Production Report System Improvement for Saint Gobain Abrasives, Shanghai Operation

A Major Qualifying Project Report:
submitted to the Faculty of the
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfillment of the requirements for the
Degree of Bachelor of Science
by

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Date: July 31, 2007

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Abstract

The goal of this project is to help St. Gobain Abrasives Shanghai Operation better utilize its Enterprise Resources Planning production data. The development of a custom built, third party software extension which was designed to support lean manufacturing initiatives will help improve manufacturing quality by identifying problem areas in the production cycle, and will eliminate waste in the form of time spent on data analysis, by St. Gobain employees.

Acknowledgements

We would like to thank the several people and accompanying organizations for the support and guidance throughout the course of the project. First off we would like to thank our advisor Professor Kevin Rong from Worcester Polytechnic Institute for providing this amazing experience and guiding us along the way. We would like to thank the following people our host university, Huazhong University of Science and Technology, in Wuhan, Hubei Province, China: Professors Gao Liang and Liu Shipping for their insight and suggestions for our presentations, and Dr. Qiu Haobo for advising us so much and accompanying us to the company. We would like to thank the following employees of Saint-Gobain Abrasives Shanghai for providing this challenging project that we have worked so hard on: Mr. Tong Youyue, the plant manager, for coming up with this unique project and overseeing the process of building the database, Miss. Lv Jing and Mr. Shen Yijun for providing guidance on the more complex database issues specific to Shanghai, and Miss. Tu Zhuoxia for answering our countless questions promptly.

Table of Contents

1. Introduction

In recent years many corporations have employed Enterprise Resource Planning (ERP) and Manufacturing Resource Planning (MRPII) systems as tools to make business decisions. These systems rely heavily on IT solutions to collect, store and analyze data. ERP systems monitor all business resources (accounting, sales, warehouse inventory, personnel etc.) to maximize effectiveness, and reduce waste in all sectors of the business.

In the case of manufacturing, ERP and MRPII systems are utilized in many ways. They can be used to schedule manufacturing orders, monitor progress on individual orders, monitor quality, track amounts of available raw materials, and determine pricing for orders. The amount of data that can be stored using ERP systems and the resources that have been developed to interpret this information is great.

Based on the capabilities of ERP systems, they are often thought to be the ultimate solution for businesses. However these systems cost a great deal of money, time, and business reorganization for the maximized results, and more often than not the implementation of these systems are not considered to be effective. Further the effectiveness varies between cultures, and research has shown that despite the high amount of manufacturing operations in China, the effectiveness of these implementations is very low.

St. Gobain Abrasives, Shanghai manufactures 4 product lines; Vitrified and Resinoid bonded abrasives, Rubber bonded abrasives, coated abrasives, and construction products. The Shanghai operation located in the Minghang development of Shanghai has utilized the SAP R/3 ERP system since the summer of 2005. This system has collected all the manufacturing data for their system since that point. While this data has been collected, they have no tool to interpret and display the data in a clear concise manner and do not have an effective way to identify

problem areas in the manufacturing system. Other St. Gobain facilities have used tools such as Microsoft Access databases to interpret, and display manufacturing data. While St. Gobain Shanghai have these databases, the systems are not relevant to the Shanghai operation.

The goal of this project is to develop a production report system that will utilize the data collected by the SAP R/3 system to help in the areas of production planning, rejection analysis, and overall waste removal from the production cycle. For this the development of a database to collect the SAP R/3 raw output data is necessary. To make this database effective and useful it will include reports that will present information in graphical, easily understood manner.

While ERP systems are useful tools for making scheduling and other business decisions as well as identifying problem areas in Lean Manufacturing systems, they are useless without the proper tools to interpret the data.

2. Background

In order to perform a reliable analysis and propose constructive recommendations for Saint-Gobain, an understanding of the background information and material must be obtained. We looked at the history of Saint-Gobain in regard to its company history and its abrasive process histories. A study of manufacturing principles, specifically lean manufacturing, was conducted. In addition, an in-depth look at specific grinding wheel manufacturing processes was performed. Further, to better understand production report systems, research on the topic of Enterprise Resources Planning was performed to understand better, the type of system that is currently in place, and to better identify the problem areas.

2.1 Saint-Gobain Company Profile

Since it's founding in 1665, St. Gobain has been known world wide as "The materials mega-group[1]" who manufacture a wide range of products which include, flat glass, abrasives, ceramics, plastics, packaging, and building materials, which include glass insulation, cast iron pipe, mortar and exterior products, and is a worldwide leader in nearly all sectors of it's business[2]. Further St. Gobain operates in more than 50 countries worldwide with a workforce of more than 200,000. St. Gobain has been heavily involved in the abrasives industry since it's 1990 acquisition of Worcester, Massachusetts based Norton Company[3]. Currently St. Gobain is the world leader in abrasives.

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[1] "Compagnie De Saint-Gobain Company Profile - Yahoo! Finance," [cited 2007]. Available from http://biz.yahoo.com/ic/40/40729.html.
[2] "Saint-Gobain Business Sectors," [cited 2007]. Available from http://www.saint-gobain.com/en/html/groupe/metiers.asp.
[3] "History of the Saint-Gobain Group." [cited 2007]. Available from http://www.saint-gobain.com/en/html/groupe/historique.asp.

2.2   Shanghai Operations

Saint-Gobain Abrasives Co., Ltd. manufactures four types of abrasives in Shanghai, China. It was established in 1994 and currently has 800 employees at two plants located in Minhang Economic and Development Zone and one remote plant in Dongguan, South China.[4] The plants and products are of the highest quality mandated by its ISO 9001 Certification and following or exceeding industrial standards like GB, JIS, and ANSI.[5] Saint-Gobain Abrasives provides high-quality technical support for its products as well as on-site tests.[6] The Shanghai plants are a sub company of Saint-Gobain Abrasives, which has been present in China since 1985 and is a division of the world's leading manufacturer and distributor of abrasives products and systems[7].

2.3   Abrasives Overview

Abrasives are defined as "small, non metallic hard particle[s] with sharp edges and irregular shape … and are capable of removing small amounts of material from a surface through a cutting process that produces tiny chips.[8]" Within the classification of abrasives are three subcategories: bonded abrasives, coated abrasives, and superabrasives. Saint-Gobain is the only international company to produce all three types of abrasives.[9] Each produce different types of abrasives parts and tools and are utilized in various industries.

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[4] "Saint-Gobain China - Jobs," [cited 2007]. Available from http://www.saint-gobain.com.cn/html/jobs/trainees_abrasives.htm.
[5] "Saint-Gobain Abrasives Shanghai - Home," [cited 2007]. Available from http://abrasives.saint-gobain.com.cn/.
[6] "Saint-Gobain China - Jobs,"
[7] "Saint-Gobain Abrasives (Shanghai) Co., Ltd." [cited 2007]. Available from http://www.saint-gobain.com.cn/html/companypages/Abrasives_SH.htm.
[8] Serope Kalpakjian, *Manufacturing Engineering and Technology,* Reprint with corrections, November 1989d ed. (Reading, Mass.: Addison-Wesley, 1989), 1199, 8, 19. 88024219; ocm18379052.
[9] "Saint-Gobain Abrasives (Shanghai) Co., Ltd."

2.3.1   *Bonded Abrasives*

The first type of abrasives is bonded abrasives. It consists of grinding wheels, sharpening stones, and mounted points. These perform roughing, precision grinding, and sharpening of materials and tools. These processes are used in the aeronautics, automotive, metals processing, mechanical bearings, and iron and steel industries. Some competitors of St. Gobain in the area of bonded abrasives are Carbo plc of the United Kingdom, Noritake of Japan, and Tyrolit of Austria.[10] Wheel grinding and cutting-off wheels perform cutting and trimming, which can be used in the metals processing, maintenance, energy, iron and steel, construction, and home improvement industries.[11]

Most are familiar with various bonded abrasives typically in the form of grinding wheels and sharpening stones, and these abrasives have a wide variety of uses in manufacturing processes. Bonded abrasives are material removal tools that feature an abrasive grain suspended and held together in a matrix of bonding materials. Abrasives typically come in two main forms, conventional abrasives, and super abrasives. The differences between these two forms lie both in the hardness of the abrasive, and the hardness of material that is to be cut.

2.3.1.1   Bonded Abrasive Development

The first grinding wheels were round wheels carved from naturally occurring sand stone. As manufacturing processes improved so did the need for grinding wheels capable of grinding harder materials such as steels. Natural abrasives are "generally referred to as those that have

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[10] "Saint-Gobain - Press Download Center: Financial Reports, Annual Reports, Quarterly Reports," [cited 2007]. Available from http://www.saint-gobain.de/en/presse/download_center/finanzberichte.html?pe_id=38.Saint-Gobain Annual Report 2004, p.7.
[11] Ibid.Saint-Gobain Annual Report 2004, p.7.

been produced by the uncontrolled forces of nature.[12]" Due to impurities and general inconsistent quality few naturally occurring abrasives are still used. A few of the primary natural abrasive still in application include Crocus, Corundum, Emery and Diamonds. Crocus is naturally occurring as well as in the form of manufactured iron oxide. It is a very fine powder and is used to polish and remove corrosion from precision instruments, where a minimal amount of material removal is desired[13]. Corundum is naturally occurring Aluminum Oxide, and is a desirable abrasive material that is capable of bonding with ceramic and pottery materials[14]. Emery has many components, the most significant of which is corundum, or Aluminum Oxide, Al_2O_3. Due to overall inconsistency of emery grains, emery is seeing fewer and fewer applications in manufactured abrasives.

The first manmade bonded abrasive grinding wheels were made from Emery around 1864[15]. With this development manufacturers were able to sharpen and hone metals with greater consistency and accuracy. Also there came an increasing need for harder, more consistent abrasives to keep up with the developments being made both in manufacturing processes, and advances in the areas of materials science and metallurgy. Synthetic, manufactured abrasive grains were the answer.

2.3.1.2 Synthetic Bonded Abrasives

Synthetic bonded abrasives are abrasive grains that are manufactured in controlled environments. These are desirable for bonded abrasives as they provide consistent grain size,

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[12] Stephen F. Krar, *Grinding Technology,* 2ndd ed. (Albany: Delmar Publishers, 1995), 3. 94002612; (OCoLC)ocm29668542; (OCoLC)29668542; 263946.
[13] Ibid., 3.
[14] Ibid., 3.
[15] Johnson Heywood and Grinding Wheel Manufacturers Association, *Grinding Wheels and their Uses; a Handbook and Textbook on Modern Grinding Practice and Theory,* 2d ..d ed. (Cleveland, O.: The Penton Publishing Co., 1942), 2. 43001119; (CaOTULAS)150749108; ocm00563221 820217.

and are largely free of impurities. The most common synthetic abrasives include silicon carbide, aluminum oxide, cubic boron nitride (cBN), and manufactured diamonds.

2.3.1.3 Characteristics of Bonded Abrasives

There are four main types of bonded abrasives; Vitrified, Resin Bonded, Rubber Bonded, and Metal Bonded abrasives, which are typically reserved for superabrasive applications. For the first three types the abrasive grain is typically mixed with the respective bonding agent, and then molded and pressed into their respective shapes.

Vitrified bonds are typically made of clay or feldspar. This type of bond has to be heated to a high temperature to fuse the bond and the abrasive material. When cooled the bond forms a glass like structure. This structure has good hardness and rigidity, but also allows the bonds to break easily and fracture when the forces become too great, or the grain becomes dull. This property allows the grinding wheel to continually sharpen. Other advantages to vitrified bonded abrasives are their hardness, and compatibility with cutting fluids[16].

Resin bonded abrasives are very similar to vitrified abrasives. Instead of a clay or feldspar based bonding agent, resins are used. These resins are most commonly mixed in powder form, mixed with the abrasive grain, molded and pressed. Once pressed, the resin bonded abrasive must be cured in a process similar to annealing, where the green mold is heated and cooled gradually. When baked, the green mold softens, and then hardens once it reaches its curing temperature, and retains this hardness when it cools back to room temperature. Typically these curing processes take nineteen to upwards of forty-eight hours. Advantages to these types

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[16] Stuart C. Salmon, *Modern Grinding Process Technology,* (New York: McGraw-Hill, 1992), 26. 91045421; ocm25026549.

of wheels are their ability to operate at higher speeds than vitrified wheels, but drawbacks

include their incompatibility with cutting fluids[17].

Rubber bonded abrasives mix the abrasive grain into a synthetic or natural rubber. Sulfur

is added to vulcanize, or harden the mix. The mix is then rolled into sheets, and the wheel

profiles are cut out, and vulcanized. Rubber wheels are utilized because of their ability to be

made very thin, and are used in applications with tight tolerances or requiring good surface

finish.

2.3.2 *Coated Abrasives*

The second type of abrasives is coated abrasives. It consists of belts, disks, rolls, and

sheets for sanding and finishing. These surface treating parts are used in the aeronautics,

automotive, furniture, portable machines, steel, jewelry, watchmaking, and biomedical

industries. Some competing companies are 3 M of the United States, Hermes of Germany, and

Klingspor of Germany.[18]

2.3.3 *Superabrasives*

The third and final, superabrasives consist of diamond-edged grinding wheels, diamond

saw blades, and CBN products. These products are then used for precision glass products, and

building materials. In addition superabrasives are used in aeronautics, automotive, bearings,

cutting tools, electronics, composite, and materials industries. Competing companies for

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[17] Ibid., 30.
[18] "Saint-Gobain - Press Download Center: Financial Reports, Annual Reports, Quarterly Reports," Saint-Gobain Annual Report 2004, p.7.

superabrasives are Asahi of Japan, Diamant Boart of Belgium, Noritake of Japan, and Wendt

Boart of Belgium.[19]

2.4 Lean Manufacturing

Lean manufacturing is the analysis and elimination of waste in every aspect of the

process to create a product. In this project we will be examining what constitutes lean

manufacturing and its analysis in the realm of manufacturing grinding wheels. Lean

manufacturing strategies are important for any manufacturing process, since it increases profits,

decreased work in progress, less operation time needed, more production capabilities, and less

stock required to make the same product.

2.4.1 *Wastes*

Lean manufacturing principles are implemented by reducing sources of waste in the

production cycle from order to delivery. Waste is process or step that does not add value to the

finished product.[20] The main kinds of waste are:

- Overproduction
- Waiting time
- Inventory
- Transportation in the manufacturing cycle
- Product defects
- Unnecessary Motion
- Product processing[21]

Removing waste increases higher product quality, increased profits, and improves

delivery efficiencies. In Michael Regan's The Kaizen Revolution each kind of waste is

explained in depth and why it is considered to be a waste.

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[19] Ibid.Saint-Gobain Annual Report 2004, p.7.

[20] Kalpakjian, "Manufacturing Engineering and Technology," 37.
[21] Ibid., 38.

Overproduction is when more products are produced than can be sold and therefore leaves unsold inventory on shelves, which causes a storage cost and delays when it is sold. Products should be produced in a just-in-time environment for maximum theoretical efficiency. If overproduction is occurring then work-in-progress at each stage, including the final, the end product is sitting in inventory creating wastes. [22]

Waiting time occurs when workers cannot perform their job at that moment because for whatever reason. For example, if one task takes one minute and another takes one and a half minutes and one worker is performing each task in a line there will be one half wasted minute every cycle of tasks. Waiting is a fairly common waste and it happens to be one of the easier to reduce. Waiting can occur if workers are not motivated to work quickly enough to prevent waiting.. All processes must add value to the product being manufactured. Since waiting does not add value it must be removed.[23]

Inventory, like overproduction, creates the need for storage and shelving, which have associated costs. Inventory can also be interpreted as waiting, in that the product or work in process (WIP) is waiting to be moved or sold. Relocating products to and from storage are unneeded and non-necessary steps and create transportation waste. [24]

Transportation takes time and energy and thus is non-value adding. The less transportation that occurs, then the less waste occurs. Manufacturing plants should be laid out in such a manner that forms work cells that create the least amount of transportation needed between both raw stock, and process cells. [25]

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[22] Michael D. Regan, *The Kaizen Revolution : How to use Kaizen Events to Double Your Profits,* (Raleigh, N.C.: Holden Press, 2000), 246. (OCoLC)ocm45009569.
[23] Ibid.
[24] Ibid.
[25] Ibid.

Unnecessary motion causes waste also. Motion consists of unnecessary movement by employees or robots. Employees or robots moving around, like transportation for the product, are not a value adding activity. For example a worker puts pieces together picking them up from different bins in a large area around him, instead of all the parts already correlated into a pile of everything he needs right in front of him. Product processing causes waste since additional processing requires time and therefore money as well.[26]

Unnecessary product processes are defined as any process that is not value adding. For instance, mandating a very precise size with low error when it doesn't need to have that level of precision creates waste.[27] Product defects are a very obvious form of waste. When a defect occurs, the part can either be thrown away or repaired, both of which require wasted time and money.[28]

2.4.2 *Ingredients of Lean*

The goal of lean is to reduce waste; utilizing lean ingredients is how to get there. Following these ingredients is key in implementing lean manufacturing. The Kaizen Revolution defines the following eight ingredients:

- Just-in-time production
- Continuous one piece flow
- Work cells
- Setup reduction
- Preventative maintenance
- Kanban
- Workplace organization and cleanliness
- Standard work
- Teams[29]

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[26] Ibid.
[27] Ibid.
[28] Ibid.
[29] Ibid.

Just-in-time production produces products relative to demand. So that when an order is made with a completion date the product is manufactured and produced on time and not before. The just-in-time ingredient helps combat waste from overproduction and inventory.[30]

Continuous one piece flow is when raw material is processed constantly and becomes a final product without ever becoming stock, or having to wait excessive periods of time between processes. This will reduce waste from overproduction, inventory, transportation and defects. However, overproduction might increase waste from waiting time due to the decreased buffer, due to the lack of stock.[31]

Work cells are groupings of machines and processes that produce a product family. This allows for better micro-management and efficiency as well as reducing the waste from motion and transportation sources. [32] Setup reduction allows machines to be switched between different uses in shorter amounts of time and less required effort. Setup reduction also includes the amount of steps necessary to prepare a work piece to be machined in a single process. This allows for flexibility in manufacturing different batches or products as opposed to an entire setup built for a specific manufacturing process, or product exclusively. To prevent waste created by this lean ingredient it is necessary to finish orders in complete batches before changing machine setup. Waste can be in the form of motion, product processing, and waiting time.[33]

Preventive maintenance is to maintain machines nd equipment such that they don't break down. This will guarantee that the machines will be continually working. Preventive

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[30] Ibid.
[31] Ibid.
[32] Ibid.
[33] Ibid.

maintenance prevents wastes from waiting time, during downtime associated with defects, and reduces defects themselves. [34]

Kanban is the use of clearly marked areas for raw stock and work in progress to be placed along the process line while waiting for the next process to be done. This creates stock, which is a waste, but it also allows a near continuous state of manufacturing since it eliminates potential waiting time by making sure every process has materials to work on.[35] It also reduces unnecessary motion by having an area to store necessary materials that is close to the work cell. The marking system for the Kanban area allows for easy notification that either a raw material is running out and needs to be replaced, or that there are orders in the queue that need to be processed.

Workplace organization and cleanliness is necessary to reap the benefits of a healthy, safe, and productive environment for its employees and programs. The Japanese created five terms known as the 5Ss to represent the different factors in this ingredient. They are Seiri, Seiton, Seiso, Seiketsu, and Shitsuke that translate into English sort, straighten, scrub, schedule and score, respectively. Sort means limiting tools in the work cell, and equipment on the shop floor, to only those tools and equipment that are absolutely necessary. Straighten means ordering everything into their respective places, and returning items to their homes after each use. Scrub means maintaining cleanliness, both in the work cell and in the manufacturing plant as well. Scheduling is maintaining a timetable for the other three Ss to be performed to promote good routines. Score means to rank how well the first three Ss (sort, straighten, scrub) are performed.[36]

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[34] Ibid.
[35] Ibid.
[36] Ibid.

Standard work ensures that the best way to perform a process is the way it is performed each time resulting in both efficiency and consistency. If a superior method of performing the process is found to exist then the process will change.[37] Teams allow issues to become apparent quickly, by having several people look at the same problems with a reduction of several different wastes.[38]

2.5 Quality Measurement and Report System

To ensure a reliably high level of quality for its products, companies must have a quality monitoring and reporting system in place. Their accreditation in ISO 9001 Certification and other industrial standards depend upon it. All profits are impacted by quality. For example, every instance of a product not fitting specifications or failing a replacement decreases profit. At this point, we know that there is a quality monitoring and reporting system in place in the Saint-Gobain Shanghai Abrasives plant, however we are unaware how successful it is, other than their wish for it to be improved.

2.6 Integrated Manufacturing Systems in China

In the past 20 years the level of manufacturing production in China has increased dramatically. This stems both from the availability of cheap land and labor for foreign manufacturing firms looking to open Chinese manufacturing plants, and the inclusion of private, non state owned manufacturing companies in China. Inclusion of western business culture on manufacturing firms in China created an environment with competitive wages, not a standard wage for everyone, and promotions based on performance and experience, not simply on seniority, change the working culture. Along with these developments came the demand for

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[37] Ibid.
[38] Ibid.

increased quality which led Chinese manufacturing firms to look toward integrated

manufacturing systems for possible answers.

Integrated manufacturing systems rely on several factors; Total Quality Management

(TQM), Real Time Monitoring Systems (RTMS), Manufacturing Execution Support systems

such as Manufacturing Resource Planning (MRPII) and ERP, and Manufacturing Technology.

TQM is an organizational culture that promotes total overall quality, and as little waste as

possible. Real time monitoring systems and manufacturing execution support systems are

typically bundled together in the form of MRPII and ERP systems. MRPII and ERP systems are

tools that can help support TQM in an organization, by developing a scheduling system that

utilizes the resources of the manufacturing system to their greatest effectiveness.

While integrated manufacturing systems are thought as the ideal manufacturing system,

Chinese corporations have had a great deal more difficulty implementing these systems than

their western counterparts[39]. These difficulties stem from many different sources which vary

from organization fit with ERP systems, to the cultural differences that exist between the

companies that build the integrated manufacturing tools, and the organizations that use them in

other countries.

2.7   Manufacturing Execution Support Systems

While the integration and optimization of manufacturing ordering, scheduling, and

production, has grown rapidly in the last decade, due in part to the advances made in information

technology, its beginnings date back to the 1960s when "inventory control concepts such as

reorder point system, customized software packages were designed to suit the requirements of

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[39] Zhe Zhang et al., "A Framework of ERP Systems Implementation Success in China: An Empirical Study," *International Journal of Production Economics* 98, no. 1 (10/18 2005): 56-80.

manufacturing companies.[40]" In the 1970's, the focus shifted to a practice called material

requirement planning (MRP). This practice planned manufacturing processes by scheduling

orders. This was done in order to control work in progress through proper timing of order

placement. As technology advanced, so did the complexity of the scheduling and manufacturing

control systems.

With increased integration in manufacturing comes the need for increased coordination

between business and manufacturing processes. Manufacturing Execution Support Systems

(MES) are systems which are equipped to collect and store all pertinent information from the

manufacturing and business processes. "It is the purpose of an integrated manufacturing

execution system to give support to the specific tasks and to collect all information from these

tasks in a common database."[41]

2.7.1   *Enterprise Resource Planning (ERP)*

As the globalization of manufacturing and production has increased, so have expectations

of customers for quickly delivered, quality parts. This need saw the development of practices

such as lean principles, total quality management (TQM), and just-in-time (JIT) practices, to

produce products as efficiently as possible with as little waste as possible. With the development

of computer technologies, came the further development of production planning methods which

led to the development of Enterprise Resource Planning[42].

> ERP systems are the software tools used to manage all the enterprise data, and to
> provide information to those who need it when they need it. These systems help
> organizations deal with their supply chain: receiving, inventory management,
> customer order management, production planning and managing, shipping,

[40] Mahesh Gupta and Amarpreet Kohli, "Enterprise Resource Planning Systems and its Implications for Operations Function," *Technovation* 26, no. 5-6 (2006/0)

[41] Andreas Schumann, "SAP-R/3 in Process Industries: Expectations, Experiences and Outlooks," *ISA Transactions* 36, no. 3 (1997): 161-166.

[42] Gupta and Kohli, "Enterprise Resource Planning Systems and its Implications for Operations Function,"

accounting, human resource management, and all other activities that take place in a modern business (Davenport, 1998b).[43]

This is achieved in ERP with the usage of modules. Modules measure and control different functional areas of the entire system, and then incorporate this data into the main ERP database. Examples of these modules are:[44]

- FI – Financial Accounting
- CO - Controlling
- QM – Quality Management
- MM – Materials Management
- PP – Production Planning
- SD – Sales and Distribution
- PM – Plant Maintenance
- HR - Human Resources
- CA – Cross Application
- PO – Production Order Management

These operate to measure and report various aspects of the process to develop optimized production schedules.

2.7.1.1 SAP – R/3

The most popular ERP system among manufacturing industries is SAP – R/3. It has been implemented at Saint-Gobain Shanghai plants. One of the reasons SAP is very popular is due to its production logistics suite which is based on Manufacturing Resource Planning (MRPII).

> [SAP]…is able to create a master schedule due to its integration of sales forecasts, customer orders (sales and distribution), production using MRP, and procurement using materials management module. Further, Total Quality Management (TQM) is promoted using the quality management module[45].

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[43] Toni M. Somers and Klara G. Nelson, "The Impact of Strategy and Integration Mechanisms on Enterprise System Value: Empirical Evidence from Manufacturing Firms," *European Journal of Operational Research* 146, no. 2 (2003/4/16)

[44] Gupta and Kohli, "Enterprise Resource Planning Systems and its Implications for Operations Function,"

[45] Ibid.

Further SAP has many other capabilities in the areas of enterprise planning, which control production planning based on projected sales and human resource management. Another area where it is superior to its competitors is in product development, where SAP can prevent the manufacture of products that may be too expensive or unreasonable to manufacture. Production logistics such as JIT, which seeks to minimize inventory, and TOC, the theory of constraints which manages bottlenecks. Procurement techniques are easily determined by SAP, which determines quantities of raw material, and suppliers with reputations for providing quality raw materials.

SAP is a very powerful tool for the development of flexible production systems. SAP is able to process through financial, human resource, and manufacturing cycles to pick the manufacturing configurations and scheduling that will use the manufacturing to its greatest potential with the least amount of waste. By identifying areas where the process is unnecessarily slowed we will be able to improve the overall effectiveness of this manufacturing system.

2.7.2 *Implementation Problems with ERP systems*

As the technology developed for companies to build their own ERP and production planning system, so did the market of prepackaged ERP solutions. These became very popular for several reasons, but largely due to the time, cost, and effort that a company must expend to design, build and implement such solutions on their own. Other factors that leant to the popularity of these systems were built in analysis software tools that came with many of the packages. While these generic ERP systems seemed like the easy way out for many manufacturing firms, they also came with many implementation struggles and unforeseen costs, and one study suggests that nearly ¾ of all firms implementing ERP packages consider them to

be failures[46]. Simply put "An ERP implementation failure may be fatal to a firm: either wasting enormous sums of money or destroying the competitive advantage of the firm.[47]"

While there are two main approaches for aligning ERP and business system; forming the organization to fit the software, or forming the software to fit the organization, the former is often chosen. Business organizations are often molded to the ERP software, as ERP vendors fear that changing the software will adversely affect the performance of their product. Many of the problems, and failures organizations experience during ERP implementation stem from the organization's failure to understand that the implementation of an ERP package is a total business reorganization, and not simply a software installation.

Coupled with business process change to align the organization functions with ERP, ERP adaptation is necessary to fill the gap between the functions of the ERP package and the needs of the organization[48]. According to Glass, ERP Adaptation can be broken into three categories; customization, extension, and modification[49]. Customization is the configuration of the software to meet the needs of the organization without changing the source code of the ERP package. Extension utilizes third party tools to interpret the raw ERP data; this method fills the gap between the functionality of the ERP package and the needs of the organization. Modification alters the source code of the ERP system, and is the highest level of ERP adaptation.

Despite the potential gains that manufacturing organizations stand to benefit from through the implementation of ERP systems, there is still a great deal of difficulty implementing

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[46] Kyung-Kwon Hong and Young-Gul Kim, "The Critical Success Factors for ERP Implementation: An Organizational Fit Perspective," *Information & Management* 40, no. 1 (2002/10)
[47] Ibid.
[48] Ibid.
[49] Ibid.

these systems effectively. Without the proper preparation on the part of the Managing

Executives of the firm, implementation time frames and budgets can spiral out of control.

2.8 Previous WPI/HUST Saint-Gobain Project

A Worcester Polytechnic Institute student, Nakhoon Kim, and two HUST students, Emily

Lv and Young Xu, worked for Saint-Gobain in 2006 on a project involving recommending a new

layout of one of its grinding wheel conveyor lines utilizing lean manufacturing principles. The

then current layout was an archaic linear design that was highly inefficient. Saint-Gobain had a

proposed improvement to the manufacturing process but its benefits had not been analyzed. The

student team collected data for and analyzed the then current layout, the proposed design, as well

as their own two proposed designs in terms of net gain for the company as well as their relative

feasibilities. They concluded that one of their proposed designs would most beneficial for the

manufacturing process. Saint-Gobain was pleased with the results of the application of their

recommendations.

3. Methodology

Upon arrival at St. Gobain in Shanghai, we were introduced to the company and its scope, and received more detailed information on St. Gobain Abrasives. In addition we were introduced to the products produced in the two Shanghai facilities. Along with the introductions came the project description. Beginning in the summer of 2005 St. Gobain Shanghai has been operating with the SAP R/3 ERP package, which was implemented without incident, although, not to its greatest potential. The summer of 2006 saw a Senior Major Qualifying Project by a team of students from Worcester Polytechnic Institute, and Huazhong University of Science and Technology. This project focused on redesigning the work cells on the manufacturing floor for improved effectiveness, and maximum efficiency.

This years project focuses on effective use of the SAP R/3 data. Effective use of this information has a great deal of potential in helping schedule manufacturing more effectively, and identifying problem areas in the manufacturing cycle. Currently St. Gobain has no efficient means of interpreting this data, so a third party ERP extension is necessary. We were given a Microsoft Access Database that was developed for use at the St. Gobain Abrasives manufacturing facility in the United Kingdom as an example of the functions that the Shanghai Operation would like to use. While there are more powerful and flexible means of developing a database to handle and interpret ERP data, Microsoft Access is desirable as it provides database management and development tools that do not require a great deal of programming skills, and is a flexible platform for future development. This project focuses on the development of databases for Order Tracking, Production Indicator Reports, and if time allows Rejection Analysis, based on the functionality of the UK database system.

3.1   Identification of Problem

To identify the problem, and develop a plan to for the project it was necessary to visit St. Gobain at the beginning of the project. At that time we asked many question on the current use of SAP data, and the implementation process. The visits included tours of the operation and several interviews with individuals who serve in the areas of production planning, production management, and rejection analysis. These interviews were conducted to understand the role that SAP has in the production system, and areas in the system that can be improved with the development of a third party SAP extension.

At the time of the interview we were given an Access Database that was developed for use in their UK Abrasives plant. We were asked to develop a system similar to this so that they will be able to easily and quickly obtain information regarding order loads, reject information, and order tracking information, items of information that are of great interest to St. Gobain Shanghai. In addition to the UK Access database they provided us with several spreadsheets into which planners and production managers manually input SAP data to retrieve key information for the Shanghai plant. It is the goal of this project to develop a software extension for SAP R/3 that will analyze, interpret, and display information that is critical to the improvement of the production system, and will utilize SAP R/3 data with greater effectiveness.
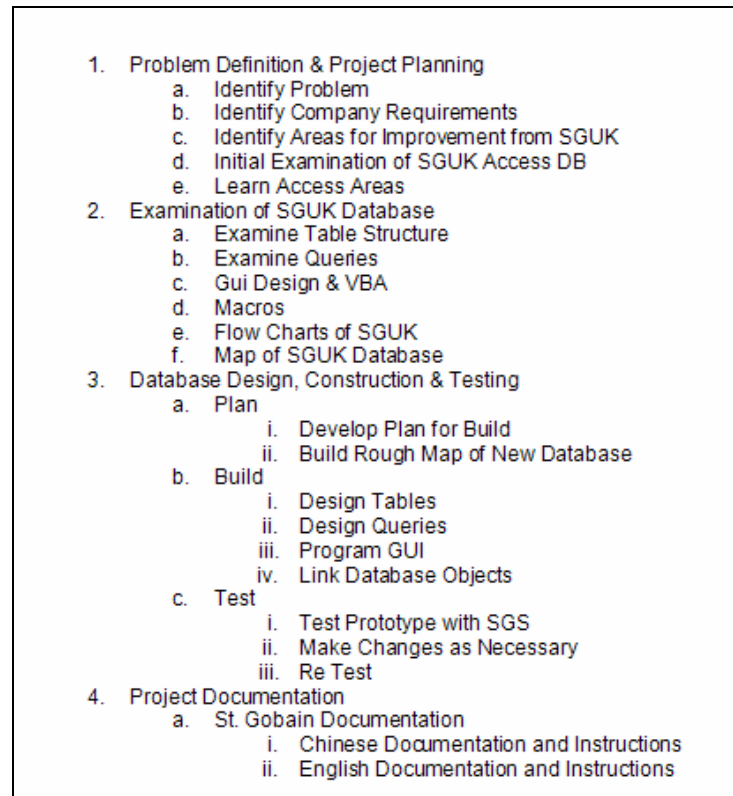
3.2   Identification of Company Needs

In order to better understand the goal of the project we first determined and analyzed the needs of the company. From our problem identification phase of the project it became very clear that the planning, production and quality managers at St. Gobain Shanghai need a tool to analyze SAP R/3 data. To complete this task we determined several steps that would guide us in identifying the company needs. These steps included:

- Functional analysis of the UK database to understand how production and planning managers at other St. Gobain facilities utilize the SAP data to improve their production

- Analysis of the Excel spreadsheets used in Shanghai to determine how the information is used currently and to identify where automation can be applied for automatic manipulation of SAP R/3 data

- Interviews to ascertain how much information they currently obtain from SAP

3.3 Discussion of Overall Project Plan

At the start of the project we discussed how we would approach this complex task. Since none of us had extensive experience using Microsoft Access, we decided that it was necessary to have both a quantitative and qualitative understanding of how the example UK database works. Coupled with this we learned those aspects of Access that would help us to understand how to build our database most effectively for the Shanghai

```
1.  Problem Definition & Project Planning
      a.  Identify Problem
      b.  Identify Company Requirements
      c.  Identify Areas for Improvement from SGUK
      d.  Initial Examination of SGUK Access DB
      e.  Learn Access Areas
2.  Examination of SGUK Database
      a.  Examine Table Structure
      b.  Examine Queries
      c.  Gui Design & VBA
      d.  Macros
      e.  Flow Charts of SGUK
      f.  Map of SGUK Database
3.  Database Design, Construction & Testing
      a.  Plan
            i.   Develop Plan for Build
            ii.  Build Rough Map of New Database
      b.  Build
            i.    Design Tables
            ii.   Design Queries
            iii.  Program GUI
            iv.   Link Database Objects
      c.  Test
            i.    Test Prototype with SGS
            ii.   Make Changes as Necessary
            iii.  Re Test
4.  Project Documentation
      a.  St. Gobain Documentation
            i.   Chinese Documentation and Instructions
            ii.  English Documentation and Instructions
```

Figure 1: Detailed Project Outline

operation. Once we developed a good understanding of the skills and steps that were necessary to build a new database we developed the outline shown in Figure 1: Detailed Project Outline. With this outline of the tasks and steps that would be necessary to complete the project we were

able to build a comprehensive schedule and accompanying Gantt chart to allow us to easily track progress and milestones visually.

3.3.1 *Problem Definition and Project Planning*

The first and most important step for this project was to quickly identify the problem, and then develop of a rigorous schedule that would allow the team to finish well within the project schedule. For this phase of the project the team spent 10 days developing and understanding the complexities of the project, and learning what skills were necessary to develop a new database that would function at least as well as the example database that was given to us by the UK facility. In this time the team split the five main areas of access, and each learned the skills that were necessary to create each set of database objects in the UK database system. By learning the skills that were necessary to create the UK system, we were able to effectively learn the necessary skills without wasting time learning skills and principles that would not be necessary for project completion. Further, by learning intimately how the database was created in the beginning of the project, we were able to make a realistic schedule that would allow us to finish the project within the given time frame.

3.3.2 *Examination of St. Gobain United Kingdom Database*

This phase of the project was crucial to the success of the project for two main reasons: examining this system would allow us to learn the skills necessary to complete the project, and it would give us a better understanding of how the information is processed in the database so that we can produce a similarly functioning database for the Shanghai operation. Simply put, the better that we understood the UK database, the easier and more efficiently the new database would be to create.

Based on our early knowledge of the complexity of the UK database we were able to develop a plan to systematically study the structure of the UK database. These steps included:

- Analysis of the UK database by using it extensively, and studying how it was intended to function

- Building flow charts illustrating the relationships between queries, tables and forms

- Mapping the UK database objects to understand the flow of information within the system

- Data analysis to understand the differences between the information that exists in the UK database, and the information provided to us by the Shanghai operation

These steps were developed in order to learn the necessary skills to develop the database for Shanghai. These steps were developed so that we would gain in our understanding in an organized, systematic manner.

3.3.2.1   Functional Analysis of Saint Gobain United Kingdom (SGUK) Database

The first step in this process was to learn about the system by using it. By using the database, while studying advanced topics would allow us to learn the system quickly as it would allow us to learn only the skills that would be necessary for the completion of the database. In this step we formulated a list of all the functions that the UK database performed and analyzed whether it was necessary for the Shanghai version. In addition to allowing us to learn more quickly, this step in the process will allow us to identify areas in SGUK that could be improved for simpler, more intuitive use in Shanghai. This step is necessary for learning the skills to create a new database, and identifying ways to make the Shanghai database most effective.

3.3.2.2   Flow Charts of SGUK Database

The next step in this process was to build flow charts to graphically represent the relationships between queries, tables, forms, and reports. By creating flow charts relating the database objects we will organize visually the function of the database on a macroscopic level. Organizing the functions visually helped to better understand how the data is stored, manipulated, and presented through the functions of the database. Understanding how each aspect of the database interacts would make the process of designing a new database much easier, with less trial and error.

3.3.2.3   Mapping of SGUK Database

We decided that coupled along with flowcharts that mapped the function of the database, it would also be necessary to create more comprehensive "maps" of the structure. This was deemed necessary due to the intricacy and interdependence of the tables and queries. By understanding the structure and functions of each of the queries, tables, and macros, we would achieve a deep level of understanding of the database functions whereas flow charts would only permit a superficial understanding of the general operation.

This phase of the project was completed by carefully studying each of the 53 queries in the SGUK database, and mapping their function, and how they stored and transferred the data within the database. By completing this section we were able to design a database that would function with greater efficiency

3.3.2.4   Data Analysis

Comparing the data in the UK database to the data provided by Shanghai allowed us to construct the backbone of the database correctly. By looking at the fields of information from

the UK and Shanghai next to each other we were able to tell to what extent the databases would

be similar. When a field was present in the UK version but not in the Shanghai version that had

relationships that a query or table relied on we had to alter the design for the Shanghai database.

In the inverse situation where there was field in the Shanghai version but not for the UK version

we looked at how we could use that data to more effectively store data and relate tables and

queries. An important note about how the Shanghai's data differed from the UK's data in regard

to how to analyze it was that Shanghai's data came in five different files and the UK's only came

in two. Knowing the data and its differences well was crucial to understanding how to build the

new database's tables and queries.

3.4   Project Schedule

In order to accomplish the goals of the project in its limited time frame it was necessary to

build a comprehensive schedule that was divided into four different phases of the project. The

phases were developed as smaller goals whose sequential completion would lead to the total

completion of the project. These phases covered the areas of:

- Problem Definition and Project Planning

- Examination of St. Gobain United Kingdom Database

- Database Design, Construction, and Testing

- Project Documentation

Based on these four phases we developed a comprehensive schedule that designated clearly the

steps that would be necessary to complete the project, as well as assigned those areas to different

individuals to distribute the work and share accountability. To organize this schedule we utilized

Microsoft project to handle scheduling and develop Gantt charts to convey visually the process

that we developed to accomplish our goals, and our schedule. Figure 2: Gantt chart of project schedule, shows this schedule that we developed to keep track project process, and to identify milestones necessary to complete the project. Due to the level of understanding that we were able to attain before determining the plan for the rest of the project, we were able to produce a schedule that should require few revisions and updates.
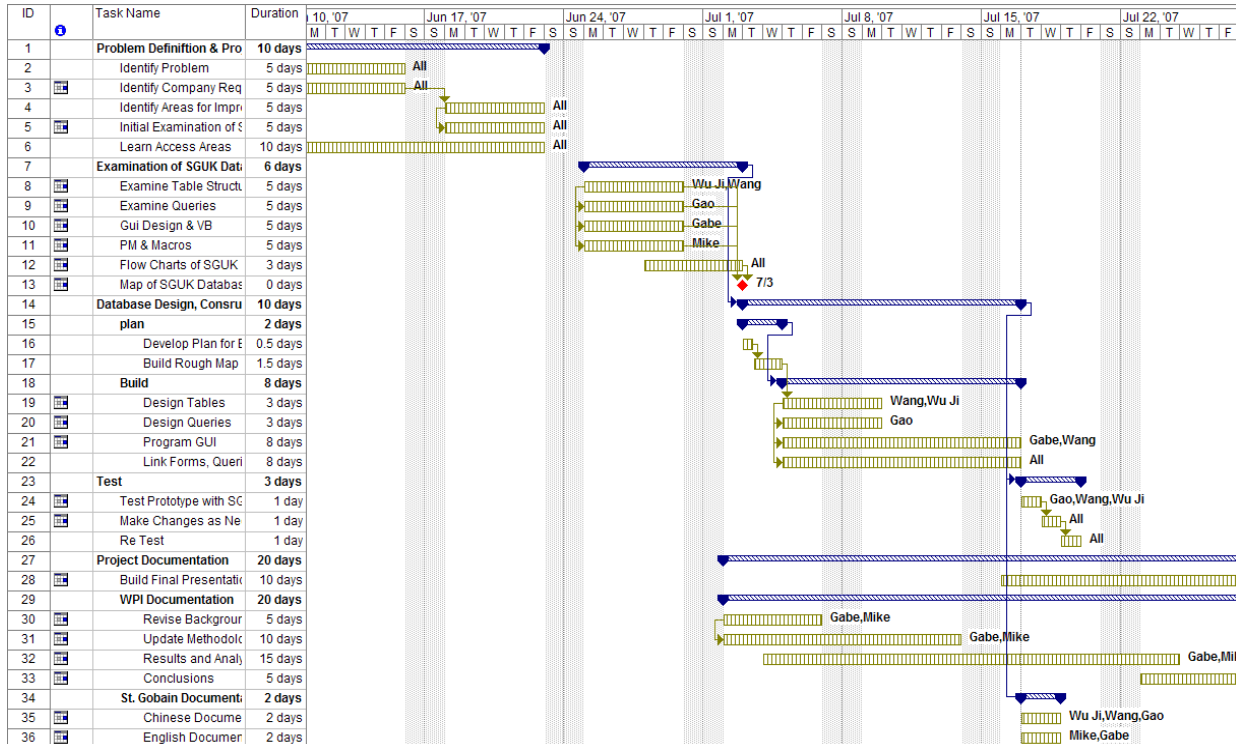
ID	Task Name	Duration
1	Problem Definiftion & Pro	10 days
2	Identify Problem	5 days
3	Identify Company Req	5 days
4	Identify Areas for Impr	5 days
5	Initial Examination of S	5 days
6	Learn Access Areas	10 days
7	Examination of SGUK Dat	6 days
8	Examine Table Struct	5 days
9	Examine Queries	5 days
10	Gui Design & VB	5 days
11	PM & Macros	5 days
12	Flow Charts of SGUK	3 days
13	Map of SGUK Databas	0 days
14	Database Design, Consru	10 days
15	plan	2 days
16	Develop Plan for E	0.5 days
17	Build Rough Map	1.5 days
18	Build	8 days
19	Design Tables	3 days
20	Design Queries	3 days
21	Program GUI	8 days
22	Link Forms, Queri	8 days
23	Test	3 days
24	Test Prototype with SG	1 day
25	Make Changes as Ne	1 day
26	Re Test	1 day
27	Project Documentation	20 days
28	Build Final Presentatic	10 days
29	WPI Documentation	20 days
30	Revise Backgrour	5 days
31	Update Methodolc	10 days
32	Results and Analy	15 days
33	Conclusions	5 days
34	St. Gobain Documenti	2 days
35	Chinese Docume	2 days
36	English Documer	2 days

Figure 2: Gantt chart of project schedule

3.5   Development of New Database

After studying the St. Gobain United Kingdom Database it was clear that the development of a new database that would be tailored to the needs of Shanghai was in order. It was determined that there were no sections of the UK database that would be suitable for use in a Shanghai database. The process that we undertook for studying the database allowed us to understand explicitly the database objects that would be necessary to build a database solution for St. Gobain Shanghai.

3.5.1 *Strategy*

The first step in this phase of the project was to create a database that would function similar to the UK database, with the functional requirements that were chosen specified by the company. As such we needed a great deal of information, both qualitatively on how they expected to use the database, and quantitatively with the actual data that we would work with. The qualitative understanding of the company's expectations was completed as part of the initial interviews with the company. The raw SAP data, which we would need to input into the database was much harder to obtain.

The strategy for designing the database was quite simple. Because we completed a thorough examination of the SGUK database, we had a comprehensive understanding of how the database objects should interact with each other. As a result of this we understood the elements that were necessary to build a functioning database. Since the structure of a database is dependent upon the information that get input into it, it was important that we understood what data we would have to input into the system. Since getting the exact information that we would be inputting into the database, we would need to create a generic solution, which would later be tailored to the actual data.

While it was not the ideal method for creating the database, this is the method that we were forced to adopt. First we created all the tables where the data would be stored and manipulated. Once the tables were in place we would be able to link tables of sample information. With the tables and information in place we then developed the queries that would be necessary for the database to work. As the queries were developed they were tested against using the sample data to ensure that they would work properly. Once the queries were complete the forms and reports would be created.

By constructing a database this way we would be able to ensure that the database would function properly once the proper data is input into the system. It also would allow for less time working with company employees since we would be able to tell them exactly the information that we would need from them in order for the system to work. This method would all us to take as much time to build the database as needed in Wuhan, and then make only minor changes wile in Shanghai to complete and implement the product.

4. Results and Analysis

This section documents both the end products of this project and the process that was followed to complete the project. This section will give an overview of the final database product, and will evaluate the methods that we utilized to complete the project.

4.1 Intermediate Products

The main goal of the project was to create a database for Saint-Gobain. This however was not the only product that we produced. There were several intermediate stages that required us to create something. These intermediate products include a map of the SGUK system, coupled with flow charts of SGUK database function. These two products helped us to ascertain exactly the methods that we would utilize for the development of the SGUK database. These products also directly influenced the development of the Shanghai database since we replicated and simplified many of the database elements that were used to create the United Kingdom database. These methods also help to expedite the process of database construction since we would learn only the methods and techniques that were absolutely necessary for the successful completion of the project.

4.1.1 *Map of SGUK*

The map of the SGUK database allowed us to see how all the database objects fit together. The map was built in a word document. Every object instance is labeled with each of its fields and relationships. The map's contents were color coded, organized, and their type and relationships labeled. See **Appendix A: Map of St. Gobain UK Database** for the map of the UK indicator report. This map helped us later to determine the structure of the Shanghai database and the helped to ensure that we would include all of the necessary components to ensure that the

database we were working to create would function at least as well as it's UK counterpart. Creating this map helped to visualize the connections between all of the queries, and to understand exactly how each query functioned to capture and manipulate the data.

4.1.2   *Functional Analysis of SGUK*

In addition to the map of the queries and essential database objects, it was necessary to perform a functional analysis of the UK database. This was necessary because it helped us to identify areas that needed improvement for the Shanghai database as well as understand how the creators of the UK database intended for users to interact with it. As a result of this analysis we formulated a comprehensive list of the functions of the UK database. They are as follows:

- Display reports and graphs of:
    - **Orders**
    - **Paper Loads**
    - **In Process Loads**
    - **Produced Loads**
    - **Rejects**
- Weekly and Monthly Summaries
- Input regular data updates

The reports listed the data contained in their respective areas by both product group and bond group in separate reports with the same field for each. Every report contained the quantity of grinding wheels and their weight in kilograms. The **Orders** and **In Process Loads** reports contain the additional fields of order count. The **Paper Load** reports use the field **Group Range** as a sub category to have the data organized into. The **Group Range** field had the categories **Available Load** and **Forward Load**, which indicate whether all the required components are in stock and can begin the **In Process** stage.

The graphs all were formulated the same way, with the Y-axis containing the number of kilograms of grinding wheels in it's report's respective stage and the X-axis was the time in units

of weeks. The data points are derived from the weekly data from the respective product groups or bond groups.

The *input regular updates* function allowed data to be input on a regular schedule by selecting both the correct year week and year month that corresponds to the update date. The update function is contained on a separate page and is accessed using a button on the main menu of the UK database.

The function of weekly and monthly summaries displays the data from each of the different stages (Orders, Paper Loads, etc.) with the same fields that are contained in the respective reports. These summaries are displayed on one page so that it can be printed on one sheet of paper. An additional function of these summaries is that there is a drop down window where the week or month can be selected so that only the data for the selected date range would be used for that summary.

4.1.3 *Flow Chart of Basic SGUK Function*

The flow chart of the Saint-Gobain UK database was the visual linking of all the different parts of the database to each other. This particular flow chart contains macroscopic detail of the general functions of the database. This was used both as a tool to show the project sponsors in a

Figure 3. Database Relationships Flowchart.
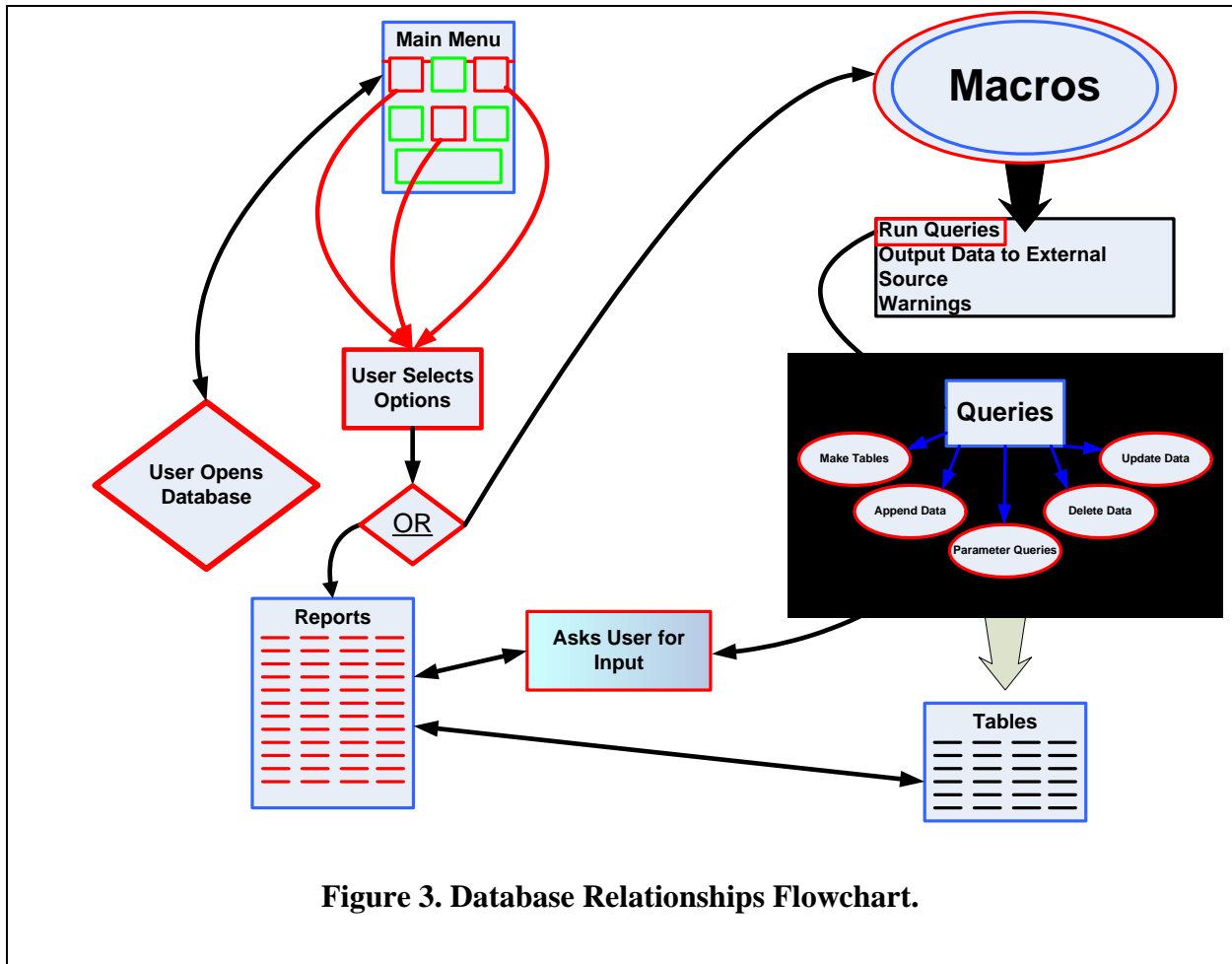
simplified manner how the database functions. This flow chart also acted as a means to help the team organize its efforts and better understand the steps that would be necessary to create the final product. The flow chart of the database can be seen in Figure 3. Database Relationships Flowchart. The specific relationships between the different objects present in the database are

delved into much detail in their specific objects' section, and acts as a means to understand the general function of the database.

4.2   Development of New Database

In the development of the new database for the Shanghai plant we looked at the needed functions and how to implement them best utilizing the different objects in Microsoft Access with the general template of the UK's database as the guideline. To determine the needed functions that would be necessary beyond the capabilities of the SGUK database we conducted interviews to understand how St. Gobain Shanghai currently manipulates and uses its ERP data. Upon further inspection it was found that the employees at St. Gobain Shanghai (SGS) currently input the necessary information from SAP R/3 into Excel spreadsheets manually.

Upon further inspection of the Excel spreadsheets, we found that there were some functions of the SGUK database that were not necessary in Shanghai. We also found that there were some features that would need to be included in Shanghai that were not considered in the UK. These fields included sorting orders into size ranges, and also by where in the production cycle the orders are. By studying the SGUK database and by conducting interviews with stake holders we were able to provide a database that would provide the most ideal functionality for the end users.

4.2.1   Database Functions

After analyzing whether or not all the same functions were required in the Shanghai database that were in the UK database we concluded that all the main functions were necessary. However, some of the details of the functions needed to be changed. The largest omission for the Shanghai database was the bond group category, because both product group and bond group were not necessary because of the fewer categories of products that the Shanghai plant produces.

This effectively reduced the number of reports and graphs by a factor of two, but did not change the number of kinds of graphs. One change for the In Process report is that the database will categorize the data by listing the grinding wheels by what product group they fall under, vitrified or organic, then by what stage they were in the manufacturing cycle and finally by their sizes. The other reports will only categorize their data by product group and size. The graphs were the same from the UK to the Shanghai. The weekly and monthly summaries remain largely unchanged, with the only change coming from the added fields that each report would also add. The input regular data updates function in the UK system was changed fairly thoroughly. The method of updating the data was moved to the main menu of the database and instead of selecting from drop down menus the correct month and week there was a graphic calendar that the user could interact with and select the day the update was for, since Shanghai used three data updates a week on a Monday-Wednesday-Friday schedule.

4.2.2 *Database Objects*

There are five kinds of objects in Microsoft Access: tables, queries, forms, reports, and macros. These objects interact with each other to create a working database. The objects can be used different ways to create many different types of databases to fit the needs of any user.

4.2.2.1 Tables

A table is the essence of a database; it is the container where all the information is stored. There are three different types of tables: normal tables, link tables, and reference tables. Normal tables are tables that Microsoft Access builds and uses in storing information in the database both indefinitely and temporarily. Link tables connect to outside files and only store the

information about how to access and edit those files' data. Reference tables are a very unique form of normal table, which contain a fixed set of information that seldom, if ever, changes.

The Shanghai database has five original link tables that connect to the Microsoft Excel (.xls) files that SAP outputs. These tables are then accessed by make table queries that create new temporary tables that hold the information contained in the .xls SAP files. Then append queries add the newly created temporary tables' data into their five respective history tables, which contain all the data from the last three years. The history tables' data is then used to generate reports, graphs, and summaries of the data.

There are two different reference tables in the Shanghai database. The first one is Year Week, which contains all the weeks in the form of "2007-23" until 2012. The second is Year Month, which contains all the months in the form of "2007-10" until 2012. These tables function as reference points for queries to organize the data in a linear time line which is then represented on reports.

The UK database's table is very similar to the tables of Shanghai's database. The key difference is in the number of link tables. The SGUK database only uses two link tables that contain more fields of information than all five of the link tables in the Shanghai version. The reason for this difference is only because of the difference in formats of the ERP SAP data from each plant, with one using two output files and the other using five output files. One of the data fields not included in the Shanghai ERP SAP data was material group category, which eliminated the need for a reference table with all the different kinds of material groups contained.

4.2.2.2 Queries

Queries have many functions and serve as the backbone and circulatory system of the database. There are four different kinds of queries: append queries, make table queries, delete

queries, and select queries. Append queries add data from one table into another. Make table queries create new tables. Delete queries delete existing tables, or delete fields of information from selected tables. Select queries, when run, find information from tables and return the values to the place where the query was called from.

Shanghai's database has five make table queries that create temporary tables, which are filled with information that the make table queries take from the five original link tables. Append queries add the newly created temporary tables' data into history tables. Delete queries are called to delete the temporary tables so that they can be created again anew without potential lingering data causing numerical errors. There are select queries for each of the sub-forms in the weekly and monthly overviews. These select queries combine the data from the respective time length and feature those results in the sub-form.

The queries of the Shanghai database are very similar to the queries of the UK database. Several of the queries that the UK database utilized were useless in the Shanghai version, including one pertaining to bond groups, which aren't used in the Shanghai version. Interestingly the UK version had archaic queries that were not even used in its own system and we eliminated these.

4.2.2.3 Forms

Forms are the graphical user interfaces or menus the operator uses to navigate and execute the various functions of the database. There are three types of forms: primary forms, secondary forms, and sub-forms. The primary form is the form that is displayed when the database starts up and all the functions are either present on this page or are linked to from it. A secondary form is a form that is accessed by way of another form. Sub-forms are forms that are

present within another form's interface, which can be navigated with or without affecting the

host form.

The primary form for Shanghai's database can be seen in Figure 4. Shanghai database

Main Menu. It serves as the main menu and contains a majority of all the functions contained
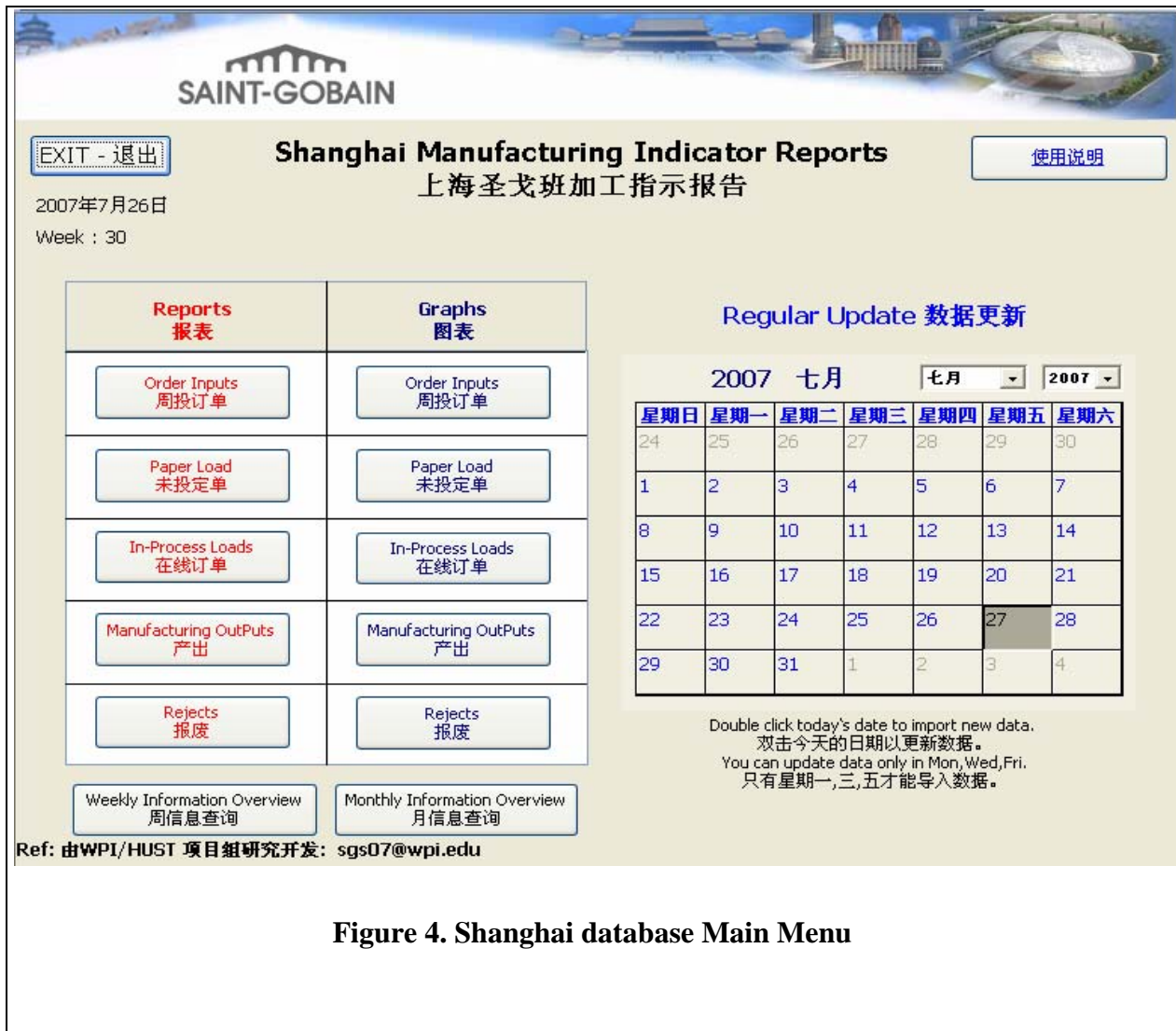
Figure 4. Shanghai database Main Menu

within the database. The focus of the page is the two columns on the left containing the reports

and graphs. The reports are in red and the graphs are in blue and they are labeled with the title of

their respective report or graph. Clicking on each of these buttons will bring you to the desired

report or graph. The calendar on this page functions as the method for updating the database

with new ERP SAP data. Double clicking on the current date will prompt the user with dialogue

box asking whether or not to update the database with new data. The button on the top right of

the screen opens the users manual for the database, in the form of a .PDF file. The label on the

user's manual button conforms to the language of the computer it is on; the screenshot featured

in Figure 4. Shanghai database Main Menu was taken on a Chinese language computer. The

button on the top left of the screen exits the database and closes Microsoft Access. The buttons

below the reports and graphs lead to the secondary forms weekly and monthly summaries.

      The secondary forms Weekly Information Overview and Monthly Information Overview

can be seen in Figure 5: Weekly Information Overview Secondary Form and Figure 6: Monthly

Information Overview Secondary Form respectively. Both of these forms contain a drop down

box with a selector for that particular week or month's data whose summary is desired. After a

particular week or month is selected that data is displayed within the sub-forms in that same

page. The weekly and monthly secondary forms display data in six and seven sub-forms

respectively. These sub-forms display the same fields that the reports do, but they do not break

the data into categories of size (and the current process for the In Process stage) like the reports

do.

Figure 5: Weekly Information Overview Secondary Form

Figure 6: Monthly Information Overview Secondary Form

The Monthly Information Overview secondary form also contains a link to a report that shows the monthly reject percentage.

The forms of the UK version and Shanghai version varied significantly. The primary form for the UK database was poorly laid out and caused confusion to new users and can be seen in Figure 7. The buttons for reports and graphs received the greatest overhaul by being reorganized and eliminating unnecessary buttons. Very few similarities can be seen between the primary pages of each of the databases now. The UK version had a separate secondary form for importing new data to the database, which was very difficult to use since it expected the user to know what week number referred to what month number. This additional form was eliminated by the use of the calendar on the primary page of the Shanghai database. All labels in the
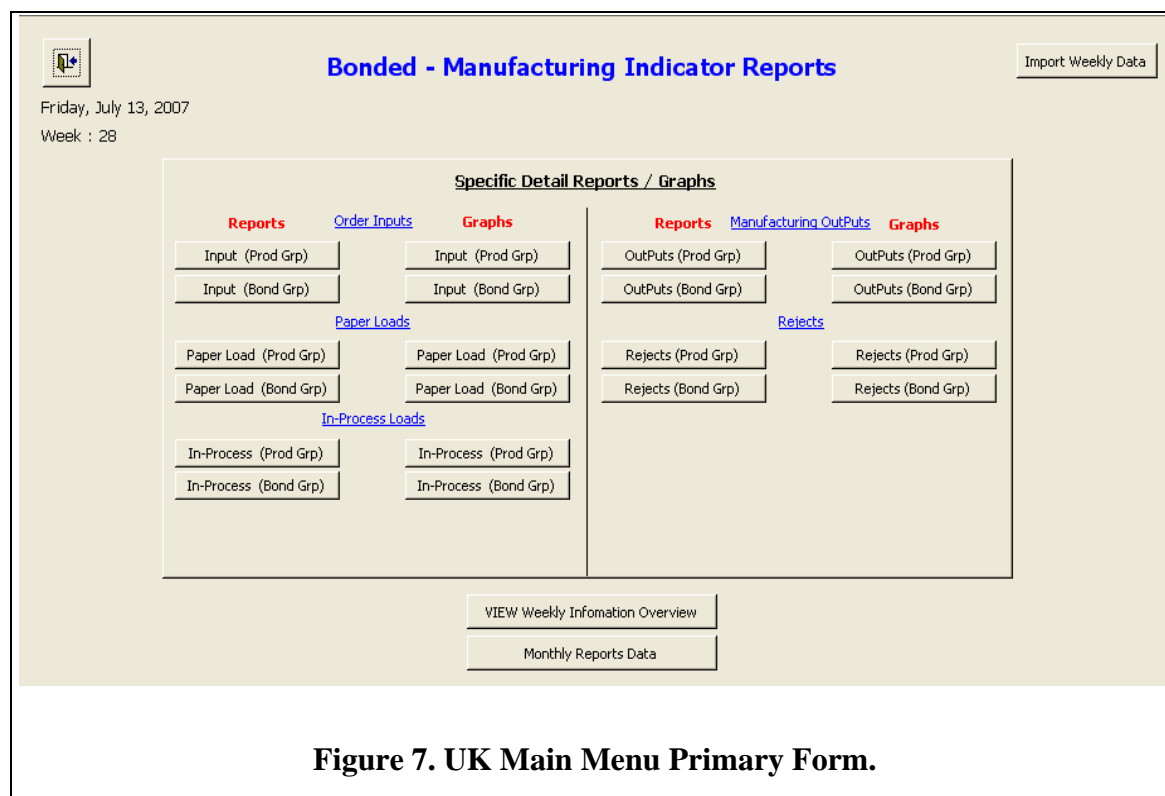
Figure 7. UK Main Menu Primary Form.

Shanghai forms were translated into Chinese to make the database have bilingual capabilities.

The UK version had many instances of using inconsistent naming practices that created difficulties for the readers of the forms, as well as the resulting reports. The secondary forms and their sub-forms for weekly and monthly overviews remain the same as the UK version.

4.2.2.4 Reports

Reports are where the data is organized for the purpose of analyzing a particular section of data. There are two types of reports: traditional reports and graph reports, here after referred to as reports and graphs. Both types display data but do so in different ways. Reports list data in text form within the format of columns and rows. Graphs display data graphically ranging from pie charts, bar graphs, and x-y data point.

Shanghai's reports are in the form of a series of pages displaying information within a week time frame and data associated with the purpose of the report. For instance the In Process report, as seen in **Error! Reference source not found.**, categorizes the data by listing the grinding wheels by what product group they fall under, vitrified or organic, then by what stage they were in the manufacturing cycle and finally by their size. The other reports will only categorize their data by product group and size. All the reports contain the weight in kilograms of the grinding wheels and the number produced. The Order Inputs and In Process Load also contain the field with the number of orders of grinding wheels.

Shanghai's graphs were all formulated the same why, with the Y-axis containing the number of kilograms of grinding wheels in its reports respective stage and the X-axis was the time in units of weeks. The data points are derived from the weekly data from the product groups. Figure 10 shows an example graph of the In Process Loads.

In-Process by Product Group - 在线订单

2007年7月26日

Year Week 年周	Product Group	Status 加工状态	Size Range 尺寸类型	OutStanding QTY 数量	Outstanding Kgs 重量	Outstanding Ords
07-30 Wed	O	1-加工	L	73	5,431	12
			M	2	4	1
			M-L	119	2,611	14
			S	1,476	1,819	14
			toolroom	50	57	1
		Manu_Status Total: 按状态汇总:		1,720	9,922	42
07-30 Wed	O	2-窑炉	L	105	8,812	15
			M	25	387	3
			M-L	119	2,611	14
			S	1,878	2,156	17
			toolroom	50	57	1
		Manu_Status Total: 按状态汇总:		2,177	14,023	50
07-30 Wed	O	3-成型	L	105	8,812	15
			M	25	387	3
			M-L	119	2,611	14
			S	1,878	2,156	17
			toolroom	50	57	1

Figure 8 In Process Shanghai Report
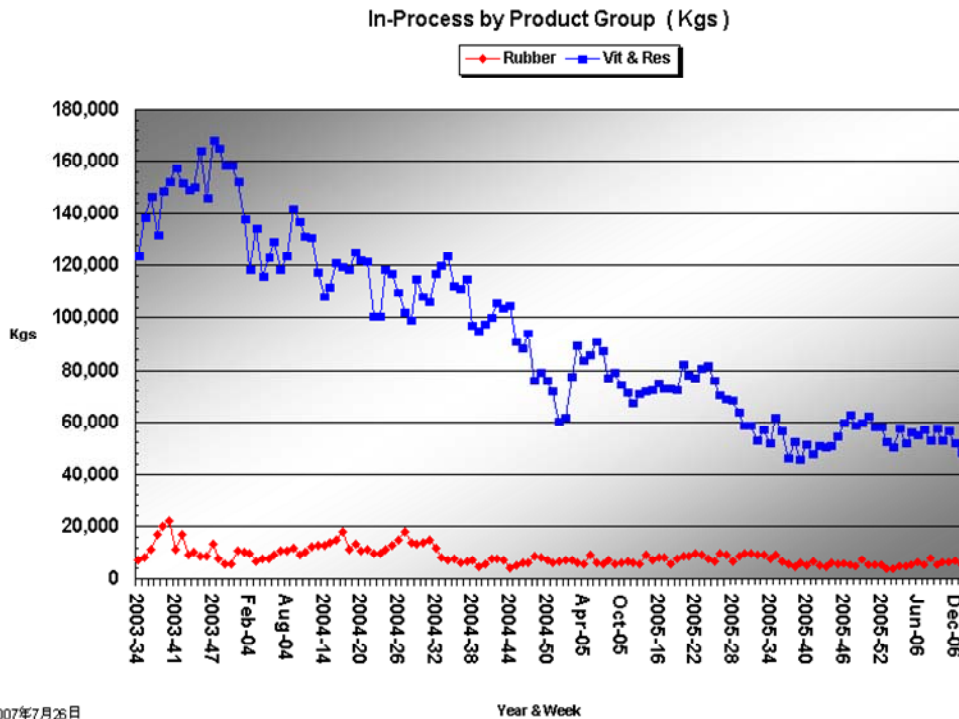
Figure 9: In-Process Graph

In-Process by Product Group

Thursday, July 26, 2007

Year Week	Product Group	Outstanding Ords	Outstanding QTY	Outstanding KGS
2003-34	Rubber	114	24851	7,398
2003-34	Vit & Res	898	23940	123,871
	Week Total InProcess:	1,012	48,791	131,269
2003-36	Rubber	136	8585	8,014
2003-36	Vit & Res	805	16734	138,445
	Week Total InProcess:	941	25,319	146,459
2003-37	Rubber	120	9438	11,279
2003-37	Vit & Res	760	26038	146,578
	Week Total InProcess:	880	35,476	157,857
2003-38	Rubber	98	8204	16,999
2003-38	Vit & Res	705	24097	131,852
	Week Total InProcess:	803	32,301	148,851
2003-39	Rubber	108	6342	20,089
2003-39	Vit & Res	732	20664	148,768
	Week Total InProcess:	840	27,006	168,857

Figure 11. In Process UK Report

The reports of Shanghai are very similar to those of the UK. With the addition of only a few

fields to organize the data into the reports are nearly the same. One obvious difference is the

inclusion of Chinese language translations to the English text in the Shanghai version. Another

difference is the appearance of the reports with a striking improvement in the readability in the

Shanghai version. The In Process report for the UK can be seen in **Error! Reference source not**

found. and can be compared to the Shanghai version in **Error! Reference source not found.**.

50

The graphs in the Shanghai version are identical to the graphs in the UK version with the exception of the inclusion of Chinese translations in the labels.

4.2.2.5 Macros

Macros, short for macro-instruction, are the helpers of the database world. Macros allow multiple functions to be run at once within a predefined order. Some examples of the functions they can trigger are: running queries, open a message box, open a report, select an object, or create a form.

The macros within the Shanghai database are used solely for the process of updating the information within the database. The macros trigger a series of queries that include make table queries, link table queries, append queries, and delete table queries. This series of queries act to take the information from the external data files and add them to temporary tables and then append them onto the long term data tables and finally delete the temporary tables. The Shanghai database's macros are for all practical purposes identical to the UK database's macros. The only differences are their logical ordering of the query operations.

4.2.3 *Product Users*

This database will be used primarily by the production scheduling manager at the Shanghai plant. She will input data three times a week into this database. This process will take about thirty minutes, whereas it previously took her approximately two hours by hand in Microsoft Excel. The reports and graphs will be prepared for the plant manager after the regular data updates. The reports and graphs will then be analyzed and changes implemented to cope with changing supply and demand as well as provide insight as to where bottlenecks or increased defects are occurring in the production cycle.

4.2.4 *Users Manual*

We produced a user's manual for the benefit of the users of the database as well as providing the ability to edit and/or upgrade the database to display different data or create different functions for the database. The primary function of the user's manual was to provide exclusively Chinese employees with the information needed to run and troubleshoot the database correctly, so the organization of the user's manual was built utilizing that fact. The important areas were then translated into English. The user's manual is provided in.

5. Conclusions

The ineffective utilization of Saint-Gobain Abrasives Shanghai's ERP SAP data was solved by our providing a database application that automated the processes previously done by hand. By creating a database that creates reports, graphs, and summaries the management will be able to cope with changing supply and demand, identify problem areas in the manufacturing system, and gain insight into how and where to apply lean manufacturing principles. The current practice of manually summarizing the data by hand taking an estimated two hours will be eliminated and replaced with a process that should take well below thirty minutes and will provide much more valuable insight into the status of the plant at the various stages from orders to manufacturing to rejects.

The project team fulfilled its project objectives through tight adherence to its schedule, and thorough problem identification early in the term of the project to attempt to avoid oversights that would prevent project completion. The objectives, and final product, were met and completed by clearly identifying the problem, systematically analyzing the example database and pragmatically learning the skills that would be necessary to complete the project. Successful execution of an aggressive project schedule would allow plenty of time for completion and the troubleshooting of possible errors.

After delivering the database application to the plant in Shanghai we received some valuable feedback on how well it suits their needs. Some of the positive comments we received translated from Chinese include: "this database system is quite good," "the menu is beautiful and convenient," and "the logic of the queries and table design is clear and rational." They did express some concern by saying "the data will still need to be confirmed" by testing over the

next couple weeks, but the production scheduling manager did feel comfortable saying that she "believes that it will work correctly."

The Shanghai plant should expand this database to include the areas of tracking analysis and rejection analysis. Tracking analysis would provide detailed information and insight into how individual orders progress through the plant as well as timeline of needed and collected raw materials. Rejection analysis would provide detailed information into the causes of rejects and where they were occurring in the manufacturing line. It was out of our projects scope to include these additional functions due to the time restrictions of our seven week project.

Through the process of going through our objectives to solve problem the company's problem of poorly utilized ERP SAP data we learned many Chinese cultural values and traditions from our partners, our sponsoring company, the advising professors, and through our day-to-day activities. Our Chinese partners gained a great deal of insight into how American students approach a problem and their organized way of looking at it from the macroscopic level. This experience of undergraduate students from American and Chinese universities working on a real world project for an international company made this a unique cross-cultural experience.

Appendix A: Map of St. Gobain UK Database

Indicator Product

Part One

Two original tables: LoadInProcess, Paper load

The definition of four Macros:
(1) Run_InProcess_Load_Update(use the command of OpenQuery):
  Import_new_LoadInProcess(Generate Table query)
  Create_Temp_InProcess(Generate Table query)
  Delete_InProcess_entry(delete query)
  Append_InProcess_Hist(append query)
(2) Run_Paper_Input_Update(use the command of OpenQuery):
  Create_Temp_input(Generate Table query)
  Delete_Input_entry(delete query)
  Append_Input_Hist(append query)
(3) Run_Paper_Load_Update(use the command of OpenQuery):
  Import_new_PaperLoad(Generate Table query)
  Create_Temp_Load(Generate Table query)
  Delete_Load_entry(delete query)
  Append_Load_Hist(append query)
(4) Run_Service_Update(use the command of OpenQuery):
  Import_new_MTO_Service(Generate Table query)
  Import_new_MTS_Service(append query)
  Delete_Service_entry(delete query)
  Create_Temp_Service(Generate Table query)
  Append_Service_Hist(append query)

各个表中的数据项

Gross_Output_Daily: (ReportMonth, ReportWeek, ReportDay, Product_Group, Monthly_Groups, Main_Report_Groups, SumOfQtyOut, OutKgs)
Gross_Output_History: (ReportMonth, ReportWeek, Product_Group, Monthly_Groups, Main_Report_Groups, SumOfQtyOut, OutKgs)
Material_Groups:(Material Group, ProdType, Grit, Dimensions, Product_Group, Main_Report_Groups, Stafford_Manuf_Flag)

InProcess_Load_History: (ReportMonth, ReportWeek, Product_Group, OutStandingQTY, OutstandingWeight, OutStandingCount)
Temp_InProcess__Data: (ReportMonth, ReportWeek, Product_Group, Stafford_Manuf_Flag, OrderQty, Outstanding Qty, Net Weight Pwheel, OutstandingWeight)
New_load_InProcess: (ReportMonth, ReportWeek, Product_Group, Material Group, Product type, Product Line, Order, Order Type, Strategy Grp, Material, MatDesc, Net

Weight Pwheelx, Main_Report_Groups, Outstanding Qtyx, OrderQtyx, OutstandingWeight, Stafford_Manuf_Flag)
LoadInProcess:(Material Group, Product type, Product Line, Order, Order Type, Strategy Grp, Material, MatDesc, Net Weight Pwheel, Outstanding Qty, OrderQty)

Paper_Load_History: (ReportMonth, Report_Year_Week, Product_Group, Range, Load_KGS, Load_QTY, Load_Count)
Temp_Load_Data: (ReportMonth, ReportWeek, Product_Group, Range, BasicStartweekYR, TarQty, tot_net_weight, Stafford_Manuf_Flag, ThisWeek)
New_Paper_load:(PO / PLN Order, Status, Order type, Basic start, Created On, Actual release, Material Group, Material, Mat_Desc, Number of Records, TargetQty, NetWeightKGS, checknet, nweight, TarQty, tot_net_weight, Stafford_Manuf_Flag)
Paper load:(Order, Sales document, Created On, Basic start, Actual release, BW Status: SYSO, Order type, Material Group, Material, Mat_Desc, Number of Records, Target Quantity, Net Weight Pwheel)

Paper_Input_History: (ReportMonth, ReportWeek, Product_Group, InputQTY, InputWGHT, InputCOUNT)
Temp_Input_Data: (ReportMonth, ReportWeek, Product_Group, inputweek, TarQty, tot_net_weight, Stafford_Manuf_Flag)

Reject_History: (ReportMonth, ReportWeek, Product_Group, Main_Report_Groups, ScrapQty, ScrapKgs)
Reject_History_Daily: (ReportMonth, ReportWeek, ReportDay, Product_Group, Main_Report_Groups, ScrapQty, ScrapKgs)
Year_Month:(Year_Week)
Year_Week: (Year_Week)

Part Two

Append_InProcess_Hist(append query)
From Temp_InProcess__Data(table) **to InProcess_Load_History**(table)
Append_Input_Hist(append query)
From Temp_Input_Data(table) **to Paper_Input_History**(table)
Append_Load_Hist(append query)
From Temp_Load_Data(table) **to Paper_Load_History**(table)

Append_Service_Hist(append query)
From Temp_Service(table) **to Service_History**(table)
Import_new_MTS_Service(append query)
From Service_MTS(table) **to New_Customer_Service**(table)

Delete_InProcess_entry(delete query)
From InProcess_Load_History(table)
Delete_Input_entry(delete query)

From Paper_Input_History(table)

Delete_Load_entry(delete query)

From Paper_Load_History(table)

Delete_Service_entry

From Service_History(table)

<mark>十个生成表查询</mark>

check_inputs(没有实际用处)

From Material_Groups(table)**, New_Paper_load**(table) **When Stafford_Manuf_Flag="Y" and Format(CVDate([Created On]),"yyyy\-ww")=Format(Now()-7,"yyyy\-ww")**
to Temp_Input_Data(table)

check_inputs_new(没有实际用处)

From Material_Groups(table)**, New_Paper_load**(table) **When Stafford_Manuf_Flag="Y" and Format(CVDate([Created On]),"yyyy\-ww")=Format(Now()-7,"yyyy\-ww")**
to Temp_Input_Data(table)

Create_Temp_InProcess

From Material_Groups(table)**, New_load_InProcess**(table) **When Stafford_Manuf_Flag="Y"**
to Temp_InProcess__Data(table)

Create_Temp_input

From Material_Groups(table)**, New_Paper_load**(table) **When Stafford_Manuf_Flag="Y" and Format(CVDate([Created On]),"yyyy\-ww")=Format(Now()-7,"yyyy\-ww")**
to Temp_Input_Data(table)

Create_Temp_Load

From Material_Groups(table)**, New_Paper_load**(table) **When Stafford_Manuf_Flag="Y"**
to Temp_Load_Data(table)

Create_Temp_Service

From New_Customer_Service(table)
to Temp_Service(table)

data_check(没有实际用处)

From Material_Groups(table)**, New_Paper_load**(table) **When Stafford_Manuf_Flag="Y"**
to Temp_Load_Data(table)

Import_new_LoadInProcess

From Material_Groups(table)**, LoadInProcess**(table)
to New_load_InProcess(table)

Import_new_MTO_Service

From Service_MTO(table)
to New_Customer_Service(table)

Import_new_PaperLoad

From Material_Groups(table)**, Paper load**(table) **When [Paper load].[Created On] <>"#"**
to New_Paper_load(table)

Import_new_LoadInProcess_check(没有实际用处)
From **Material_Groups**(table), **LoadInProcess** (table)

Import_new_PaperLoad_Check(没有实际用处)
From **Material_Groups**(table), **Paper load**(table) **When** **[Paper load].[Created On] <>"#"**

InProcess_Load_Monthly
From **Inprocess_monthly_link**(select query)

Inprocess_monthly_link
From **InProcess_Load_History**(table), **main_grp_qry**(select query)

Inprocess_rpt_overview
From **InProcess_Load_History**(table), **main_grp_qry**(select query)
When **ReportWeek= [Forms]![weekly_Info_Overview]![selyrwk]**

Input_rpt_Monthly
From **Paper_Input_History** (table), **main_grp_qry**(select query)
input_rpt_overview
From **Paper_Input_History** (table), **main_grp_qry**(select query)

Load_Report_Monthly_link
From **Paper_Load_History** (table), **main_grp_qry**(select query)
Load_rpt_overview
From **Paper_Load_History** (table), **main_grp_qry**(select query)

Loads_Monthly_Rpt
From **Load_Report_Monthly_link**(select query)

main_grp_qry
From **Material_Groups**(table)

Output_rpt_Monthly
From **Gross_Output_History** (table), **main_grp_qry**(select query)

Output_rpt_Monthly2
From **Gross_Output_History** (table)

Output_rpt_overview
From **Gross_Output_History** (table), **main_grp_qry**(select query)

Rej_rpt_Monthly
From **Reject_History** (table)
Rej_rpt_Monthly2

From   Reject_History (table)

Rej_rpt_overview
From   Reject_History (table) ， **main_grp_qry**(select query)

Reject_%_Graph(没有实际用处)
From   Output_rpt_Monthly2(select query)，**Rej_rpt_Monthly2**(select query)

Service_Ontime_Monthly
From   Service_History (table) ，   **service_sum_OnTime_month**(select query)

Service_RPT_overview
From   Service_History (table) **,service_sum_grp**(select query) **,service_sum_OnTime**(select query)
When   ReportWeek= [Forms]![weekly_Info_Overview]![selyrwk]

service_sum_grp
From   Service_History (table)
service_sum_OnTime
From   Service_History (table) **When   Delayed_Working_Week_Range= "0n Time"**
service_sum_OnTime_month
From   Service_History (table) **When   Delayed_Working_Week_Range= "0n Time"**

Servive_Ontime_qry
From   Service_History (table), **service_sum_OnTime**(select query)

Part Three
寻找窗体的数据来源
Gross_Output_subform
Select from **input_rpt_overview**(select query)
InProcess_Monthly_Subform
Select from **InProcess_Load_Monthly**(select query)
InProcess_rpt subform
Select from **Inprocess_rpt_overview**(select query)
input_rpt subform
Select from **input_rpt_overview**(select query)
Inputs_rpt_Monthly Subform
Select from **Input_rpt_Monthly**(select query)
Load_rpt subform
Select from **Load_rpt_overview**(select query)
Loads_Monthly_Subform
Select from **Loads_Monthly_Rpt**(select query)

Monthly_Reports_Data
Select from **Input_rpt_Monthly**(select query)， **Loads_Monthly_Rpt**(select query)，
InProcess_Load_Monthly(select query)， **Output_rpt_Monthly**(select query)，

Rej_rpt_Monthly(select query), **Output_rpt_Monthly2**(select query),
Service_Ontime_Monthly(select query), **Rejects_Monthly_Graph_%**(report form)

Output_rpt_Monthly subform
Select from **Output_rpt_Monthly**(select query)
OutPut_rpt_subform
Select from **Output_rpt_overview**(select query)
rej%month_tot_sub
Select from **Output_rpt_Monthly2**(select query), **Rej_rpt_Monthly2**(select query)
Reject%_subform
Select from **Rej_rpt_overview**(select query), **Output_rpt_overview**(select query)
Reject%sub_Month
Select from **Output_rpt_Monthly2**(select query), **Rej_rpt_Monthly2**(select query)
Reject_Output_subform
Select from **Rej_rpt_overview**(select query)
Rejects_Monthly_Subform
Select from **Rej_rpt_Monthly**(select query)
Service_Ontime_Monthly subform
Select from **Service_Ontime_Monthly**(select query)
Service_rpt_subform
Select from **Service_RPT_overview**(select query)

weekly_Info_Overview
Select from **input_rpt subform**(form), **Load_rpt subform**(form), InProcess_rpt
subform(form), **OutPut_rpt_subform**(form),   Reject_Output_subform(form),
Service_rpt_subform(form), Reject%_subform(form)

Weekly_Update
关闭窗体

Part Four

寻找报表数据的来源
InProcess_BondGRP_Graph
From InProcess_Load_History(table)
InProcess_BondGRP_Report
From InProcess_Load_History(table)
In-Process_ProdGRP_Graph
From InProcess_Load_History(table)
InProcess_ProdGRP_Report
From InProcess_Load_History(table)

Input_BondGRP_Graph
From Paper_Input_History (table)
Input_BondGRP_Report
From Paper_Input_History (table)
Input_ProdGRP_Graph
From Paper_Input_History (table)

Input_ProdGRP_Report
From **Paper_Input_History** (table)

Load_BondGRP_Graph
From **Paper_Load_History** (table)
Load_BondGRP_Report
From **Paper_Load_History** (table)
Load_ProdGRP_Graph
From **Paper_Load_History** (table)， **main_grp_qry**(select query)
When Range **"< = to 6 weeks Load" Or <="This Week Availabl"**
Load_ProdGRP_Report
From **Paper_Load_History** (table)， **main_grp_qry**(select query)

OutPuts_BondGRP_Graph
From **Gross_Output_History** (table)
OutPuts_BondRP_Report
From **Gross_Output_History** (table)
OutPuts_ProdGRP_Graph
From **Gross_Output_History** (table)， **main_grp_qry**(select query)
OutPuts_ProdGRP_Report
From **Gross_Output_History** (table)， **main_grp_qry**(select query)

Rej_%_Monthly_Graph

Rejects_BondGRP_Graph
From **Reject_History**(table)
Rejects_BondRP_Report
From **Reject_History**(table)

Rejects_Monthly_Graph_%

Rejects_ProdGRP_Graph
From **Reject_History**(table)， **main_grp_qry**(select query)
Rejects_ProdGRP_Report
From **Reject_History**(table)， **main_grp_qry**(select query)

Service_Graph
Service_Graph_MTO
Service_Graph_MTS
Service_Graph_test
Service_MTO_MTS_Report
From **Service_History** (table), **service_sum_OnTime**(select query), **service_sum_grp**(select query)
Service_Ontime_Report
From **Service_History** (table), **service_sum_grp**(select query)
When **Delayed_Working_Week_Range= "0n Time"**

Part Five

Reports

Input (Prod Grp) From Input_ProdGRP_Report(report form)
Input (Bond Grp) From Input_BondGRP_Report(report form)
Paper Load (Prod Grp) From Load_ProdGRP_Report(report form)
Paper Load (Bond Grp) From Load_BondGRP_Report(report form)
In-Process (Prod Grp) From InProcess_ProdGRP_Report(report form)
In-Process (Bond Grp) From InProcess_BondGRP_Report(report form)
OutPuts (Prod Grp) From OutPuts_ProdGRP_Report(report form)
OutPuts (Bond Grp) From OutPuts_BondRP_Report(report form)
Rejects (Prod Grp) From Rejects_ProdGRP_Report(report form)
Rejects (Bond Grp) From Rejects_BondRP_Report(report form)

Graphs

Input (Prod Grp) From Input_ProdGRP_Graph(report form)
Input (Bond Grp) From Input_BondGRP_Graph(report form)
Paper Load (Prod Grp) From Load_ProdGRP_Graph(report form)
Paper Load (Bond Grp) From Load_BondGRP_Graph(report form)
In-Process (Prod Grp) From In-Process_ProdGRP_Graph(report form)
In-Process (Bond Grp) From InProcess_BondGRP_Graph(report form)
OutPuts (Prod Grp) From OutPuts_ProdGRP_Graph(report form)
OutPuts (Bond Grp) From OutPuts_BondGRP_Graph(report form)
Rejects (Prod Grp) From Rejects_ProdGRP_Graph(report form)
Rejects (Bond Grp) From Rejects_BondGRP_Graph(report form)

VIEW Weekly Infomation Overview
From weekly_Info_Overview (form)

Monthly Reports Data
From Monthly_Reports_Data(form)

Import Weekly Data
From Updates(form)

Monthly Reject % Graph
From Rejects_Monthly_Graph_%(report form)

Updates

Update Weekly Loads && Inputs From Run_Paper_Load_Update(macro),
Run_Paper_Input_Update(macro)

Update Weekly In Process From Run_InProcess_Load_Update(macro)
HIDDEN _ Update Weekly Customer Service From Run_Service_Update(macro)

Part Six

Material_Groups(table)中用Material Group字段与其他表进行连接，并使用Product_Group，Main_Report_Groups字段

导入文件LoadInprocess.txt 里面的数据项在未清定单状态—生产计划5-11能够找到，除Material Group，Product Line，Product type，Strategy Grp外。

导入文件Paper Load.txt 里面的数据项在未清定单状态—生产计划5-11能够找到，除Actual release，BW Status: SYSO，Material Group，Number of Records，Target Quantity外。

Gross_Output_History ,Reject_History两个表中的数据怎么更新，可能是依靠Gross_Output_Daily，Reject_History_Daily两个表来人工输入。

main_grp_qry选择查询中的结构和数据是固定的，可以预先人工输入。

There is a problem with the report form named Rej_%_Monthly_Graph

Appendix B: St. Gobain Shanghai Users Manual

软件使用说明书 (Software User Documentation)

目录(Table of Contents)

一,软件介绍(Introduction)

　　本软件是为上海圣戈班磨料磨具公司开发的数据库管理软件.本软件以Microsoft公司的Office 2003组件中的Access 2003数据库开发软件为设计平台, 参照了UK Saint-Gobain 公司的数据库管理软件, 根据上海圣戈班公司的需求和现存报表的形式,重新构建数据库系统而开发出来的.
本软件提供了数据的录入,更新和查询的功能,并以报表和图表的形式显示出来,可以减少员工制作报表的时间和方便管理者查阅数据并指导生产.

The function of this Microsoft Access program is provide Saint-Gobain Shanghai with data management and summaries. It produces reports and graphs in the areas of orders, paper loads, in process, manufacturing outputs, and rejects. It also shows summaries of both weekly and monthly data in all areas.

This Microsoft Access database provides management with the ability to see in both reports and graphs the pertinent information about the grinding wheels at each phase.

二,软件使用者说明(Information for use of the documentation)

1.对于一般用户(for end-users)

对于员工,请按照本说明书第三章 "软件操作流程" 所示的步骤初始化和更新数据.
对于管理者(部门经理),打开本软件后,直接在主窗体中选择所需的报表,图表及查阅历史数据.

2.对于系统管理员(for system administrators)
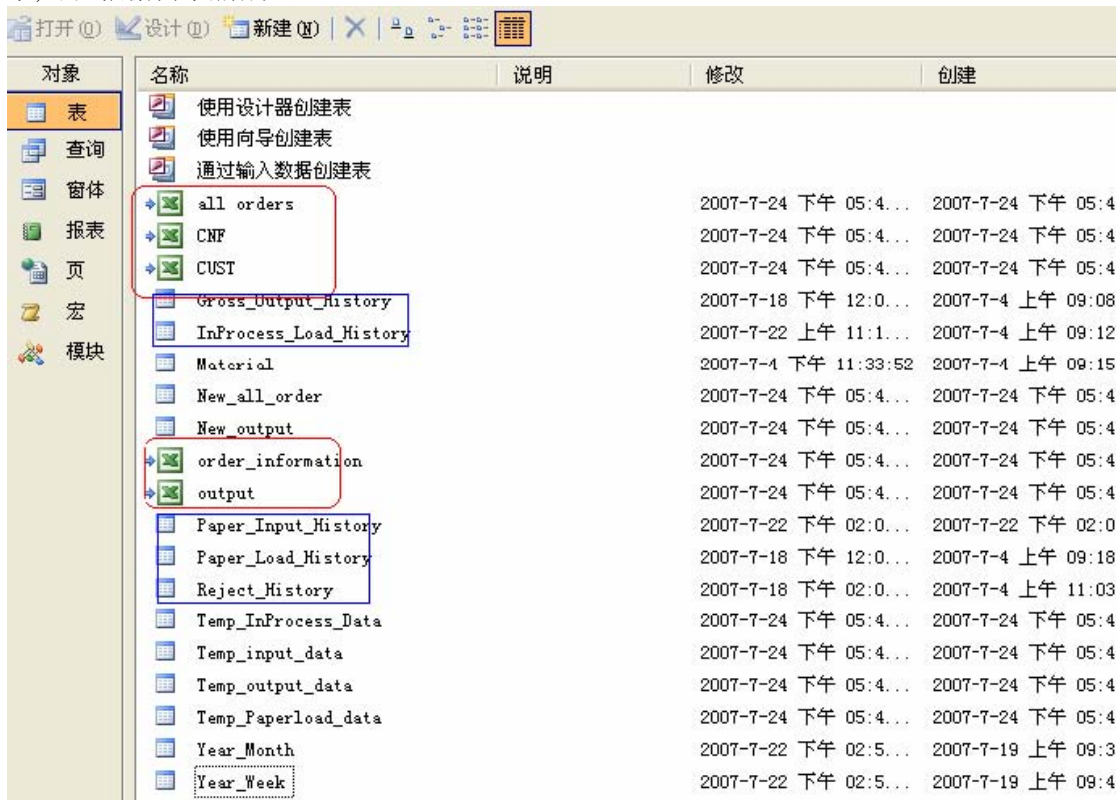
1.系统安装(How to install the system)

只需安装Microsoft Office 2003 中的数据库软件Access 2003,即可打开本软件

2.系统维护和升级(How to maintain and update the system)

使用前先将本软件备份,以免误操作造成系统故障而无法复原.
本数据库使用了表,查询,窗体,报表和宏共五类对象.表有19个,其中包含5个链接表,如图2-1所示,可以根据需求删减.

图2-1
红色线框所示为链接表,表中的数据可从SAP数据库导出;蓝色线框所示为历史数据表,每次更新完的历史数据都追加到这些表中,表中保存近三年的历史数据.
查询共有30个,包括6个生成表查询,5个追加查询,4个删除查询和15个选择查询,如图2-2所示

图2-2

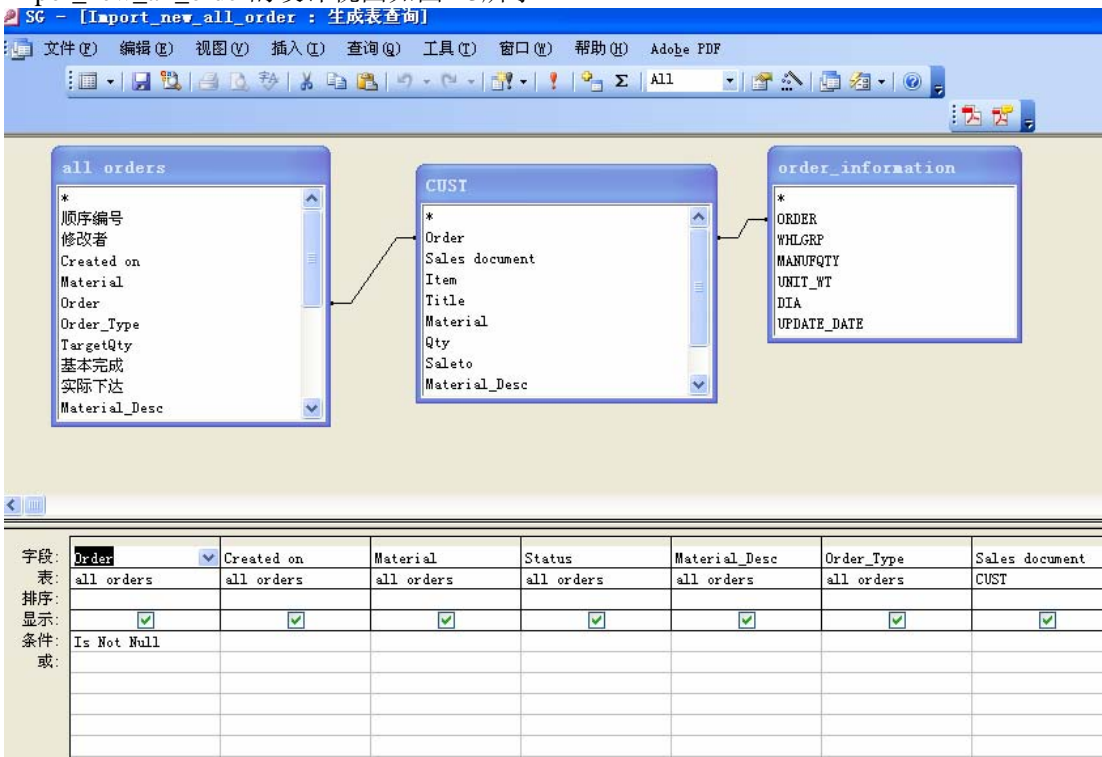现以生成表查询Impor_new_all_order为例说明创建查询的思路和升级的方法, 生成表查询
Impor_new_all_order的设计视图如图2-3所示

图2-3

订单号Order是唯一的,用字段Order来连接表all orders, CUST和 order_information,获取目标数量
(用于计算砂轮片数),Title(用于区分日本砂轮),UNIT_WT(用于计算总重),DIA(用于尺寸分类). 将

66

这些重要数据生产于一张新表中(New_all_order), 根据这张新表生产历史数据表. 其中,尺寸分类是通过一个嵌套函数来实现的,函数如图2-4所示

图2-4

其他分类需求可以借鉴以上的函数来实现,可有系统管理员灵活处理.

在本软件中,宏是由多个查询按顺序运行来实现数据的自动更新.如图2-5所示

图2-5

更新数据的过程是:生成临时数据表>删除历史数据>追加新数据

系 统 管 理 员 可 以 根 据 实 际 需 要 , 在 宏 的 设 计 视 图 中 进 行 设 计 .

三,软件操作流程(Procedures)

1.初始化(Initialization)

    进入Windows 操作系统,将本数据库软件所在的文件夹 "圣戈班上海" 复制于桌面上.文件夹中包含数据库SG.mdb 和 五张Excel表: all orders.xls, CNF.xls, CUST.xls, order information.xls, output.xls. 如图3-1所示.
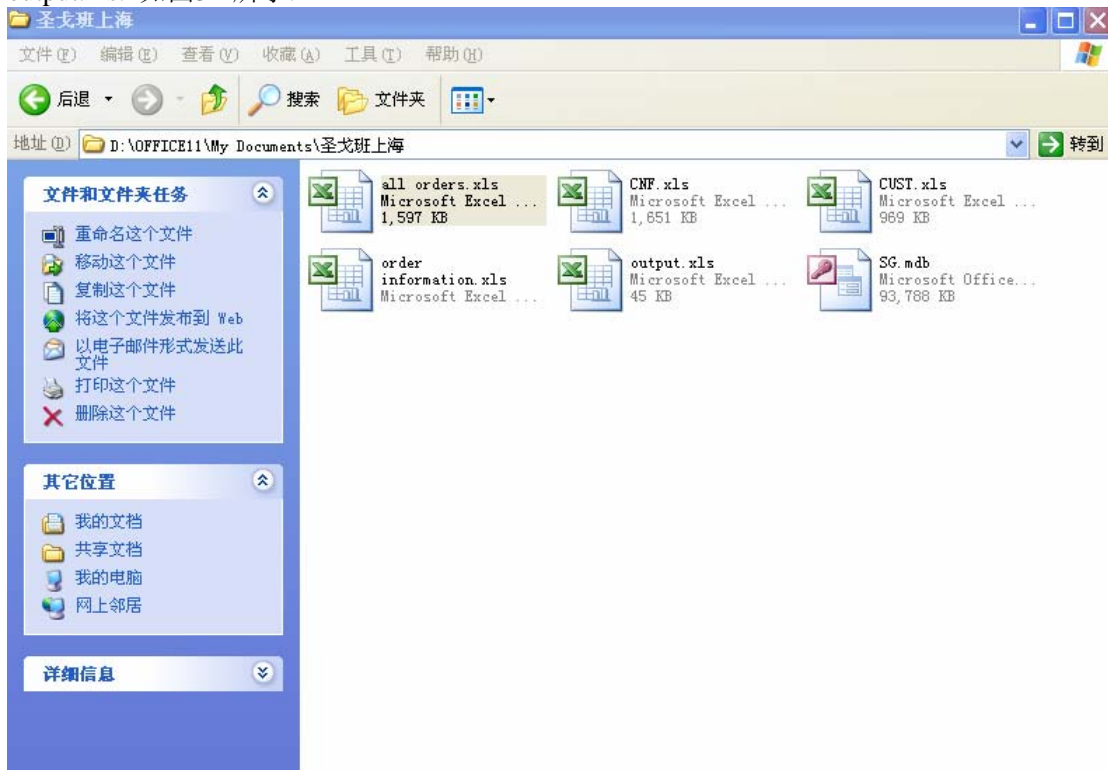

<p align="center">图3-1</p>

打开SG.mdb, 选择【文件】/【获取外部数据】/【链接表】,如图3-2所示
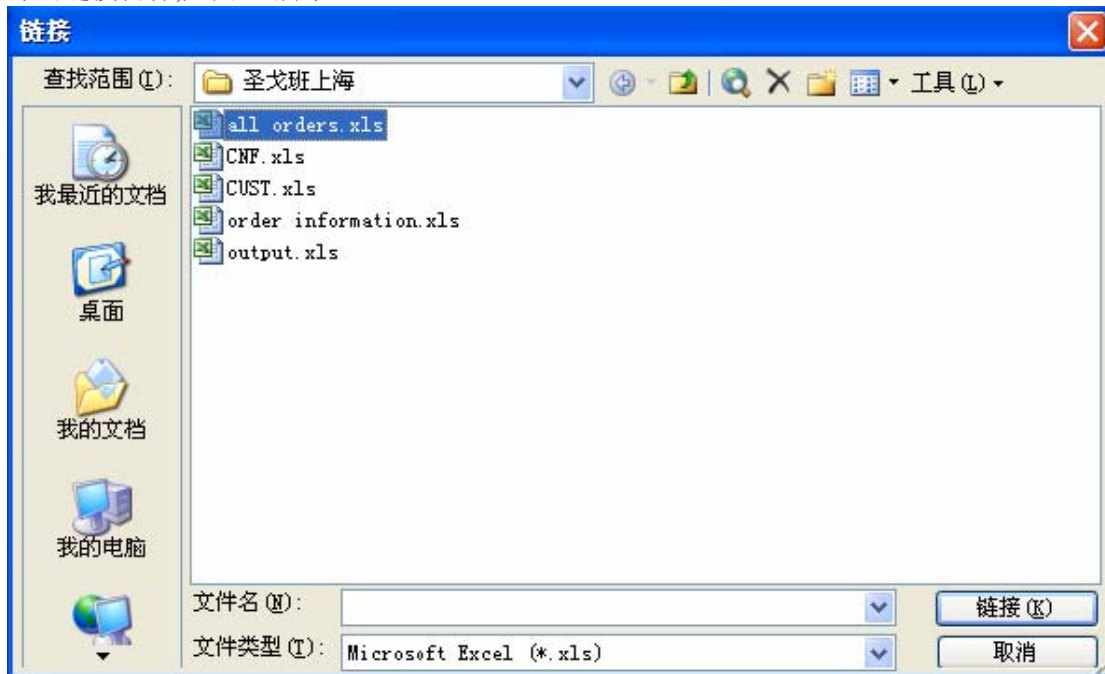
图3-2

弹出链接窗体,如图3-3所示

图3-3

双击所选Excel表, 弹出链接数据表向导,如图3-4所示

图3-4

单击下一步,弹出如图1-5所示窗体,更改链接表名称为文件夹 "圣戈班上海"中Excel表中对应的链接表名称,更改完毕后,单击完成.

图3-5

另外四个链接表的初始化方法同上,按图3-2至3-5所示的方法链接即可.(注意:导入表的名称必须

和数据库中的已经存在的五个链接表的名称严格一致,包括大小写和空格符)

2.更新数据(Update data)

将从SAP中导出的数据表转换成Excel表的形式并存放于桌面上,五张表中需要的数据项(字段)必须与文件夹 "圣戈班上海"中的Excel表中的数据项(字段)严格相等(包括大小写,下划线和空格符).即将 图3-6所示的格式转变为 图3-7所示的格式.

A	B	C	D	E	F	G	H	
2007/07/23								
	订单	创建日期	类型	顺序编号	修改者	商品	目标数量	基
	1.02E+08	2007-7-9	ZP04	20070830	TUZ	6.63E+10	18	#
	1.02E+08	########	ZP04	20070830	TUZ	6.63E+10	18	#
	1.02E+08	########	ZP04	20070830	TUZ	6.63E+10	4	#
	1.02E+08	########	ZP04	20070828	TUZ	6.63E+10	1	#
	1.02E+08	########	ZP04	20070817	LVJ	6.63E+10	2	#
	1.02E+08	########	ZP04	20070817	TUZ	6.63E+10	10	#
	1.02E+08	########	ZP04	20070817	TUZ	6.63E+10	10	#
	1.02E+08	########	ZP04	20070903	ZHANGJI	6.63E+10	2	#
	1.02E+08	########	ZP04	20070903	ZHANGJI	6.63E+10	8	#
	1.02E+08	########	ZP04	20070906	HOUY	6.63E+10	40	3
	1.02E+08	########	ZP08	20070525	ZHANGJI	6.63E+10	3	#
	1.02E+08	########	ZP04	20070711	TUZ	6.63E+10	1	#
	1.02E+08	########	ZP04	20070905	ZHANGJI	6.63E+10	2	3
	1.02E+08	########	ZP04	20070821	TUZ	6.63E+10	4	#
	1.02E+08	########	ZP04	20070904	ZHANGJI	6.63E+10	2	#
	1.02E+08	########	ZP04	20070807	TUZ	6.63E+10	100	3

图3-6

Created on	Material	Order	Order_Type	TargetQty	Material_Desc
2007-7-16	66253068221	102313430	ZP08	29	01_125.00x3.20x12.70_8C6T23A12020M48V34+
2007-7-9	66253068471	102293570	ZP04	18	01_914.00x100.00x355.60_1H10C365J7B24.
2007-7-12	66253068471	102302367	ZP04	18	01_914.00x100.00x355.60_1H10C365J7B24.
2007-7-12	66253068471	102302368	ZP04	4	01_914.00x100.00x355.60_1H10C365J7B24.
2007-7-9	66253068332	102289261	ZP04	1	01_750.00x75.00x305.00_8L10A801H8B24.
2007-7-11	66253068858	102298080	ZP04	1	01_915.00x35.50x304.80_7P10A5499L+48V12+
2007-7-17	66253072891	102314660	ZP04	2	01_1065.00x41.50x304.80_8C7P23A6020L48V+
2007-7-17	66253072892	102314661	ZP04	8	01_915.00x40.50x304.80_8C7P23A6020L48VH+
2007-6-27	66253073421	102262376	ZP08	3	01_230.00x5.00x31.75_1B1G21C8020K47V02.
2007-7-17	66253075137	102314567	ZP04	1	01_610.00x30.00x254.00_SGB8031L44VH.
2007-7-16	66253075361	102309269	ZP04	10	01_750.00x80.00x304.80_5D6T25A4620G6B24+
2007-7-17	66253076050	102314965	ZP04	4	01_1067.00x38.60x304.80_SGB4653L48VS.
2007-7-12	66253076106	102302342	ZP04	300	01_200.00x10.00x50.00_1H10C3201H9B24.
2007-7-13	66253078038	102305545	ZP04	30	01_750.00x80.00x304.80_8L10A601G7B24.
2007-7-16	66253078331	102310155	ZP04	1	01_1065.00x150.00x508.00_1H10C361H7B24.
2007-7-16	66253078337	102310065	ZP04	1	01_150.00x13.00x32.00_SGB6053K48VH.
2007-7-16	66253078340	102310066	ZP04	1	01_180.00x13.00x32.00_SGB12053K48VH.
2007-7-9	66253078935	102293838	ZP04	10	01_510x76x38.1_5B10A1699R5B302.
2007-7-15	66253080875	102308990	ZP08	13	01_180x6x31.75_8L7P23A32020K43VF.
2007-7-12	66253082013	102304952	ZP04	1	01_610.00x22.00x254.00_SGB15050L48VH.

图3-7

将五张Excel表的数据项更改完毕后,按照上述1.初始化 的方法分别导入五张链接表. 然后打开数据库SG.mdb, 如图3-8所示.

图3-8

选择更新时间,如图3-9所示.

图3-9

选择今天的日期, 双击日期更新数据;弹出窗体并单击【是(Y)】,如图3-10所示

图3-10

更新完毕后,在主窗体中.分别点击 "周投订单", "未投订单", "在线订单" 即可以得到所需报表,如图3-11所示

73

2007-30	V	1-加工	L	117	5,051	1
			M	1,389	8,649	1
			M-L	1,043	24,017	1
			S	25,200	33,358	1
			toolroom	39,159	21,856	1
		Manu_Status Total: 按状态汇总:		66,908	92,931	1
2007-30	V	2-窑炉	L	217	10,663	1
			M	2,286	12,658	1
			M-L	1,561	33,799	1
			S	29,346	43,191	1
			toolroom	41,713	22,561	1
		Manu_Status Total: 按状态汇总:		75,123	122,872	1
2007-30	V	3-成型	L	409	17,866	1
			M	4,664	28,183	1
			M-L	3,834	70,575	1
			S	50,569	66,975	1
			toolroom	84,582	43,161	1
		Manu_Status Total: 按状态汇总:		144,058	226,760	1

图   3-11

四,常见错误及解决方法(Error messages and problem resolution)

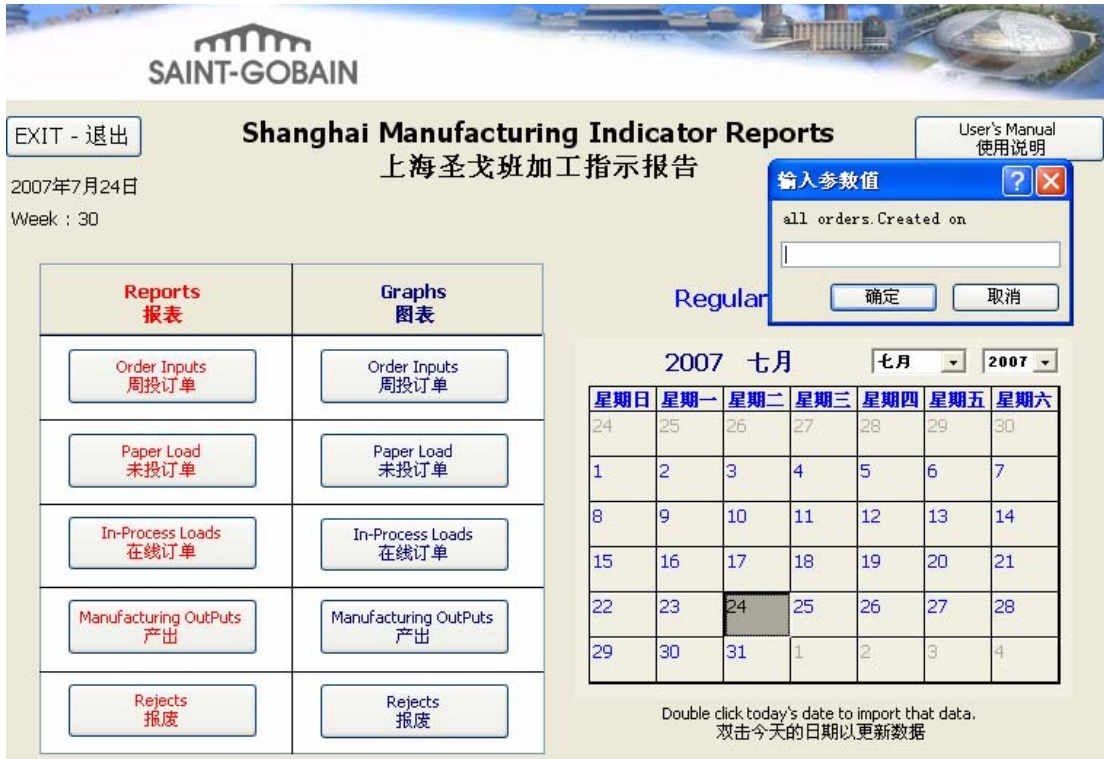**1.**更新时弹出如图**4-1**所示窗口,更新后"周投订单"报表出错.

图4-1

出错原因: Excel表all orders.xls中缺少数据项(字段) "created on"

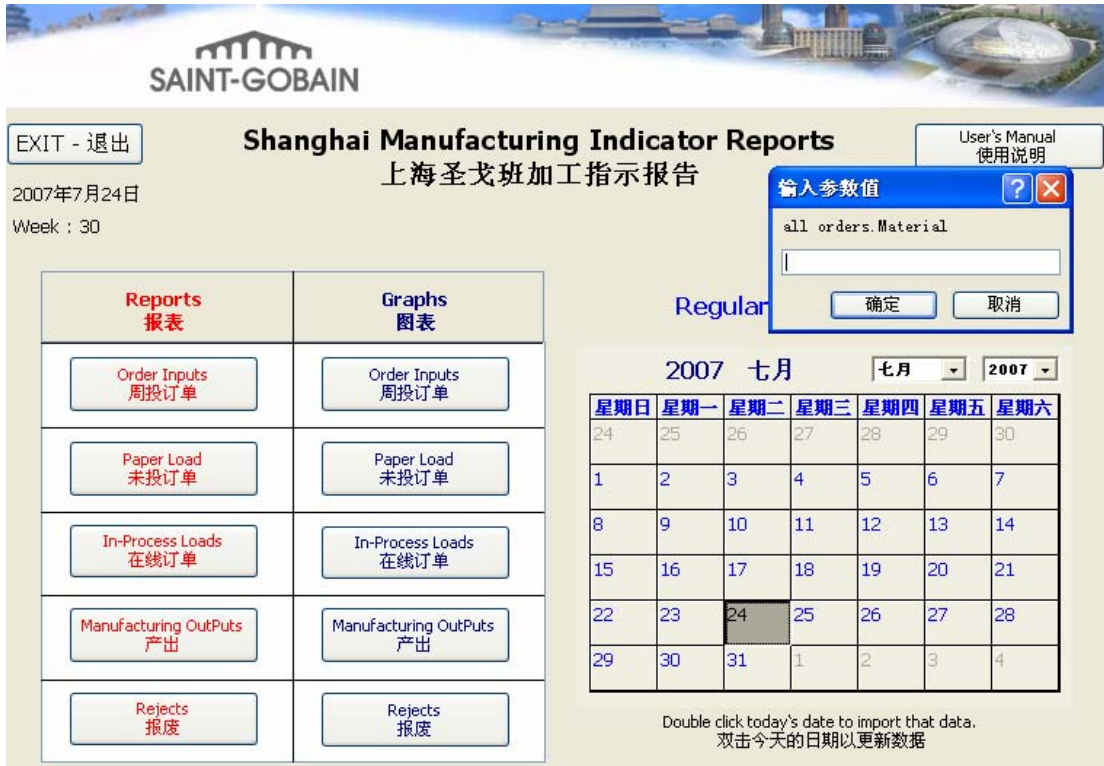解决方法:从SAP中导出数据项(字段) "created on",并添加到表all orders.xls中,然后重新导入链接表,再更新.
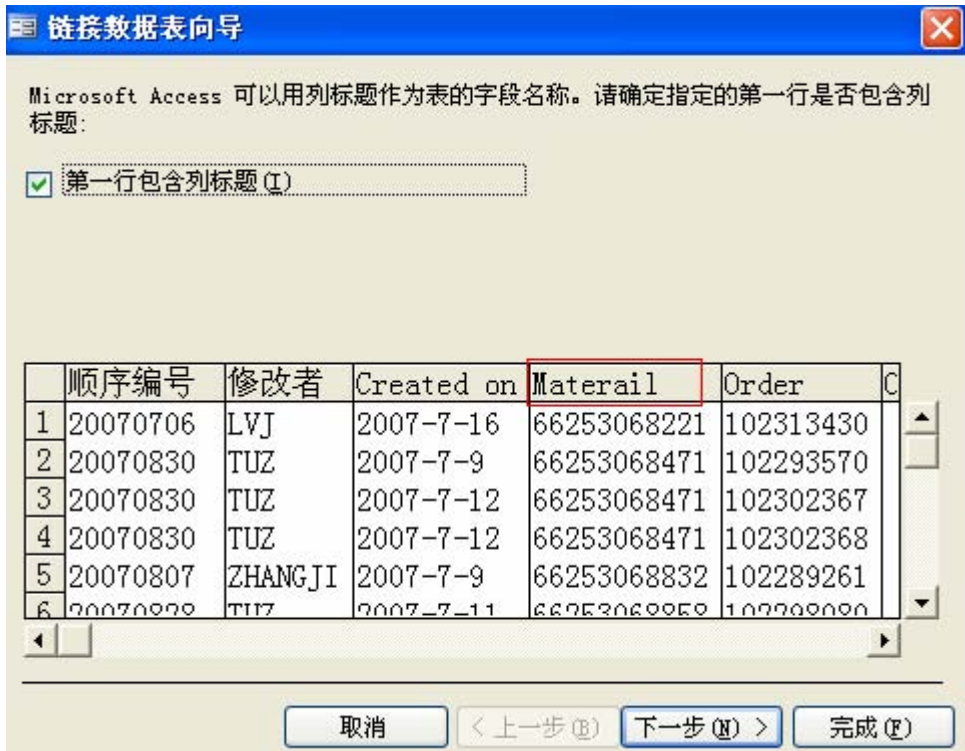
2.更新时弹出如图4-2所示窗口

图4-2

图4-3

出错原因: 转换字段时出错,即数据项(字段)名称不相同,如图4-3所示, "Material"误拼写为
"Materail" .

解决方法: 更正出错字段,并重新导入链接表.

76

3.更新时弹出如图4-4所以窗口,单击确定后,弹出如图4-5所示窗口,显示 "操作失败"

图4-4

图4-5

出错原因: 更改数据项(字段)时, 字段前有空格符,如图4-6所示
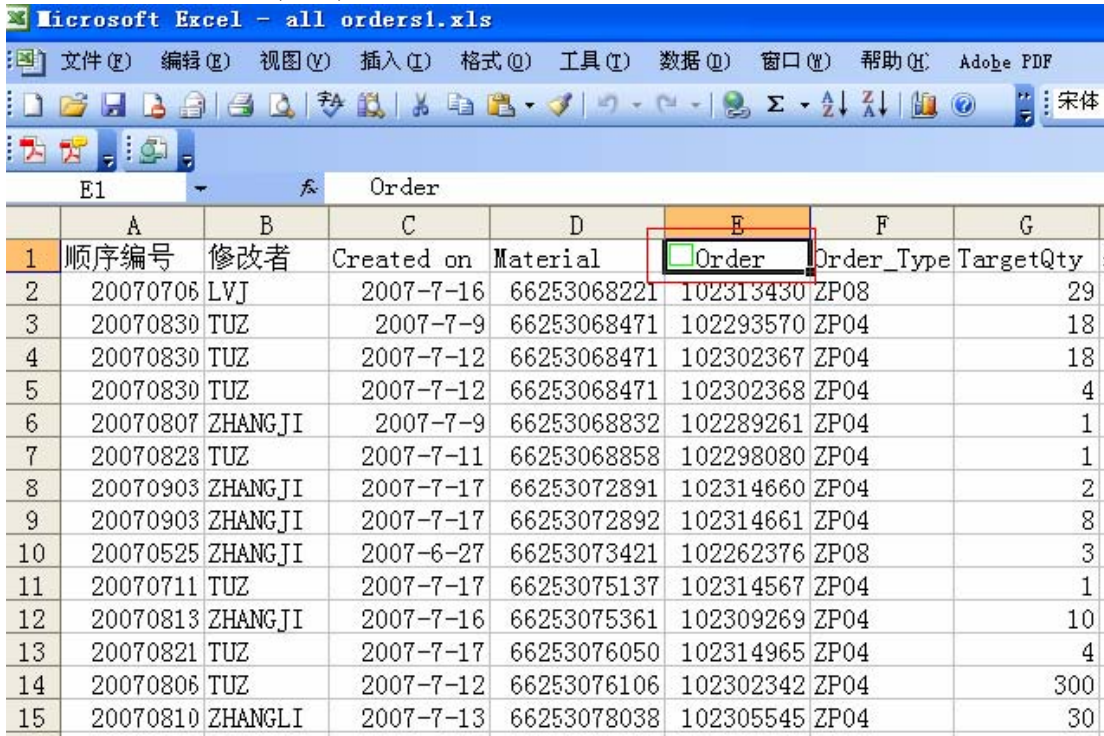
图4-6

解决方法: 去除空格符,重新链接数据表.然后再更新数据,如图4-7所示

C	D	E	F	G	H
Created on	Material	Order	Order_Type	TargetQty	基本完成
2007-7-16	66253068221	102313430	ZP08	29	2007-8-8
2007-7-9	66253068471	102293570	ZP04	18	2007-8-28
2007-7-12	66253068471	102302367	ZP04	18	2007-8-28
2007-7-12	66253068471	102302368	ZP04	4	2007-8-28
2007-7-9	66253068832	102289261	ZP04	1	2007-8-3
2007-7-11	66253068858	102298080	ZP04	1	2007-8-27
2007-7-17	66253072891	102314660	ZP04	2	2007-8-30
2007-7-17	66253072892	102314661	ZP04	8	2007-8-30
2007-6-27	66253073421	102262376	ZP08	3	2007-7-31
2007-7-17	66253075137	102314567	ZP04	1	2007-9-3
2007-7-16	66253075361	102309269	ZP04	10	2007-8-9
2007-7-17	66253076050	102314965	ZP04	4	2007-8-28
2007-7-12	66253076106	102302342	ZP04	300	2007-8-6
2007-7-13	66253078038	102305545	ZP04	30	2007-8-8
2007-7-16	66253078331	102310155	ZP04	1	2007-8-16
2007-7-16	66253078337	102310065	ZP04	1	2007-8-15
2007-7-16	66253078340	102310066	ZP04	1	2007-8-15
2007-7-9	66253078935	102293838	ZP04	10	2007-8-23

图4-7

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