Name: ______________________________
Condition: ______________________________
Group Number: ______________________________
Participant Number: ____________________

My email address for the purposes of this study is:

Hotmail email address: dissertationparticipant______@hotmail.com
Hotmail user password: _password_____

☐ My third meeting with the experimenter or experimental staff is to be held on:

Date: __________ Time: ______________

*If you must change or reschedule this meeting time please contact Joe Sasson via email at jrsasson@earthlink.net or via telephone at (269) 352-8873 as soon as possible.

Appendix T

Text to be Typed by Participant One

Participant 1 Text

The primary purpose of this research was to examine the effects of conducting observations as a part of the behavior based safety process. The research was conducted in both the patient accounting and the patient scheduling departments of a large hospital. Employees in the aforementioned departments used keyboards to enter data as a primary function of their job and perform their jobs at computer-oriented workstations for their entire shift, which places them at risk for various musculoskeletal disorders. Employees in these departments had not been given any formal ergonomics training prior to this study and several employees had filed workers compensation claims for work related MSDs. As a part of BBS programs designed to improve ergonomic behavior, data collectors often use direct observation methods and checklists to assess levels of safety. Alvero and Austin conducted a laboratory study to examine how conducting BBS observations would affect the safe performance of the observer. The current study was designed to replicate and extend the findings of Alvero and Austin by utilizing similar methodology in an applied setting.

Each year the number of work-related MSDs reported continues to rise. Measures taken to improve the behaviors that lead to MSDs would result in clear financial gain for employers, as well as clear health benefits for employees. The dependent variables targeted in the current study were behaviors that have been shown to be major contributors to many types of MSDs. Therefore, increased performance on the target behaviors in this study would mitigate the likelihood of the development of some MSDs and increase the comfort and health of the participants involved. In the event of substantial behavior change cost savings may also be achieved by the hospital, which may experience a resultant reduction in workers compensation claims over the long term.

Every year in the United States thousands of employees report work related musculoskeletal disorders. Musculoskeletal disorders have also been referred to as repetitive stress injuries, cumulative trauma disorders, and repetitive strain injuries. According to OSHA, MSDs account for 34% of lost workday injuries and illnesses and there were more than 670,000 lost workdays due to MSDs in 1996 alone. In 1999 there were approximately 247,000 MSDs reported, and at an average cost of $11,420 per claim, the annual medical costs alone were near $3 billion. Furthermore, these injuries cost business $20 billion in workers compensation costs and the indirect costs may run as high as $45 to $60 billion each year. Aside from the obvious monetary consequences to the business, workers affected by these injuries may ultimately be faced with a crippling disability; a disability that may prevent them from doing simple everyday tasks such as combing their hair, picking up a baby, or reaching for a book on a high shelf. Considering some of the changes that have occurred in the work environment over the last 20 years, such as the addition of computers and an increase of time spent sitting at desks, it is not surprising that more people are experiencing MSDs than ever before. The number of people with computers on their desks at work has been estimated at nearly 50 million, and the use of a computer is a major contributing factor to people spending increasing periods of time in a static posture. According to an in depth analysis of over 600 epidemiological studies reviewed by the National Institute for Occupational Safety and Health (NIOSH), and the National Academy of Sciences (NAS), there is sufficient evidence to suggest a causal relationship between highly repetitive work and neck and neck/shoulder MSDs. According to NIOSH, there is also strong evidence that persons with static or extreme working postures involving the neck/shoulder muscles, such as those involved in prolonged periods of computer usage, are at increased risk for neck and shoulder MSDs (conditions which are common for participants of this study).

Many researchers, consultants, and organizations attempt to reduce injuries by either altering the work environment to eliminate potential risk factors, or by altering the behavior of employees in the environment. In the majority of cases equipment changes constitute a necessary, but not sufficient, improvement for establishing safe performance. In other words, altering equipment may enable safe performance in the workplace, but it does not guarantee that it will occur. Take the example of an ergonomically designed chair. Although the chair may be adjustable in every possible way to support the users height, lumbar, or desired tilt, the worker may still lean against the back of the chair, or sit with legs crossed. In order for behavior change to occur reliably over time, employees need adequate equipment, controls, knowledge and skills, and motivation to behave safely. Focusing on the behavior of employees in order to increase safety performance is the foundation of the behavior based safety process. Studies show the effectiveness of the BBS process in many settings including manufacturing, construction, food preparation, driving, mining, and more. Studies have also demonstrated reductions of unsafe work behavior in attempts to reduce the number of MSDs. The BBS process has demonstrated success at reducing workplace injuries in a number of domains, and in a review of 33 articles that reported incidence rates as a dependent variable, 32 of the articles reported a reduction in injuries due to BBS programs. This reported reduction in injuries spares workers immeasurable amounts of pain and suffering, and has the added benefit of cost savings.

Appendix U

Text to be Typed by Participant Two

Participant 2 Text

Sulzer-Azaroff and Austin define behavior-based safety as a systematic approach to promoting behavior supportive of injury prevention. Daniels defines performance management as a systematic, data-oriented approach to managing people at work that relies on positive reinforcement as the major way to maximizing performance. The BBS process employs the principles of applied behavior analysis and performance management to achieve its goals of increased occupational and personal safety. Although the fundamental concepts of BBS remain constant, an application can vary in form with each location or implementation. As Sulzer-Azaroff and Austin stated, depending on an organization's needs, resources, and objectives, each system will have uniquely customized features. Whatever customizations may occur, Sulzer-Azaroff and Austin have identified the key elements of an effective BBS package as: 1) Identifying behaviors that impact safety; 2) Defining those behaviors precisely enough to measure them reliably; 3) Developing and implementing mechanisms for measuring those behaviors in order to determine their current status and setting reasonable goals for their improvement; 4) Providing feedback; and 5) Reinforcing progress toward goal attainment.

Sulzer-Azaroff, Loafman, Merante, and Hlavacek used a behavior-based intervention to reduce the number of OSHA recordables and lost time injuries in a large industrial plant. OSHA recordables were defined as any injury referred for medical treatment beyond first aid. Lost time injuries were defined as any injury leading to at least one day off the job. The authors described an intervention consisting of a combination of feedback, reinforcement, and goal setting. Behavioral observations were conducted by the researchers to assess the increases in safety performance. The study showed an increase in safe behavior, a decrease in both OSHA recordables and lost time injuries, and a conservative estimate of a first year net savings of $55,500. The Sulzer-Azaroff et al. study illustrates the effectiveness of behavior based interventions that employ package interventions consisting of feedback, reinforcement, and goal setting while illustrating that attempts to reduce workplace injuries using behavioral methods can result in great benefits to a company and its employees.

Researchers have also demonstrated the effects of behavioral techniques to address other significant health concerns. It is estimated that over 90% of food borne illness is attributed to human behavior. To address this issue Geller, Eason, Phillips, and Pierson used an ABACADA design to evaluate the effects of multiple interventions on the sanitation behavior of food preparation employees. In an attempt to reduce the collection of microorganisms on employees' hands, three interventions were established to increase hand washing after employees engaged in behavior that was designated as high risk for collecting microorganisms. The researchers compared three interventions, including: 1) Hand watching – telling employees that their sanitation behaviors were going to be videotaped and having visual-recording equipment in full view of the employees; 2) Sanitation training; and, 3) Feedback on microorganism collecting and hand washing behavior sequences. An increase in safe behavior was observed in all intervention conditions, with the feedback intervention resulting in the greatest performance improvement. In the training condition, a significant increase in hand washing occurred only on the day following the delivery of the sanitation training. This observed lack of maintenance is a common result of training interventions. During baseline hand washing occurred at a mean rate of 2.1 occurrences per day and increased to 5 occurrences per day during the feedback condition. The study shows that behavioral procedures can effectively increase the frequency of hand washing under necessary conditions, thereby increasing sanitation in a kitchen environment.

Fox, Hopkins, and Anger implemented a token economy system at a large open-pit mine in the northern portion of the United States. The authors evaluated, over the course of more than 10 years, two implementations of behavior-based safety. The two dependent variables were: 1) the number of job related injuries that caused a worker to be absent from work one or more days; and, 2) the total number of days absent from work due to injuries. Direct costs of injuries were also monitored and included costs for compensation insurance, medical care for insured workers, and costs of repairing damaged equipment. Cost figures were proportioned to the yearly number of person-hours worked and adjusted for inflation. The index of injury severity – the total number of days absent from work due to injuries - showed an 89% decrease at Site A, and a 98% decrease at Site B. The direct costs of injuries were also reduced dramatically, and produced an annual savings of approximately $265,000 at Site A and $325,000 at Site B. Perhaps the most significant contribution of this study is the longevity demonstrated by the BBS implementations. By decreasing both injury rates and the costs associated with those injuries, the BBS process maintained both owner and employee support for many years. When executed correctly, the BBS process becomes a part of an organization's culture and remains for the life of the organization. In this case, Site A continued to use their BBS program for 12 years until mining ceased at the site due to resource depletion. As of the last published report, Site B had been using the plan for 11 years and was still using BBS as a way to eliminate accidents and injuries.

Appendix V

Text to be Typed by Participant Three

Participant 3 Text

On January 16, 2001 OSHA's ergonomics standard took effect, mandating that employers take measures to ensure they are providing employees with ergonomically sound work environments. Unfortunately, within 45 days of taking effect and the beginning of a new Republican administration, the standards were overturned, and were no longer applicable. Sandy Smith, the managing editor of Safety Online, has said that these standards would have affected over 100 million workers and could have saved 4.6 million people from experiencing MSDs over the next 10 years, resulting in a national savings of $9.1 billion each year. Smith also quoted Jerry Spree, president of the American Federation of State, County and Municipal Employees (AFSME), who claimed that the NAS analysis of over 600 studies confirms what millions of American workers have learned the hard way: repetitive motion causes workplace injuries. The NAS stated that a rapid work pace, monotonous work, low job satisfaction, little decision-making power, and high levels of stress are associated with back disorders. Although partially attributing MSDs to psychosocial factors in the workplace, the NAS recognized the leverage that can be gained over MSDs by utilizing the principles of human behavior. At the 1999 Government-University-Industry Research Roundtable held by the NAS on an annual basis, the contributions of the behavioral sciences were duly noted. The GUIRR noted that engineers say that they are continually surprised by the behavior of operators and users, which can produce accidents with heavy costs. They tend to blame human error in such cases. Human factors experts say that most could be avoided by better integrating behavioral knowledge into engineering, operations, and training. The GUIRR also noted that although social and behavioral scientists have much to contribute to industry and society, they are rarely in positions to influence design or business strategy and are therefore automatically limited in the impact they can achieve. The GUIRR made recommendations for cross training, suggesting that the few outstanding individuals with expertise in bridging behavioral backgrounds with industry problems and methods have demonstrated themselves as industry leaders and are able to make decisions that go beyond current situation "quick fixes", and that industry can help to build this expertise by offering internship programs to students in the field.

Dennis Downing, president of Future Industrial Technologies has achieved such cross training. Downing has coined a term for what many would refer to as BBS. He calls it Bionomics. The word "bio" replaces the word "ergo" to shift the emphasis from the work - "ergo"- to the body -"bio". Downing realized that although his company was giving correct ergonomics training, the content of their training was being applied incorrectly or not at all, and there was no reduction in workers' compensation costs with his clients. Downing began to shift the focus of his training to human behavior, and felt that there must be a "doingness" to training, and that the learner must engage in some task-related activity rather than simply watching a video or listening to a lecturer. Downings' practices of actively involving learners in training activities is also supported by training experts such as Brethower and Smalley who said that having learners engage in the task is an essential component of effective training and will increase the transfer of training to the actual work environment. According to Downing, since his shift in focus, his programs have been able to achieve consistent, sustainable reductions in injuries. It appears as though business and industry are just coming to realize what many academics in the behavioral community have long since known – all of the training and system changes that are implemented will have little impact if they do not effectively change the worker's behavior.

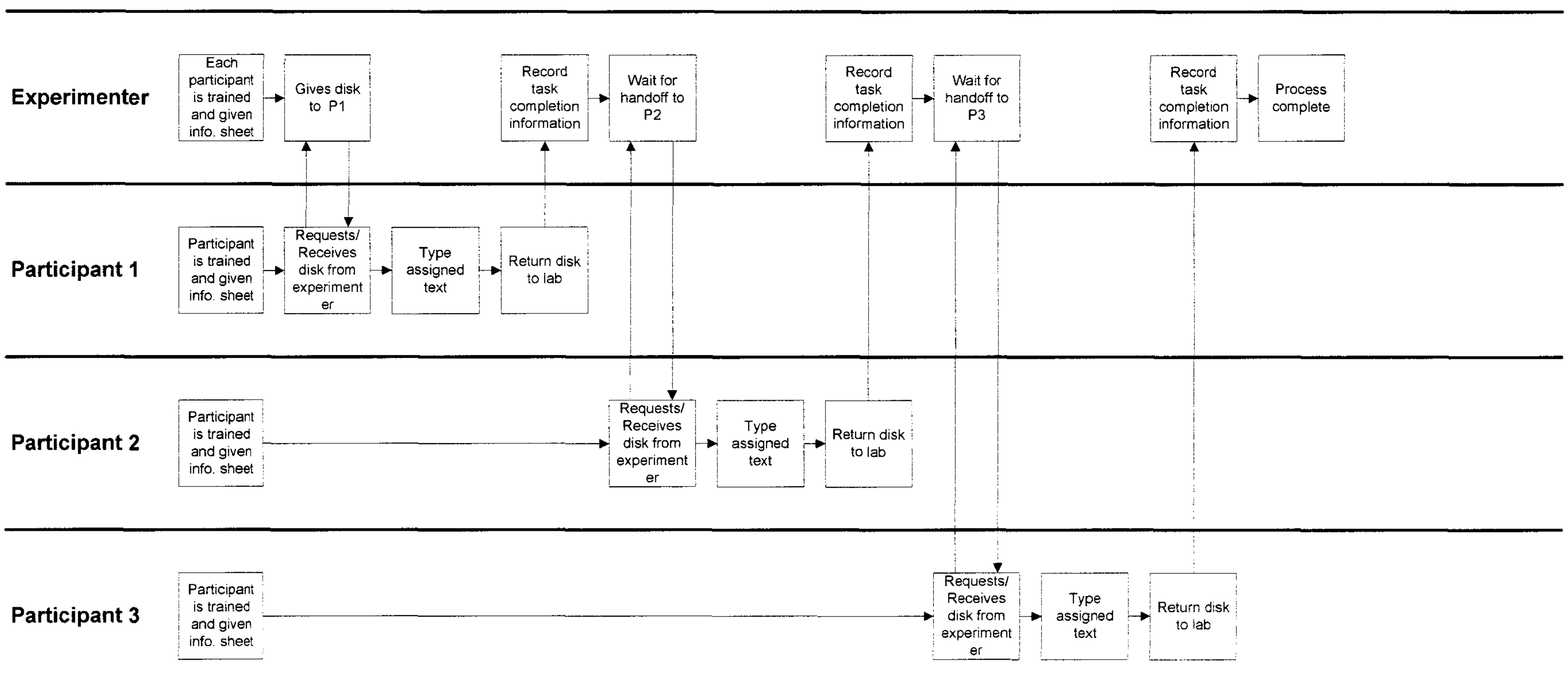
In a scientific attempt to reduce MSDs using behavioral methods, Blake McCann and Sulzer-Azaroff used a feedback, reinforcement, and goal setting procedure to increase correct posture and hand-wrist position of participants engaging in keyboarding tasks. Using a multiple baseline across participants design, consisting of a baseline, training and self-monitoring, and treatment package intervention (feedback, reinforcement, and goal setting), performance rose to near maximal levels during the training condition. During this training condition the participants did not receive any additional feedback on their performance or information on past performance, and levels of safe performance increased across all target behaviors. The results of the study suggest that self-monitoring in conjunction with training can be effective in reducing unwanted behaviors and increasing ergonomically correct behaviors.

Alvero and Austin conducted a laboratory study to improve both postural behaviors and wrist position of computer terminal operators. Independent variables included (a) information on ergonomic behavior; and, (b) observation and scoring of videos depicting a confederate engaged in office work. After observing and scoring a video of a confederate engaging in common office tasks (i.e., typing, talking on the phone, picking up boxes), the participant entered a simulated office environment to engage in tasks that were identical to the ones the confederate had been performing in the video. Although slight performance gains were observed when information on ergonomic behavior was distributed to the participants, more significant gains were produced when participants observed and scored a video of a confederate engaging in the same tasks.

Appendix W

Process Map of the Manual Work Process

Manual Work Process - For use with and without a Behavioral Intervention package



This process is a manual process (MP). It will be used by participants in two conditions. Condition One (MP) will use this process with written instructions only. Condition Two (MP+BI) will use this process will use this same process with both written instructions and a Behavioral Intervention package (i.e., performance specifications and monetary incentives).

Appendix X

Disk Distribution Sheet

Disk Distribution Sheet

Participant Name: ______________________________
Condition: __________ Group Number: ________ Participant Number: _______

You must return this disk no later than:

Date: _________ Time: _____________

--Disks may be returned to room 2510/2530 Wood Hall between the hours of 9AM and 5PM Monday through Friday.

*If you require additional instruction with Microsoft Word, please stop by room 2510 for assistance.

As a reminder, your debriefing session with the experimenter is to be held on:

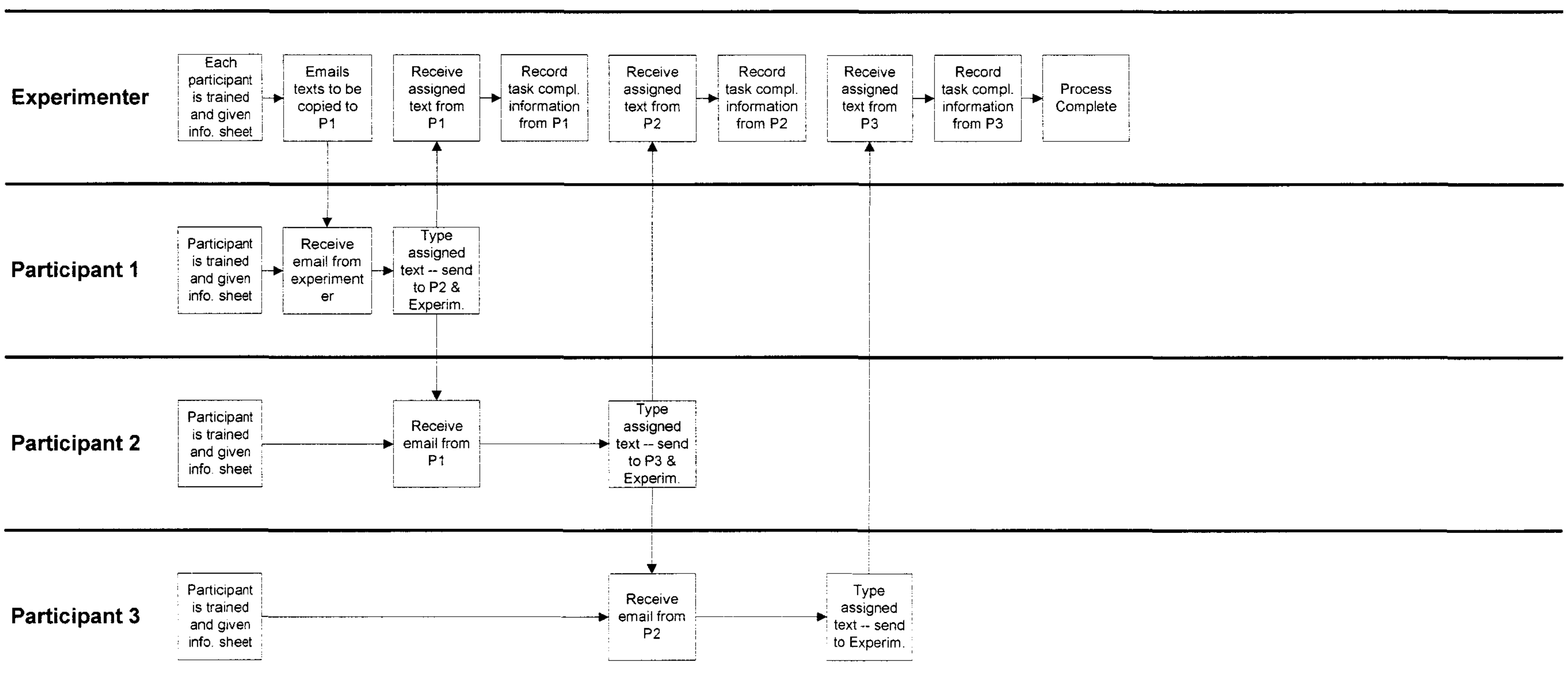
Date: __________ Time: _____________

*If you must change or reschedule this meeting time please contact Joe Sasson via email at jrsasson@earthlink.net or via telephone at (269) 352-8873 as soon as possible.

Appendix Y

Process Map of the Electronic Work Process

Electronic Work Process - For use with and without a Behavioral Intervention package



This process is an electronic process (EP). It will be used by participants in two conditions. Condition Three (EP) will use this process with written instructions only. Condition Four (EP+BI) will use this process with both written instructions and a Behavioral Intervention package (i.e., performance specifications and monetary incentives).

Appendix Z

Participant Exit Interview

Participant Exit Interview

(To be read by the experimenter at the conclusion of the study, before the Participant Debriefing Script.)

Thank you for participating in this study. Before we go through our final debriefing I would like to ask you a few questions about your participation in this study, and the equipment you used to complete the work task.

Participant Name:__________________

Condition: ______________ Group #: ___________ Participant #: _________

Participant Characteristics

1. Is the participant a male or female? ☐ Male ☐ Female
2. What is the participant's age?
3. What environmental factors influenced your to decision to acquire, complete, and return the task materials?

☐ Work Schedule ☐ Family Responsibilities ☐ Social Commitments
☐ Class Schedule ☐ Weather ☐ Other: ______________

Computer Questions

4. What speed processor did the computer you were working on have?
5. How much RAM did the computer you worked on have?
6. What type of internet connection did the computer you were working on have?
7. Did you complete the work task on a personal computer, or on a WMU computer?
8. How would you rate yourself on your ability with Microsoft Word: 1) Beginner, 2) Intermediate, or 3) Advanced?
9. Do you feel that the training you received was adequate enough for you to complete the required tasks in Microsoft Word? ☐ Yes ☐ No
10. How would you rate yourself on your ability with Microsoft Hotmail: 1) Beginner, 2) Intermediate, or 3) Advanced?
11. Do you feel that the training you received was adequate enough for you to complete the required tasks in Hotmail? (for EP and EP+BI groups only) ☐ Yes ☐ No

Process Questions

12. Would you have rather A) participated in a process in which you had to pick up and drop off your materials at a room in Wood Hall, or B) preferred to have your documents emailed to a Hotmail account, and then forward the materials to the next participant through Hotmail?

13. On a scale of 1 to 5, how satisfied were you with the steps you had to take to complete your work task?

Very Unsatisfied	Unsatisfied	Neutral	Satisfied	Very Satisfied
1	2	3	4	5

14. How many times did you check back at room 2532 to see if your disk was ready for pickup? (for MP and MP+BI groups only)

15. How many times did you check your email to receive your documents to be completed? (for EP and EP+BI groups only)

16. Did you experience any problems using Hotmail or MS Word? (Please Describe)

17. Was the time period allotted for completion too long, too short, or just right?

18. What systems could have been in place to help you return the document even quicker than you did?

19. Could you have performed more efficiently (meaning less time to complete AND return your work) if a monetary contingency was in place (meaning you would get "paid for performance")? (for MP and EP groups only)

Incentive Questions

20. If you had the option to choose extra credit points or money for participation in this experiment, which did you choose, and why?

21. Was the money you earned a sufficient amount of money in comparison to the extra time and accuracy required (if money was earned)?

22. Was the potential to earn $10 (too little / just right / too much) as a monetary incentive given the additional time and accuracy requirements?

23. How would you improve the monetary incentive system?

24. If the monetary incentive system did not motivate you, why didn't it?

☐ Not enough money at stake ☐ Accuracy standards were too strict
☐ Too much time had passed ☐ Other: ______________________
☐ Wasn't worth coming back to campus for $10 (if in MP+BI group only)

Appendix AA

Participant Debriefing Script

Participant Debriefing Script

(To be read by the experimenter upon completion of the study, after the Participant Exit Interview.)

Many business schools across the country teach students how to improve organizational performance by "streamlining" processes. In essence, they seek to reduce the number of steps a person a must go through to produce a product or deliver a service. This is done by eliminating unnecessary steps, combining steps, improving communication between steps, or by utilizing technology to make a process more efficient. In this method of performance improvement the ultimate focus is on the ***way*** the product or service is delivered, with a less intense or sometimes nonexistent focus on the people who actually do the job.

Many psychology programs, such as the one here at WMU, also teach their students how to improve organizational performance, although the primary focus is on the ***people*** who actually do the job. As opposed to simply restructuring the work process, analyses of skills, abilities, job aids, training, consequences, and contingencies are conducted. These analyses are then used to guide human performance improvement interventions.

The study in which you have participated examined the improvement achieved under four different conditions. First, various performances were measured in an electronic process using Microsoft Hotmail as a document exchange tool. Second, performances were measured in a manual process in which participants had to come to Wood Hall to exchange documents through the experimenter and research assistants. Third, a behavioral intervention consisting of a job aid and monetary incentives was added to both the electronic and manual processes.

The task of copying a text was chosen as it provided the experimenters with a means of equating participant performance on the task, while altering process variables and human performance variables across ***equated*** groups, thereby adding reducing variability between groups to gain a more sensitive measure of the independent variables. The task was also chosen because it is very common to have multiple people work on documents in a collaborative fashion, which adds social validity to our findings.

At this point in time data are still being collected and analyzed, and so the final results of this study have not yet been calculated. You may contact the experimenter in the Spring semester of 2004 if you would like to meet to discuss the results of this experiment.

Lastly, this experiment is ongoing. Please do not discuss the details of this study with your friends or anyone in your classes. Also, please erase any experiment-related files that you may have in your possession and do not share any of your experimental materials with anyone.

Thanks again for your participation.

	Manual Process (MP)	**Electronic Process (EP)**
No Behavioral Intervention	Condition 1 (MP)	Condition 3 (EP)
Behavioral Intervention (BI)	Condition 2 (MP+BI)	Condition 4 (EP+BI)

*Explain all conditions to the participant and which condition they were in. Also explain the intent behind the behavioral intervention and the process improvement intervention.

Appendix AB

Data Recording Form

Data Collection Sheet

Condition (Select One): ☑ MP ☐ MP+BI ☐ EP ☐ EP+BI

Group Number: 2

Participant 1: John Participant 2: Jim Participant 3: Mary

Group began on: ________________ at 9:00 AM.

Primary Observer

Participant Information		Dates / Times (in possession)		Primary Observer			Total Minutes in Possession*,**		
Participant Name	Part. No.	Drop off Date	Drop off Time	Observer Name (Primary)	Observer Name (Agreement)	A / D?	Primary Observer	Secondary Observer (Min.)	A / D?
John	1								
Jim	2								
Mary	3								
						Group Average:			

Agreement Observer

Participant Information		Dates / Times (in possession)		Agreement Observer	Total Minutes in Possession*,**	
Participant Name	Part. No.	Drop off Date	Drop off Time	Observer Name	Observer Name	Number of Minutes
John	1					
Jim	2					
Mary	3					
					Group Average:	

Instructions / Notes

1) Both observers should record the date and time that each participant returns the experimental materials. Although a graduate student or anyone in lab can be an agreement observer for Time in Posssession, another RA should be the agreement observer for Minutes in Possession.

2) An experimenter or RA should sign in the primary observer column, write in the name of the agreement observer for that observation, and write an "A" for agree or "D" for disagree in the following column.

3) A primary observer should calculate the total number of minutes a participant had the materials in his or her possession, and a secondary observer should do the same (The secondary observer should be another RA, please do not ask a graduate student to perform these calculations). The primary observer should also write an "A" for agree or "D" for disagree in the following column.

*Only minutes occuring from 9:00 AM to 5:00 PM, Monday-Friday should be counted.
**In this framework, a single weekday (Mon.-Fri.) equals 480 minutes, whereas a weekend day (Sat.,Sun.) equals 0 minutes.

Appendix AC

Hotmail Reliability Test Results

Tests Conducted Using the Hotmail System to Ensure Timely Delivery of Messages

Tests were conducted using the Hotmail system to ensure timely delivery of messages from an experimenter to a participant, or from participant to participant. Ten tests were run under each condition on April 22, 2003. Each condition is described below.

Condition 1: Documents containing the images of the text to be copied for participants 1, 2, and 3 were attached, as well as the document FINAL PRODUCT, totaling 986 KB for the message and all attachments.
Condition 2: Documents containing the images of the text to be copied for participants 2, and 3 were attached, as well as the document FINAL PRODUCT, totaling 666 KB for the message and all attachments.
Condition 3: A documents containing the images of the text to be copied for participant 3 was attached, as well as the document FINAL PRODUCT, totaling 349 KB for the message and all attachments.
Condition 4: The document FINAL PRODUCT was attached, totaling 27 KB for the message and the attachment.

Two independent observers agreed on the times that the messages were sent and received using MIME email information on 100% of the tests. Each test had 0 seconds delay from when the message was sent from one Hotmail account and when it was received by another Hotmail account.

Condition 1			Condition 2			Condition 3			Condition 4		
Sent	Received	Agree	Sent	Received	Agree	Sent	Received	Agree	Sent	Received	Agree
13:04:48	13:04:48	Yes	14:15:13	14:15:13	Yes	14:35:19	14:35:19	Yes	13:05:49	13:05:49	Yes
13:49:02	13:49:02	Yes	14:20:22	14:20:22	Yes	14:36:16	14:36:16	Yes	13:06:59	13:06:59	Yes
13:47:41	13:47:41	Yes	14:21:08	14:21:08	Yes	14:36:50	14:36:50	Yes	13:07:25	13:07:25	Yes
13:54:19	13:54:19	Yes	14:21:55	14:21:55	Yes	14:37:31	14:37:31	Yes	13:07:57	13:07:57	Yes
13:57:40	13:57:40	Yes	14:26:25	14:26:25	Yes	14:38:20	14:38:20	Yes	13:08:41	13:08:41	Yes
14:02:12	14:02:12	Yes	14:27:22	14:27:22	Yes	14:44:15	14:44:15	Yes	13:12:45	13:12:45	Yes
14:03:40	14:03:40	Yes	14:28:12	14:28:12	Yes	14:44:53	14:44:53	Yes	13:13:13	13:13:13	Yes
14:09:16	14:09:16	Yes	14:31:17	14:31:17	Yes	14:45:24	14:45:24	Yes	13:13:38	13:13:38	Yes
14:10:21	14:10:21	Yes	14:31:58	14:31:58	Yes	14:46:00	14:46:00	Yes	13:14:07	13:14:07	Yes
14:13:56	14:13:56	Yes	14:32:39	14:32:39	Yes	14:46:50	14:46:50	Yes	13:14:33	13:14:33	Yes

***Sent** is the time an email was sent from a sender account; **Received** is the time the same email was received by the recipient account; **Agree** (Yes or NO) represents an instance where two independent observers agreed on both the send and receive times.

Appendix AD

Instructions for IOA Calculation Procedures

Interobserver Agreement Instructions Form

(Instructions to be used for calculating interobserver agreement)

Minutes in Possession: Whenever two observers are present to confirm the time a participant picks up or drops off materials in room 2530 or 2510 Wood Hall, the primary observer should write in the drop-off date and drop-off time, and sign in the primary observer box designated for that participant. A secondary observer (anyone else that is present) should also record the relevant information in the table designated for the agreement observer. The primary observer should then write the agreement observers' name in the appropriate box and then write an "A" for agree or "D" for disagree in the box on the same row in the following column. For documents forwarded via email the experimenter will record such times on a data collection sheet and have an independent observer collect the same data from the MIME headers on the email message before it is deleted. Two observers (both part of the experimental team) should also calculate the number of minutes in possession independently, write them in on the data collection form, and indicate whether there was agreement or disagreement using an "A" and "D" as described above.

Number of Errors: The number of errors will be assessed by two independent observers. Two reviewers should review each participants work products and record the errors on the error recording form. Next, use the IOA calculation form to identify any discrepancies between the two observer assessments.

Non-completion Rate per Group: When a participant has exceeded his or her 2,400 maximum of minutes in possession and the drop-off information for that participant has not yet been filled out on the data collection form, write "Overdue" in the drop-off date and drop-off time boxes, and obtain agreement from another observer that the materials are indeed overdue.

Appendix AE

Participant Error Recording Form

Error Recording Form

(Table to be used for recording participant errors)

Please use the table below to document the page / line number and error identified. Also turn in a hard copy of the work product with the error circled. All of the potential errors to be counted are listed below the table. Please use additional sheets if necessary.

RA Name:____________________ Condition: ____________ Group Number: ________

Participant 1:			Participant 2:			Participant 3:		
Page / Line Number	Error	# of Char./ Keystrokes	Page / Line Number	Error	# of Char./ Keystrokes	Page / Line Number	Error	# of Char./ Keystrokes

Errors include the following (one error per incorrect character): 1) Improper capitalization, 2) Improper use of an apostrophe ('), 3) Improper use of quotation marks (" "), 4) Improper use of parenthesis ( ), 5) Improper use of a comma (,), 6) Improper use of a colon (:), 7) Improper use of a semicolon (;), 8) Incorrect spelling, 9) Text that is not 12 point font, 10) Text that is not Times New Roman, 11) Improper spacing (i.e., having two spaces after a word or only having one space after an end punctuation mark, such as a period), 12) Missing words, and 13) Words unnecessarily added.

Appendix AF

Inter-observer Agreement Calculation Form

Interobserver Agreement for Errors Form

(Table to be used for calculating interobserver agreement for errors)

Participant Name:____

Condition: ________________ Group Number: ______________ Participant #:________

Observer One: _______________________ Observer Two: _______________________

Form completed by: __________________

Please use the table below to document the page / line number and error identified. Also turn in a hard copy of the work product with the error circled. All of the potential errors to be counted are listed below the table. Please use additional sheets if necessary.

Errors		**Observer 1 # of characters**	**Observer 2 # of characters**	**Absolute difference between columns 3 & 4**
Page/Line	**Error**			
	Total:			
			Total:	

Appendix AG

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