INVENTING ORGANIZATIONS FOR THE 21ST CENTURY IN MEXICO. SUPPLY CHAIN MANAGEMENT IN A BREWERY

by

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Submitted to the Alfred P. Sloan School of Management and the School of Engineering in Partial Fulfillment of the Requirements for the Degree of

Master of Science in the Management of Technology

at the

Massachusetts Institute of Technology

May 1995

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ABSTRACT

This thesis is a glimpse of the future. The future is not something that we have to wait for, but to create, to bet on. In particular, the thesis focuses on Supply Chain Management in a Mexican Brewery, CERVECERIA CUAUHTEMOC-MOCTEZUMA. To complete this analysis of the entire value chain of the Logistics System, this thesis uses the Process Handbook methodology under development at the Center For Coordination Science at MIT.

At CERVECERIA CUAUHTEMOC-MOCTEZUMA, the Logistics process involves Procurement, Operations and Distribution System. The mission established by the Top Management is in three statements: Guarantee Availability, Assure Freshness and Give an excellent Quality of Service to every element in the Value Chain.

This paper is one of thesis projects involving the Process Handbook project in the frame of the 21st Century Initiative at MIT’s Center for Coordination Science. The Process Handbook is used to analyze and redesign processes, to invent new processes, and to design computer support for processes. Part of the eventual goal will be to "institutionalize" the collection and maintenance of a processes database so that other organizations can take it over. The Process Handbook methodology encourages the analyst to decompose a complete process into it tasks and sub-tasks. Using the concepts of dependencies and specializations to refine the decompositions, the analyst looks for insights and recommendations on how to structure the process in the future. Additional power of the methodology comes from comparing studies of similar and different processes within and outside the company's industry. Also, the Process Handbook uses a common language to facilitate comparisons across processes and across industries.

This thesis provides insights in the organizations of the future, explains how all these trends are forcing Mexico to take the same train, gives the different approach of logistics and supply chain management systems, and maps in detail the current Logistical Process as well as the proposal for the new operative vision in a "Pull" philosophy environment.

Thesis Supervisor: Professor Thomas W. Malone
Title: Patrick J. McGovern Professor of Information Systems
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OVERVIEW

First of all, I want to make clear that much of the arguments expressed here are personal opinions of the author.

This thesis is organized in 6 chapters.

Chapter 1 makes a glimpse of the future organizations. It proposes the "revolution of expectatives" as an explanation of that we are facing, and divides it in four revolutions in the organizations.

Chapter 2 tries to determine the interdependence between the World Megatrends and events occurred in Mexico. The purpose of this chapter is to encourage mexican organizations to invent new kinds of thinking as well as to clarify that there is just a world marketplace without borders anymore.

Chapter 3 makes a research study of the different approaches to supply chain management. The aim of the chapter is to define the Logistics as a strategic advantage for the 21st century, and to find the best option for Cerveceria Cuauhtemoc-Moctezuma.

Chapter 4 starts to apply the Process Handbook methodology to reengineer the logistics processes of the field site.

Chapter 5 and 6 go to a deeper analysis. In the chapter 5 the analysis is of the current processes, the chapter 6 proposes the new operative vision for Cerveceria Cuauhtemoc-Moctezuma.
1. THE REVOLUTION OF THE EXPECTATIVES

New Organizations

History repeats, and sometimes, it does so periodically. We are in the last years of the century and eventhough, the environment has pushed us to be reluctant to changes, inhibiting our natural desire to learning (THE FIFTH DISCIPLINE, Senge, 1990), we believe that we will face changes in the next century. We have two choices: To wait for the future, (passive future), or to stake to the future (active future). In this wave of changes, we have the historic momentum of "inventing the world where we would like to live" ( Malone, 1991). All of us know that in the last years of the nineteenth century, there was also a big concern about the future of the businesses, Frederick Taylor headed this initiative. In these days we also want to create a new revolution in the businesses.

The Four Revolutions in the Businesses

In order to create the organizations where we would like to work, or better, to live, we need to understand and to answer some questions: Do we really need a change?, what is happening that is forcing us, pulling us, to make a change?, or on the contrary, are we who are trying to push these changes? is there a sequence of changes, that we can track? I think that all these questions have a partial YES, however, I would like to explain my vision of all these changes. I believe that the different books, articles, papers, etc., that I have read, tell just a fragment of the story, and I would like to try to assemble them.

Four are the revolutions in chain, not independently. I would like to start with a thought of Dr. Albert Einstein: "THE PROBLEMS THAT WE FACE, CANNOT BE SOLVED AT THE SAME LEVEL OF THINKING THAT WE WERE, WHEN WE CREATED THEM". There are two important points here: we have created the problems, and the level of thinking to solve them must be different. In essence, 'we have to invent the wheel again'; Bernard Shaw said "The sense men are who adapt to the world, the senseless want the world to adapt to them,...the world has changed due to senseless". The senseless are the innovators, Edison did not want to adapt to the world, using gas forever, Graham Bell did not want to shout any more, to communicate with others who were far away, and so forth.
The Customer Revolution

The first revolution is the CUSTOMER REVOLUTION, that has been pulled by the Open Economy and the expanding of Communication Networks. Everyone has the opportunity not just to watch in the TV or in the movies, different products of everywhere, but also, he/she has the chance to go to the supermarket to select among a great variety of products of everywhere. These new market of large variety teach the customer that he/she can demand more from the suppliers, teach them that we are in a market of buyers, not sellers any more, these "new" requirements started to be understood and accepted as 'customers requirements' (Ishikawa, 1980), and "the voice of customer" (Akao, 83; Shonberger, 80).

The Manufacturing Revolution

The customer requirements start to be translated into variables in the language of manufacturing: QUALITY, QUICK RESPONSE, LARGE VARIETY, LOW COST. To make this revolution, we have to alternatives: the japanese style or the western style (Yasuhiro Monden, 1980). For this new market, we needed to go from volume to variety at a lower price, responsiveness and quality. The world was moving from the "machinery age" to "materials age". The Automotive Manufacturing Industry, -perhaps the most complicated to manage- was facing three big problems: floorshop control, quality and inventory cost. The american&western style did not have the solution, the american models of determining the quantity to produce: linear programming and EOQ (economic order quantity), based in "machinery age" were obsolete. They assumed that the constraints or restrictions were the machine resources. Linear Programming is not just static and with no suboptimals, but also, is focused in production, not in the market; its use cause inventory and inflexibility in the flow of products through the factory. Moreover, it works around operations (vertical), not around the products (horizontal). EOQ (ELZ, economic lot size in manufacturing) has the same kind of problem, mathematically tries to get the optimal quantity to produce, $Q'$, based in the elements described in the appendices (see the mathematical equations).

These American&Western models also provoked another problem: the plant distribution was based in "operations department" distribution such as Cut department, Lathe department, Drill department, Welding department, Grinding department, etc., in other words, as mentioned before: operations oriented, not products oriented.
In the competitive market the name of the game had changed, the Model T idea of Henry Ford does not meet the requirements of the customers any more. Two or three decades ago, it was not difficult to find in a classroom of 50 people, the same shirt or the same shoes or the same deodorant or tooth brush. In our days, this is almost impossible. The name of the game now and in the 21st century, is VARIETY, but not just that, VARIETY with quick response and quality are the value, and with competitive price.

The change of paradigm.

Moving from VOLUME to VARIETY meant change from the scale concept to scope concept. Scale looks for cost reduction based in big lot sizes. Scale has the eyes of production. Scope has the eyes of the market, the real challenge in Scale vs. Scope is to get VARIETY with cost reduction and quick response.

The Cellular distribution, (also known like Group Technology) in a Focused Factory environment, orients all the resources to produce a large variety of products. The despatching of each product responses -in a consumption/driven basis- to the requirements from the dealers in the field, through the Kanban System (pull system/visual factory).

The reduction of the set up time, -quick job changes of the dies- is a must in a cell. The "motto" in this system is "maintain constant the flow of the product trough all the process" (Taichi Ohno/Yasuhiro Monden. Toyota Production System, 1980), all the "stops" that produce inventory (waste) should be eliminated. The following table shows "The trick of productivity" of big lot sizes without the reduction of the set up time and lot size, "this is the first biggest rock that we have to eliminate" (Shigeo Shingo. SMED the hearth of the JIT Manufacturing, 1980).

By doing this, we can go from volume to variety, from scale to scope with a cost reduction advantage and a huge reduction in the responsiveness to the market.(SEE THE NEW APPROACH TO PRODUCTIVITY IN THE APPENDICES)

So far, we already talked about two of the big problems, inventory cost and floorshop control, what about the quality problem?, unfortunately, no good news, the American models created thank to Henry Ford assembly line a new word, the divorce between production and quality: INSPECTION and this disease was spreaded through all the system. Inspection created non-value added jobs, extra jobs, to check the work of pre-operations, creating the bureaucracy.
The Manufacturing Revolution started to pull changes in the staff areas, because of all this decentralization in the operations areas, the workshop through cellular manufacturing "horizontalized" its operation, it suffered first the "reengineering". We were having factories of the 21st century but the offices, the staff's, the administrative part was terribly "vertical".

*The Processes Revolution (the coordination challenge)*

"If you move information laterally, you've saved a long round-trip" Jim Manzi, CEO, Lotus Development, (FORTUNE, July 11, 1994).

The famous concept of Reengineering is simply the concept of cellular manufacturing taken to the administrative process. In the same way that the focus in a cell is to reorient physically all the resources around the product (man, materials, machinery, methods, the four M's), in the reengineering, the focus is also to reorient the resources around the critical processes, (whiches are, in essence, products).

Here, the idea is identify the "moments of true" (Carlzon, 1985), in other words, listening to the voice of customers, we know the impacts of our business in the customer, and translate them into internal 'horizontal' processes, and then, define the global variables of the processes. (Hammer&Champy, 1993). In this new organization the focus wont be driven by changes in production like in this century, but by changes in coordination.

The IT are not just the incredible help but also the incredible pusher for more changes in a 2nd of 3rd order (Malone, 1991). The information will also serve like a source of empowerment, in order to have self-directed teams. Groupware will also support the new virtual teams. In the Virtual Corporation, the old borders among customers-organization and suppliers will be invisible. It will be difficult to recognize the limits.

In the Horizontal Corporation, the measures of performance will not be by department anymore, but a global measure evaluated by the customer. The chimney effect of vertical organization, delaying the flow of decisions, material and information will be replaced by the adhocracies, where the everyone can access to everyone in a very informal but more sensible way. The role of Top Management is not of authority but of coordination to facilitate the processes in the teams. These new managers: "coordinators" will be responsible for the people who does the work, not for the work any more.
Regarding to the concept of Highly Decentralized Organizations, I consider that in every discipline, there are the two extremes and an infinite number of points in between. One scenario of the 21st century visualizes one of the extremes: that every person owns his/her company, in other words, every person is a company, every one is independent and interdependent as well. This assumes that the coordination matter is totally solved, there is no need of having people to do that non-value added job. The technical job is the most important and because of the spread of IT to solve "coordination stuff", all the negotiations could be done 'directly'.

Everyone has found and perfectly defined his/her "core competencies" (Hamel and Prahalad, 1990,HBR), instead of his/her products and they commercialize his/her "functionalities" exceeding the expectations of his/her customers through the EXPEDITIONARY MARKETING (Hamel and Prahalad, 1991,HBR).

In the scenario for the future of Malone (Malone, 1993) there is not leadership, not power in the hands of few. This utopia is the thinking of the human beings behaving like ants. But there is a problem. The Human beings are egoist by nature (Adam Smith, 1776, The Wealth of Nations; Bible, Romans, chp. 3). This scenario looks impossible. Regarding Resnick paper; or the "allure of decentralization", it is very attractive and fascinating to our ego to try to discover something new. In all the Human history, we can see the temptation of being like gods,

The Renaissance was characterized of men trying to be gods, like Michael Angello Buonarotti, who hit his Moses when he realized that his creation could not talk. I think that in this ending of 20th century, we are living a "New Renaissance", but know, based in technology. The history show us that the mankind suffers -sometimes unbeknownst- of the same sin since the creation: the desire of being like gods, (Bible, Genesis 3:5,6). Albert Einstein, one of the masterminds of all the times said that God is who guaranteed all the theories that he was writing, Newton, Keppler, Faraday and others had similar thoughts. I consider that is silly to think that there is not a "creator" of everything, like Resnick says, and if we are concern about the world where we would like to live, it is needed, in my opinion, to consider a value judgment of the decentralization trends. In our days, the Darwinism is something like a "religion", because nobody has been able to find the "lost link".

The probability of going with the invisible hand of biology from the monkey to man is ZERO. I think that the decentralization trends will shape the future, but it is very
dangerous to reject every paradigm, even the essential ones. Unfortunately, we do not live so long to learn what are the essentials and absolutes, but the history can help us. The lives of people like Leonardo Da Vinci, and others of The Renaissance show us the danger of the wish of being like gods.

*The Learning Revolution*

Returning to the thought of Einstein, I think that we have created the organizations in the same way that we learnt, in other words, we have fragmented the organizations, because our learning was also fragmented, we learn by discipline (by department) not by process or ability, and also, as I mentioned before, our natural learning has been inhibited by the environment. I know that it is not necessary to define the concept of learning organization (Senge, 1990; Stata, 1990; Leonard, 1990). Thus, perhaps it is better to depict my impressions of one of the manufacturing organizations that I think, it is in the path (see TOM PETERS, LIBERATION MANAGEMENT, 1992).

I cannot resist to tell that ABB could be a very good example of pursuing a Learning Organization. My first reaction is that Barnevik has gotten the binomial challenge of SBU (strategic business unit) and SMU (strategic manufacturing unit) integration. The "spotlight" shows that Top Management is interested in both the process and bottom line (5000 profit centers). ABB has the concept of Management teams (lion teams, FORTUNE aug, 94), as well as self-directed teams (ant teams).

I consider that the reengineering effort to pursue a lean organization is very plausible, my only concern is that perhaps he is very focused in the denominator, more than in the numerator, and considering that the denominator focus could jeopardize the future, probably would be important to light a red signal. (committing for the future, Prahalad HBR, aug, 94). I enjoyed the idea of converting in preachers to the responsible of the business. I also liked the intense internal competition, mainly, the idea of share the information among the 25 units, "each unit receives 24 more inputs", I think that this is an excellent example of organizational learning practice, where the information is the driver.

It is not easy to get a culture that accept sharing information so freely without hard feelings. I think that one of the most important challenges in the organizational learning is really to think as a team, learn as a team, (THE FIFTH DISCIPLINE, Peter Senge, 1990). Other very important topic, that is not so described but it is obvious that exists in an outstanding way is the Information Technologies framework.
To accomplish the effort of coordination through 140 countries, 215,000 people, is not an easy job. Returning to the information shared, it is not explicit what are the variables that they share per project, how do they evaluate in standard terms? I also would like to know how does the PROCESS OF CONTINUOUS EXPERTISE TRANSFER work? The T50, seems that is a real example of Simultaneous Engineering in empowered environment. Returning to the culture of internal competition, I would like to know how did they get a "culture of trust and exchange".

I Always have thought, and I am very happy to see that somebody like Barnevik, thinks the same is that you don't have to study something to death to make a decision. In this sense, I think that the traditional Scientific Method could be out of time in terms that the solutions are subordinated to the problem. The last generation of managers were worry of maintaining the present, instead of create the future. These managers have been busy taking care of the denominator (ROI,ROS, etc.), that is, the present; and the numerator has to be with the future.

I think that within less than 5 years, in a retrospectively view, we will see that putting now all the emphasis in restructuring or reengineering is a mistake. It is a way of selling the future market share. These ideas are needed, but primarily paying attention in the creation of the future. In the future, the quality won't be a competitive advantage but the price of the market entry. The competitive advantages that we consider today will be different than tomorrow. But, How to create the future?, it is easy to say it, but How? The statistics have demonstrated that the forecasting do not work.

I think that the Top Management should dedicate its time to create different scenarios, dynamic scenarios, no to compromise the future of the company for the next 10 o 20 years, the long term is very different now; if everything changes so rapidly, our conception the long term should be updated too. Then the idea is to dedicate more than 40-30-20 to the future (HAMEL&PRAHALAD,HBR,1994). Thus, when the conditions of our scenarios are present, we already exercise about them, but not in a waiting position, but creating and "pushing" the conditions that we desire.

In the Service Industry, mainly in consulting, it is easier to avoid the "vertical" environment, in other words, the "tunnel" effect. Then, for both EDS and Mckinsey, as well as Imagination, David Kelly Design, Chiat/Day/Mojo, and Eccles and Crane's is not so difficult to change the organization to a "horizontal" organization by business unit/project. The idea of adhocracies is widely spread in these companies: "We report to
each other”. There is not formality in the way they take the leadership in the different projects. The operation by "word of mouth", in the way they can talk with whomever they want to generate the connections necessary to help get any job done, presumes that the "coordination" should be a most to the extent of having everybody wired. This also permits a real learning environment.

I think that in this sense, EDS similar to ABB, where they have gotten a incredible culture of internal competition, which is a requisite to foster the learning. I really think that behind of all this changes, it is really needed a extraordinary platform of culture, in terms of trust, confidence, open minded, as well as a change in the reward system.

It is very important the point that being very in touch with the customer in an obsessive contact could become a weakness, in order to not to loose the spirit of outsider. Regarding the point of CEO's, twenty years ago, they came from Operations, 10 years ago, they came from Financial area, but know, to face the 21st century, the new CEO must be a 'horizontal' leader, a real holistic leader. Going more specifically to Mckinsey and its idea of 'project is everything', I really don't totally agree, I think that Peters looks superficial about it, even though I completely agree that the 'on job training' is very useful, the Japanese define this in a different way, they say that the real learning is a tradeoff between NEW KNOWLEDGE and ON JOB TRAINING. Mathematically, they understand this relation as follows:

\[ \text{LEARNING} = \frac{\text{NEW KNOWLEDGE}}{\text{ON JOB TRAINING}} \]

The Japanese say this relationship should be the value of 1, in other words, the two things are important, not just the practice, but also the new knowledge. I think that Peters was very concentrated in the consultants, not in the staff, who are the people developing the methodologies so well known of McKinsey. I think that in the work with the clients, the unglued organization is very useful, this informal way is more suitable for consulting work, without falling in disorganization. In some sense, Peters sounds like wonderland.

Summarizing, I think that the different authors evaluated in this research, have only a piece of the cake, their analysis is not systemic. That has been my intention, to try, as a I mentioned at the beginning, to assemble the different initiatives of the creation of the organization where we would like to live.
2. THE WORLD MEGATRENDS AFFECTING MEXICO

The Strategic Model for the 21st Century.

In the next two pages, I will depict graphically the strategic model, and the rough conception of the Center For 21st Century. In this conception, three elements will play a role: Education, Coordination Theory, Scenarios Creation.

The three elements named above will play a systemic role and intense relation.

STRAATEGIC MODEL
World Megatrends that affect Mexico

1.- An unstable world
2.- The Redefinition of the Competition
3.- The Globalization of the Business
4.- The Universalization of the Man
5.- The Explosive growing of the Communications
6.- The Biotech Industry
7.- The Systems Development with Autonomous Decision Making
8.- The Environmental Concern
9.- The Redefinition of the Woman in the Society
10.- The Redefinition of the Government Role
11.- Democracy and Plurinominalism
12.- The Emphasis in Education
13.- The growing gap between North and South
14.- The New Structure of the Economy

In the next pages, I will try to show how these megatrends are affecting Mexico, and how are these forcing it to cope the 21st Century. In a previous chapter, I talked about the new organizations for the 21st Century. In this chapter, I will show why the interdependence of
the megatrends show us clearly, that we in Mexico, have to take the same train: Inventing the Organizations of the Future.

For this purpose I would like to address the following questions: *Is there really a Redefinition of the Competition in the world? Have the rules of the competition changed? Has the economic hegemony of the last decades changed to different players? Is there really a new World Order?* If the answer is YES, *Is this fact affecting Mexico? Are these new rules invading Mexico as well? Is Mexico more International because of this? Is the Technology also driving the path of Mexico? Is really NAFTA, so far, provoking that Mexico is a link in the chain of North American Block? Are there real signals of internationalization in the Mexican companies? Is the number of Mexican companies growing overseas? Are the strategic alliances increasing? Is Mexico getting a growing percentage of the foreign investment world wide?*

**An unstable world**

The big changes of the last years, the collapse of the communism in eastern Europe, the reborn of Islam like a fundamentalism problem, the apparent European unification, etc. have created a new reoder of the world that is not yet defined. Because of all these changes, some countries are grouping in blocks, perhaps, trying to prepare for a new world structure.

The growing interdependence provoked by the increase in commercial trades, helped by the advance of communications and information technologies is impacting instantaneous and simultaneously to all the economies.

In the next ten years we will witnesses of many political crisis provoked by the reacomodation of the new world structure. Yugoslavia and Soviet Union are examples of these crisis. The end of the Cold War also provokes the reconversion of Military Industry and a decrease in the military expenditure. which will cause a reorder in the world economy. The Formation of Economic Blocks is still an experiment. Maastrich is an example of the economic changes that we will see, and the hypothesis is that all this will affect to all the economies.

But, what are the catalyzers of this huge process?
I identify three:

a) The growing facility of communication

b) The growing number of Multinationals

c) The speed of the technological change

a) *The growing facility of communication*

At the beginning of this century, there were communities with principles of autosufficiency that generated closed economies. With the extensive use of phone, TV, radio and massive transportation as well as the reduction of the cost of transport, the interaction among nations has increased dramatically. In some extent, the distances have been reduced. One way to show this is the % of change in the number of phones and televisions:

% change in the use of phone (1977-1989)

![Graph showing the change in the use of phones](image)

% change in the use of television (1977-1989)

![Graph showing the change in the use of televisions](image)


Also we can know almost immediately what is happening in all the countries, as well as their products and services, and the decisions or problems in the powerful countries or blocks affect the life in the different countries. The cracks in the powerful stock markets affect the others less important, as it is showed in the graph:
b) The growing number of Multinationals

In the past, the countries that were autosufficient to generate wealth for all the population using their natural resources, were considered with a solid economy, but now, recent studies have demonstrated that the specialization is a better strategy for a faster economic development (Porter, *The Competitive Advantage of the Nations*).

This process has its origin in the development of Multinationals. After the First World War, in the pioneer countries of the Industrial Revolution such as England, USA and France, enterprises with a futurist vision and wishes of expansion began to consider the option to install in other countries.

Thus, the governments started to give facilities first to export, and then for construct plants and create distribution channels. Examples of this are Procter&Gamble, Coca Cola, that took their products to overseas markets. Huge Organizations shape the future of many countries. Sometimes, some of these groups have more budget that those countries.
c) The speed of the technological change

As we have learnt in the class of Innovation and Technological Change, a nation or an enterprise can domain the market or lose it because of a technological change, in a so short time, affecting important economic variables.

In order to justify this trend, I would like to give some examples: The problem in the Persic Gulf, provoked at the beginning, an increase in price of the crude, and a decrease in the NYSE (New York Stock Exchange). However, when the world knew that the missiles Patriot could beat the missiles Scud, and the US diplomacy convinced the countries of middle east to not increase the prices, the confidence returned helping to increase NYSE, as well as decrease the price of oil.

In the next graph, it can be seen two things: the unstability of the world and the interrelation among the economies. This problem affected all the world.

Source: Nulty, Peter "Fiery Wells Won't Ignite Oil Prices". Fortune. March 25, 1991 pp. 41-42

In the words of Kenichi Ohmae, US, West Europe, and Japan form the "three", he says that these three axles define the shape of the world, and because of their unstability, they cause unstability globally.

For instance, the economic costs of East German provoked an increase in the interest rate in Germany, and then, the other European currency got weaker, affecting the European growth.
The pacific rim, with Japan, the king there, impacts all the world too. In 1992, the internal problems caused a decrease of 47% in the NIKKEI index from 1989, its highest level, to 1992, affecting in 2.9 billions USD of Japanese investments in Wall Street (Toy, Stewart. "Europe gets in shape by pushing out pink slips" Business Week. march 2, 1992 pp. 22-23).

Summarizing, the effects of this first megatrend in Mexico are:

- NAFTA
- Increasing local influence of the events around the world
- Increasing financial unstability

Regarding the second one, I would like to give another example of the global interrelation: The Collapse in The International Coffee Organization. This fact provoked that the price per pound fell from $1.86 in 1986 to $1.0 in 1987, and falling until $0.50 in 1992. The negatives consequences affected to the Mexican states Veracruz and Chiapas, so the Mexican peasants suffered by the decisions made in London.

![Relation between price/ pound of coffee and Mexican exports](source: International Coffee Organization. 1993)

The most important reason of the third one is caused by the big increase of the % of the portfolio foreign investment:
FOREIGN INVESTMENT IN MEXICO

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio</td>
<td>13.4</td>
<td>43</td>
<td>61</td>
<td>65.6</td>
</tr>
<tr>
<td>Direct</td>
<td>86.6</td>
<td>57</td>
<td>39</td>
<td>34.4</td>
</tr>
</tbody>
</table>


The Redefinition of the Competition

The New Economic Order

After Second World War, the US possessed the economic hegemony. The US made the rules of the game in the world economy. Its industrial potential gave it the power to do it, first with Europe and later with Asia.

However, the end of the world also brought a new structure, not only in military (US vs. Soviet Union) but also economically. Capitalism and Communism emerged like the alternatives for Economic Systems.

Now, there is a new Competition among The Individualism Anglo-saxon, british-American, Social Capitalism of Japan and Germany.

In this new Competition, commercial and politic alliance gave birth to three big Economic Blocks: The European Union, NAFTA and The Pacific Rim (with the leadership of Japan). This has been called The New Order (Thurow, 1992).

The Competitive Advantage

Historically, people, firms and nations were rich if they possessed natural resources. Natural resources helped them to have more capital per person, access to superior technology and then more abilities than their competitors.

In the nineteenth century, the availability of water, coal and technological innovation like the steam machine gave Great Britain the advantage, and being wealthy, was easier to become more wealthy. Later, US, with natural resources and with a massive system of high level of education, acquired the economic hegemony.

Nevertheless, the traditional sources of competitive advantage are changing. To be wealthy, is less advantage than in the past. To have the leadership in technology of products also a secondary advantage in some products given the reverse engineering,
which permits create the products faster and with less cost of R&D. Thus, the technology of process and the core capabilities gain more importance.

*Components of Competitive Advantage*

**Natural Resources**

With few exceptions, natural resources are not the principal source of competitive advantage. In the US, only 3% of the population is dedicated to activities of agriculture, fishing and mining. The green revolution has been decreased. The material science revolution has permitted less use of materials per unit of GDP. The US used less steel in 1990 than 1960, eventhough the GDP was 2.5 times higher. These reductions have provoked a general decrease in the prices of raw materials. The prices of 1990 were 30% lower than 1980 and 40% lower than 1970. In the next decades, the vendors of raw materials, mainly located in the third world, will see diminished their markets for their cheaper natural resources.

In few words, to have natural resources is not the door to be wealthy, but also, not to have them is not a barrier to become wealthy.

**Capital**

The availability of national capital is also less important in terms of competitiveness. The factories in poor countries can have access to the world market of capitals, by their own or taking advantage of joint ventures with multinational companies. Therefor, the most important factor is the cost of capital available and the facility to access to the market of capitals. Thus, it is the Federal Government who controls it, and who can encourage, through macroeconomics policies, the national competitiveness.

**Location**

In the past, each industry had a natural location depending of the place of raw materials or natural resources, however, if we mention the seven industries that are considered key for the next decade: microelectronics, biotechnology, new materials, civil aviation, telecommunications, robots and machine tools, computers and software; all of them are of high intellectual capital. Then, from the point of view of raw materials, they can be located in any place of the world. In Latin America, some governments are trying to follow the model exposed by Porter (Michael Porter, 1990) of Clusters, such as the "Mexican
Detroit", located 40 miles from Monterrey, Mexico; the Textile Industry in Puebla, Mexico. The governments of Colombia, Venezuela and Bolivia are also trying to follow similar models.

Technology

Traditionally, the winners were who invented new products; the British in the nineteenth century and US in the century XX became wealthy with the domain of the technology of product. However, in the twenty first century, the competitive advantage, as I mentioned before, will be more important the technology of process, and the technology of product will have just an initial advantage.

The strategy of R&D followed thirty years ago by Germany and Japan is correct today; these two countries spend one third in the new products research and two thirds in new processes research. The result of this strategy could be seen in the next table:

<table>
<thead>
<tr>
<th>WORLD EXPORTS (percent of participation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>USA</td>
</tr>
<tr>
<td>JAPAN</td>
</tr>
<tr>
<td>GERMANY</td>
</tr>
<tr>
<td>ASIAN TIGERS</td>
</tr>
</tbody>
</table>


The US followed different strategy. Let us think in three products: the videocamera and the VCR, the fax - invented by the US- and the compact disc - invented by Europe. The bottom line results show, in terms of sales, jobs and profits; they are Japanese products. (Thurow, 1992).

Technology of Quality

The TQM movement has defined in some extent, the leadership of the markets. The Automotive industry, for instance, domained in the past by US, is facing a big competition of the Japanese. The Quality of Japanese automobiles and their accessible prices have given them a growing percentage in the World Market:
Japanese Automotive Industry

% OF GROWTH

WORLD WIDE PRODUCTION (millions of units)

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>COUNTRY</th>
<th>Annual Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM</td>
<td>USA</td>
<td>7.0</td>
</tr>
<tr>
<td>Ford</td>
<td>USA</td>
<td>5.4</td>
</tr>
<tr>
<td>Toyota</td>
<td>Japan</td>
<td>4.7</td>
</tr>
<tr>
<td>Volkswagen</td>
<td>Germany</td>
<td>3.1</td>
</tr>
<tr>
<td>Nissan</td>
<td>Japan</td>
<td>3.1</td>
</tr>
<tr>
<td>Fiat</td>
<td>Italy</td>
<td>2.5</td>
</tr>
<tr>
<td>Peugeot</td>
<td>France</td>
<td>2.0</td>
</tr>
<tr>
<td>Honda</td>
<td>Japan</td>
<td>1.9</td>
</tr>
<tr>
<td>Mitsubishi</td>
<td>Japan</td>
<td>1.9</td>
</tr>
<tr>
<td>Renault</td>
<td>France</td>
<td>1.8</td>
</tr>
<tr>
<td>Mazda</td>
<td>Japan</td>
<td>1.6</td>
</tr>
<tr>
<td>Chrysler</td>
<td>USA</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Source: The Economist. May 9, 1992. p. 86

The new Japanese production methods: Kanban System, POKA-YOKE, SMED (single minute exchange of dies), quality circles, small group activities, TPM (total productive maintenance), QFD (Quality Function Deployment), that involve the lower level in the decisions making and continuous improvement have taken to the Japanese to be the most efficient producers of the world:
Information Systems

Production, Service, R&D Systems require Information Technologies to be successful. These systems will have to be integrated through all the value chain, including Marketing, Design, as well as the Support Services and Maintenance Systems.

Education and Training for the Work Force

The intellectual power will create new technologies but the abilities of the work force will permit the use of the new technologies. The human resource will have to be able to use technologies like CAD, CAE, CAM, Statistical Process Control, Just in Time, Flexible Manufacturing Systems and all this require a capable work force.

For the creation of the new technologies, the education of the work force is critical. In the US, between 1973 y 1990, the GDP grew 28%, but for two thirds of the total work force decreased their salaries 18%. The less level of education (in years) they had, the less the benefit in their salaries:
Internationalization

It is also considered a competitive advantage, because having access to international markets permits not only to increase the production volumes and reduce costs but also, the competition helps to improve the quality and to learn from the operative systems and technology of the competitors.

Regulations and Government Support

The Government policies have gained more importance as a support for the competitive advantage. The Government not only acts actively in macroeconomic aspects such as interest, parity, taxes, but also promoting activities such as export, support and subsidies to R&D and training. One of the best example is the government of the Asian Tigers.

Infrastructure

Any Nation can be competitive without having infrastructure of Basic Services such as freeways, highways, railroad, ports, telecommunications, mail, etc. Given the process of Internationalization, bringing products from far places, this component is essential for the competitiveness.
Top Management

The good education and experience of the Top Managers determine the innovation and efficiency to manage the businesses. In the new competitive environment is necessary a manager with an international vision, commitment to quality and an innovator spirit.

Basic and Applied Research:

Yet, it is impossible to find the exact correlation or ROI (Return of Investment) of R&D, there are clear evidences of success thank to R&D, dedicated both to Product and Process such as the cases of Microsoft and CISCO systems. The different countries spend different amounts as we can see in the next table:

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>150,765</td>
</tr>
<tr>
<td>JAPAN</td>
<td>85,642</td>
</tr>
<tr>
<td>GERMANY</td>
<td>42,062</td>
</tr>
<tr>
<td>FRANCE</td>
<td>28,613</td>
</tr>
<tr>
<td>UNITED KINGDOM</td>
<td>18,874</td>
</tr>
<tr>
<td>ITALY</td>
<td>14,744</td>
</tr>
<tr>
<td>CANADA</td>
<td>7,845</td>
</tr>
<tr>
<td>SPAIN</td>
<td>4,232</td>
</tr>
<tr>
<td>KOREA</td>
<td>3,209</td>
</tr>
<tr>
<td>INDIA</td>
<td>2,495</td>
</tr>
<tr>
<td>TAIWAN</td>
<td>2,075</td>
</tr>
<tr>
<td>BRAZIL</td>
<td>899</td>
</tr>
<tr>
<td>MEXICO</td>
<td>427</td>
</tr>
<tr>
<td>VENEZUELA</td>
<td>188</td>
</tr>
<tr>
<td>TAILANDIA</td>
<td>104</td>
</tr>
</tbody>
</table>

Source: Competitiveness, World Report. 1992

In order to summarize this Megatrend, the economic changes that are product of this new scheme of competition are a fact, which can be clearly seen in the next graphs:
The Main Impacts in Mexico:

- A growing number of companies, which products are part of an US productive chain;
- A growing number of strategic alliances between Mexican and foreign companies;
- A big impulse to the technological level in Mexican companies;
- A great impact of the TQM movement in Mexican organizations.
The World Megatrends seem to help the development of Mexico, because the weaknesses of Mexico are less important in this new context. For instance, the emphasize in engineering and technology and the technology transfer, as a result of the alliances with foreign companies, make that the weakness of science and technology development appears less important and have time through R&D alliances reduce the gap.

This has been reality through the years with the installation in Mexico of World Class Plants such as Ford, GM, Chrysler, John Deere, AT&T, Honda, Sony, Honeywell, etc. A good example is the Ford plant in Hermosillo, Mexico, which is considered the most productive plant of Ford worldwide. In this plant, the joint of foreign technology and the Mexican labor produce cars of top quality.

The necessity of US industry of facing the competition of Japanese brands, make the propitious environment to form productive chains in Mexico to low their costs. In 1991, products that are already part of a US chain productivity reach 7.132 US million dollars. (Centro de Estudios Estratégicos, 1993).

Mexico has one of the highest percentage of literacy in Latin America, 87%. In the last 4 years the trade with US has grown three times to more than 70 US billion dollars.

In the first year of NAFTA, there have been many examples of companies that understand the need to establish alliances in the new block. In the Supermarket business, the largest chains of Mexico: Aurrera, Comercial Mexicana and Gigante have negotiated alliances with Wall Mart, Price Club and Flemming Companies Inc. respectively.

The openness of the market, the industry in Mexico has begun the race to modernize the Productive Plant and have also begun to accelerate their technology development. Small businesses like "Pastelerías Monterrey" are using CAD for decorating the cakes. And large companies like TELMEX, taking advantage of its alliance with Southwestern Bell and France Telecom to modernize its technology.

The Mexican Government has promoted Productivity Programs in industries such as textile, shoes, tanning. These programs were launched in 1992.

The Government also started in 1989, a year after that US Malcolm Baldrige National Quality Award, the Mexican National Quality Award, which has the same categories evaluated than the US award. This has pulled and served like a reference model to adopt the Philosophy of Quality.
The Globalization (Internationalization) of the Business

Most of the US multinationals has their most relevant growth during the interval relatively stable after second World War. The Philosophy then was that the success of a product in the nation of origin could be replicated in other nations as well and then, could gain corporate wealth. that was why they undertook businesses toward a global scale. (Ohmae, 1990).

Some circumstances of the period post-war were favorable to US companies. The awful condition of almost every industry in Europe and Japan helped US to believe that its strategy was invulnerable.

In the decade of 50's and 60's, with the establishment of Communism in East Europe and the adoption of socialists ideas in other countries of the world, the idea of globalization had some problems. The trend of Government intervention to rule the economy was gaining more and more importance.

During the decade of 70's, almost every country in Latin America focused in the statization of the companies and the massive participation of the Government in the economy. The goal behind of this was to protect the domestic market of the "ambitious" foreign companies. Accordingly, Latin America suffered both an isolation and a deep backwardness in its industry competitiveness. Meanwhile, Japan as well as European Union addressed their economies toward the globalization of the markets and then, to the internationalization of their businesses.

Since the decade of 80's, the economic blocks have been going to consolidation with the aim to promote the commercial trade among countries and regions, accepting that the real strength is not bellicose anymore but economic. Countries such as Japan, US and Germany continue growing economically, as we can see in the expansion of their businesses. In the next table, we can see the International Distribution of McDonalds restaurants:
<table>
<thead>
<tr>
<th>COUNTRY</th>
<th># restaurants/1 mill people</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>36.0</td>
</tr>
<tr>
<td>Switzerland</td>
<td>4.5</td>
</tr>
<tr>
<td>Germany</td>
<td>5.7</td>
</tr>
<tr>
<td>Japan</td>
<td>8.1</td>
</tr>
<tr>
<td>Canada</td>
<td>24.7</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>11.6</td>
</tr>
<tr>
<td>France</td>
<td>4.5</td>
</tr>
<tr>
<td>Sweden</td>
<td>7.4</td>
</tr>
<tr>
<td>Australia</td>
<td>21.0</td>
</tr>
<tr>
<td>Great Britain</td>
<td>7.7</td>
</tr>
<tr>
<td>New Zealand</td>
<td>19.1</td>
</tr>
<tr>
<td>Bahamas</td>
<td>13.3</td>
</tr>
<tr>
<td>Mexico</td>
<td>0.8</td>
</tr>
<tr>
<td>Hungry</td>
<td>1.3</td>
</tr>
</tbody>
</table>


However, the Redefinition of the Competition mentioned above brings a change in the scheme of the multinational company.

In the 80's and 90's, the emphasize is not replicate only one productive system but the building of one world productive system with processes managed in different nations.

The world growth, as a result of this new scheme, breaks all the barriers and finish with the socialists economies of East Europe, giving pass to the age of world economic globalization, where the internationalization of the business plays a very important role.

The Internationalization of the business is an effect of the forces of change that are affecting the World Economic Environment. Kenichi Ohmae, mentions three fundamental forces:

1) An increase of an eager production of capital
2) An accelerated pace of new technologies
3) A more concentrated pattern of consumption

Moreover, we have to add an opposed important factor: The Protectionism (Ohmae, 1990). Altogether, these streams are modifying the rules of the power in the different industrial sectors, and in the economies of the developed countries, both at regional and world level.
Increase of an eager production of capital.

In many competitive companies, direct labor cost is less than 10% of the total production cost. They used to be eager to labor to be now eager of capital, because of the big investments needed such as equipment, automation of processes, R&D, technology, etc.

This change avoids to locate and make them profitable, production plants of high technology in countries of low technology level and cheap labor. For most of the sectors with high growing, the benefits of cheap labor are disappearing rapidly thanks in part to the optimization of process, materials, automation, etc. All these factors, have been reducing the need of labor.

The trend is to locate the production plants in places where they have available the engineering talent, constant touch with the customers, close to the big markets. This is clear in the fact that 80% of the 100 billions US dollars of world foreign investment is made in the developed nations. Thus, the net investment in developing countries is very low. The developing nations that have gotten the flows are those who have offered the best combination of qualified labor and low salaries such as Singapore, Taiwan and Korea.

Accelerated pace of new technologies.

I have mentioned that the technology is not a guarantee of success by itself. Most of the companies can not get the world market after having developed calmly the domestic market. Given that the cost of development is high, the companies must be able to launch the product simultaneously all over the world to recover the big initial investment. The result of all this is that the companies who do not follow the world strategy could find themselves completely blocked in their same domestic market.

More concentrated pattern of consumption.

In terms of life style, among US, Japan and Europe, there is a clear trend to the universalization, what means that a company has greater possibilities of winning the career of preference of the consumers developing products that can be used universally. Companies such as Seiko, Sony, Cannon, Matsushita, Casio and Honda continuously develop products which follow a world point of view.
Protectionism

To avoid the effects of the enormous export taxes imposed by the governments, the companies must convert in "immigrant companies" in the key markets and thus, avoid, in some measure, the negative effects of protectionism.

All these forces are in some extent defining the new economic order, where the internationalization of the company is promoted.

World Manifestations of the Internationalization of the Businesses

This globalization is intimately attached to the forming of the economic blocks among regions and countries. The globalization has as its objective, to reduce the tariffs, encouraging the commercial interchange among the countries.

This trend is shown in the next table:

<table>
<thead>
<tr>
<th>BLOCK</th>
<th># of countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sistema Economico Latino Americano</td>
<td>25</td>
</tr>
<tr>
<td>Asociacion Latinoamericana de Integracion</td>
<td>11</td>
</tr>
<tr>
<td>Mercosur</td>
<td>4</td>
</tr>
<tr>
<td>Mercado Comun del Caribe</td>
<td>9</td>
</tr>
<tr>
<td>Mercado Comun Centroamericano</td>
<td>5</td>
</tr>
<tr>
<td>Grupo Andino</td>
<td>5</td>
</tr>
<tr>
<td>European Association of Free Trade</td>
<td>7</td>
</tr>
<tr>
<td>European Union</td>
<td>12</td>
</tr>
<tr>
<td>Consejo de Ayuda Mutua Economica</td>
<td>8</td>
</tr>
<tr>
<td>OECD</td>
<td>123</td>
</tr>
<tr>
<td>GATT</td>
<td>3</td>
</tr>
</tbody>
</table>


The businesses that adopt a globalized vision are who will have more possibilities of success. A good example of this is Microsoft. In only some years it has domain the market of software. Its strategy is the penetration of the world markets to reach more users. (Rebello, 1992).
The Main Impacts in Mexico

- Mexican companies go overseas to compete
- An increase of the strategic alliances among Mexican and foreign companies
- An increase in the foreign investment in Mexico

Yet, Mexico remained isolated for decades, the winds of globalization are already in Mexico. The Government Policies are fundamented now toward open markets.

The first call was the entrance to GATT, and in less than 6 years, there has been a deep trend to globalization:
- NAFTA
- Acuerdo de Complementacion Economica con Chile
- Acuerdo de Libre Comercio con Centroamerica
- Pacto Andino (Colombia y Venezuela)
- Consejo Economico de la Cuenca del Pacifico (Pacific Rim)
- Agreements with European Union
- OECD

Some examples of Mexican Companies that have commercial/manufacturing operations in overseas:

<table>
<thead>
<tr>
<th>MEXICAN COMPANY</th>
<th>COUNTRY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bimbo</td>
<td>Guatemala, Chile, Colombia, El Salvador</td>
</tr>
<tr>
<td>Camesa</td>
<td>US, England</td>
</tr>
<tr>
<td>Camex</td>
<td>US, Spain</td>
</tr>
<tr>
<td>Condumex</td>
<td>US</td>
</tr>
<tr>
<td>Cydsa</td>
<td>Chile, Argentina, Venezuela</td>
</tr>
<tr>
<td>Desc</td>
<td>US</td>
</tr>
<tr>
<td>EPN</td>
<td>US</td>
</tr>
<tr>
<td>Grupo Chihuahua</td>
<td>US</td>
</tr>
<tr>
<td>Grupo Mexico</td>
<td>US</td>
</tr>
<tr>
<td>Herdez</td>
<td>US</td>
</tr>
<tr>
<td>ICA</td>
<td>US, Venezuela</td>
</tr>
<tr>
<td>Interceramic</td>
<td>US</td>
</tr>
<tr>
<td>Maseca</td>
<td>Costa Rica</td>
</tr>
<tr>
<td>Penoles</td>
<td>US</td>
</tr>
<tr>
<td>Pulsar</td>
<td>US</td>
</tr>
<tr>
<td>Quadrum</td>
<td>US</td>
</tr>
<tr>
<td>Real Turismo</td>
<td>Guatemala, Costa Rica</td>
</tr>
<tr>
<td>Sidek</td>
<td>US</td>
</tr>
<tr>
<td>TAMSA</td>
<td>US</td>
</tr>
<tr>
<td>Televisa</td>
<td>Chile, US</td>
</tr>
<tr>
<td>TMM</td>
<td>US, England</td>
</tr>
<tr>
<td>Tremec</td>
<td>US</td>
</tr>
<tr>
<td>Vitro</td>
<td>US</td>
</tr>
<tr>
<td>Grupo ICA</td>
<td>US, Latin America</td>
</tr>
<tr>
<td>Bufete Industrial</td>
<td>US, Latin America</td>
</tr>
</tbody>
</table>


Finally, in the next graph we can see the history and trends of the Foreign Investment in Mexico:
Conclusion

The ideas and facts exposed above clearly shows that Mexico is traveling in the same train of this New Economic Order. It is true that the gap is still big, but the measures that have been undertaken have showed positive results.

Following the same approach recommended by Ackoff, the next stage would be determine the Mexican Core Competencies.

This initial study will be part of the Project of the Center for the 21st Century to be developed in the ITESM
3. LOGISTICS, THE STRATEGIC ADVANTAGE FOR THE 21ST CENTURY

The Strategic Importance of Logistics

In these competitive times, there is a great pressure to improve customer service, and at the same time to find cost savings wherever possible. Companies that focus on improvements in logistics, transportation, and distribution often find both in large measure. Many large and small companies have found profits and growth in the significant savings possible through logistics engineering.

The impact of logistics, transportation and distribution engineering must not be underestimated. In the United States, direct transportation accounts for more than 16% of the GDP. When considering all impacts of logistics engineering, which includes transportation and distribution, this could increase to 25% or more.

Logistics engineering will thus have a major impact not only on the economic growth of companies, but also on entire countries. For example, some analysts and engineers claim that if the US economy is to recover, companies should follow and practice Japanese management practices. Although many Japanese techniques and principles are universally useful, each country should take advantage of its own unique assets, rather than blindly following a plan that works in another country. NAFTA provides an incredible challenge for logistics, transportation and distribution engineering to turn the economies around and regain former progress and growth.

Logistics definition

The broadest definition of logistics, adapted from the military by the new Logistics, Transportation, and Distribution interest group of IIE states:

*Logistics consists of all activities in support of an organization's prime mission. These activities include material management and storage, scheduling, transportation, packaging, distribution, front-end systems design, logistics information, support systems management and engineering, life cycle engineering and customer service.*

This definition includes four approaches to logistics:

- Military logistics;
• Logistics systems management that includes economics, marketing, distribution and information;

• Logistics engineering specializing in transportation engineering (for both carriers and users), packaging, material handling, technical design, front-end systems design, life cycle engineering, operations research, quality control and customer service, in addition to logistics systems management; and

• Manufacturing logistics, which applies logistics engineering and systems management to production systems in areas such as scheduling, buffer stock analysis, just-in-time (JIT), logistics quality control, optimization, training, recycling, disposal, environmental issues and productivity improvement.

Supply Chain Management

Logistics, transportation and distribution engineering can be divided into internal or in-plant logistics (which includes material handling and storage systems), and external manufacturing or distribution logistics (which includes transportation modes such as trains and trucks). Both must be integrated into the overall operations using a systems approach that minimizes costs at a competitive level of service.

Procurement, Operating and Distribution System

For example, plant layout and production planning must consider internal logistics, especially if JIT production is planned. Design of manufacturing cells includes reduction of travel and buffer stocks.

External manufacturing logistics engineering is employed when work-in-process (WIP) is shipped from one plant to another.

The transportation systems become extended conveyor systems between the plants, adding time and space utility to the WIP. Unfortunately, external transportation between plants generates transport time variability due to factors such as weather and traffic, resulting in variations in delivery times which result in the need for buffer stock and additional information systems.

Work is underway to develop transport probability analysis to measure and statistically analyze these transports to allow quantification and quality control measures.
Information systems are critical to good logistics engineering. While lead times can be physically reduced by hours or days, in some cases information lead times can be reduced by weeks—and at a lower cost. Common databases, shop floor data entry and bar codes are becoming common.

Other areas of logistics engineering important to government as well as manufacturing and service industries include lifecycle engineering, environmental impacts, energy conservation and solid waste transportation and disposal.

Yet the importance of logistics engineering is often underestimated because many of the costs are hidden and may surface in other cost centers altogether. This can make a decision maker look good at the company’s expense. For instance, the transportation manager of a company that imports regular shipments from overseas may select surface shipping instead of air freight in order to obtain the lowest rate.

Each shipment could take two to three weeks to move from the country of origin by ocean freighter, through customs, and finally overland to the warehouse, which must be much larger to accommodate a large "buffer stock" to protect against the huge variability in transport times. Due to this decision, the company must maintain a huge dollar investment in both the "pipeline inventory"—goods owned but unavailable while in transit—and the buffer stock, in addition to high loss and damage, packaging and handling costs. However, this investment in inventory does not show up in transportation costs, but goes underground through the corporation to emerge in such areas as capital acquisitions, where additional money must be borrowed for new improvements. This money would be available if the excess pipeline inventory could be sold. And because of the higher rate of borrowing, interest rates are leveraged even higher.

However, hidden costs are not the only problems. The long transportation lead times and huge buffer stock will reduce flexibility and impair customer service. The company is at a competitive disadvantage and is hemorrhaging profits, but the transportation manager may receive a promotion for "cutting costs". And the company may fail.

**Logistics, the Coordination Challenge**

Within the next five years, logistics, transportation and distribution engineering will evolve into major applications and research areas. This growth has already begun. Those businesses, universities and government agencies which are now taking action to develop logistics, transportation and distribution policies and departments that incorporate industrial
engineers will be strongly competitive in the future, with no need to try to "catch up" later. Companies that not only seize control of their logistics costs from the business perspective, but apply logistics, transportation and distribution engineering and technology will reap huge benefits.

Information Technologies will help to coordinate the elements in the Supply Chain Management through the new COORDINATION THEORY. Those that do not will regret it. Logistics engineering is one remaining area where great improvements in cash flow are possible, thus it will ultimately help to determine the futures of companies and countries.

For this research, I would like to raise the following questions: What are the sources of uncertainty in the supply chain management? How to gain competitiveness with the supply chain management? What about the SAFETY STOCKS? Which would be a good model for Supply Chain Total Cost/Value? What are the Myths and Realities of Inventory Control? How is the supply policy affected by the characteristics of demand, lead time, reliability of service and the quality of information available to the customer? How do the economics of manufacturing determine lead time, reliability, flexibility and run size? How does the complexity of the range, variety and options in the product portfolio affect the supply policy?

I will try to answer these questions through different sections, addressing the different elements in The Uncertainty Cycle:

THE UNCERTAINTY CYCLE

Manufacturing
- process design
- product design
- capacity
- quality

Customer Deliveries

Supplier Performance
- responsiveness
- transportation
- location
- quality

Customer Demand
- past performance
- market research
- analytical techn.
Integrated Supply Chain Management

Much has been written in the past few years about "integrated logistics", "the total cost concept" and "supply chain management". However, very few companies claim to have fully implemented these concepts and even fewer claim to have sustained the ongoing flow of benefits that a successful implementation should create.

This section provides an overview of the various thoughts and experiences of logistics consultants and practitioners over the past five years highlighting the similarities and differences between the different approaches. But, even more importantly, it attempts to explain the relative lack of success of all these techniques so far.

Bill Perry, a member of the Oliver Wight Group, writes that supply chain management (SCM) is a formal linkage among all levels in a marketing channel. That is, it is a technique that locks at all the links in the chain from raw material suppliers through various levels of manufacturing to warehousing and distribution to the final consumer. Because this technique looks at all the links in the supply chain, it allows development of a consistent supply and demand plan from the consumer to the supplier. In other words, by taking a holistic view of the process from start to finish, a planner can devise a complete plan for the movement through the chain of a specific product, which includes where the raw materials for the product will come from, what their path through the manufacturing cycle will be, and how they will be warehoused and distributed. This kind of planning could take place between the various functional groups (sales/marketing, manufacturing, distribution) of a vertically integrated enterprise, or between several independent companies in the distribution channel (raw material suppliers, manufacturers, third-party logistics services).

According to Perry, this kind of planning provides visibility into the needs of all customers. It provides this visibility throughout the supply chain, to all participants involved in the manufacture and movement of the goods. Perry sees three keys to achieving success with SCM. The first is that each level within the supply chain must use consistent planning tools and processes. Specifically, tools used must be time-phased inventory replenishment tools, such as Distribution Resource Planning (DRP) and MRP II.

The second key is that it must be possible to integrate higher levels' needs into lower levels' demands. This means that the information systems used must be integrated, and
capable of pushing demand from one level to the next (from sales to distribution, or from manufacturer to supplier).

The third key is that communication among all levels must be both effective and timely. Again, the need if for integrated system that allow quick transmission of information about changes in demand and the plans to meet demand. In conclusion, Perry states that true SCM only when all parties benefit. To Perry the solution is education, educate supply chain partners.

Bill Copacino, Managing Partner for Logistics at Anderson Consulting, sees information systems as the enabler of integrated logistics. He sees these capabilities as a absolute requirement for the 1990's. Copacino points out that in a stable environment we design for functional efficiency. That is, each functional area manages itself independently, each with the goal of achieving functional excellence and greatest functional efficiency. However, in an uncertain, dynamic environment, we must design for functional integration. Functional integration means establishing an organization with close relationships between functions. This kind of organization can operate in an integrated fashion, with close coordination between various parts of the organizations involved in getting the product to the customer. Such an organization allows quicker response to change and more overall flexibility.

Herbert W. Davis writes that the implementation of integrated logistics planning systems will substitute information for inventory, and can improve customer service, reduce carrying costs and provide much better visibility through the logistics process. Specifically, the following are identified as key building block systems:

- order management/customer service/invoicing
- Forecasting
- Distribution Requirements Planning (DRP)
- Warehouse and Inventory Management
- Manufacturing planning/Production control (MRP II)
- Integrated Logistics research

Kearney's research describes the three stages of Integration. In stage one, companies see their management mission in logistics only as controlling finished goods transportation and warehousing. They emphasize expediting today's workload above all. They show only piecemeal efforts to automate, with very few systems being introduced. Stage two companies take more of a tactical approach. Managers in the logistics areas of these
companies see their mission as the integration of finished goods distribution to satisfy customer demand. Logistics forms teams with other departments, with the goal of overall company profitability.

In stage three, companies take more of a strategic approach to logistics. They combine materials management with physical distribution and thereby integrate the entire logistics process. The logistics function increases its level of interaction with, and support of, other business functions. In stage three, logistics is fully incorporated into the company strategy.

**Approaches to Supply Chain Integration**

Writers on supply chain integration can be divided into three groups, each exploring the issue from a different point of view. *The Strategic View; The External Relations View; The IT View.*

The first group has clearly identified the problems resulting from operating the supply chain as a series of autonomous stages. These writers emphasize the importance of thinking strategically about the supply chain in order to solve these problems. Forrester is perhaps the best known of the writers who have identified the problems of managing individual stages independently. Subsequent writers who have looked at the strategic issues of supply chain management include Porter and Christopher.

The second group focuses its attention on supplier-vendor relationships at the points in the supply chain which represent the boundaries between different organizations.

One of the main groups working in this field is the Glasgow Business School group, whose research suggests that although lip service is paid to the need for closer links between suppliers and vendors, this has not yet happened to any significant extent. Stevens has suggested that integration of the supply chain involves four phases: No Integration, Functional Integration, Internal Integration and External Integration. As the last phase is integration of external organizations it is perhaps not surprising that supplier-vendor integration is still somewhat limited.

The third group has concentrated its attention on the IT systems which are necessary to enable rapid information transfer along the supply chain. Techniques being explored include distribution resource planning (DRP), electronic data interchange (EDI) and the use of electronic bar-coding.
Methodologies for supply chain management

It is only recently that the phrase 'supply chain management' has come into frequent use by academics, consultants and practitioners as interest in this area has increased. It is used here to describe the management of flows across boundaries; these may be interdepartmental (within a company), intercompany or intercountry boundaries. The need to understand supply chains has increased for a variety of reasons, including the focusing and globalization of businesses, the coming of the single European market, the reduction in supplier bases, enabling information technologies and changing product technologies. All these factors have caused or enabled changes in supply networks from raw material source to end-customer.

Many companies are now appreciating the dynamics and complexities of the networks and chains within which they operate. However, to date little has been provided methodologically to help analyze chains of supply, identify where problems lie and examine possible causes of those problems, to help design and implement improvements. Using examples from the automotive aftermarket, this section describes research which assessed the requirements of a methodology to help in this area. It then checked available methods from various subject areas including information systems, operations management and marketing. Having identified that no single available method would perform the required tasks, the research led to the information of a hybrid methodology drawing together a variety of methods into one conceptual framework. Because this framework focused on the effectiveness of businesses in satisfying customers, rather than just internal efficiency, it became known as the Effectiveness Framework.

The Effectiveness Framework is a methodology for analyzing the requirements of external supply chains and highlighting problems in internal supply chains in meeting those requirements. It is therefore an 'outside-in' planning approach. That identification of strategic options is strengthened by an assessment of external opportunities and internal capability is widely accepted. The framework identifies areas of business activity critical to end-customer service. End-customer service is defined in terms of:

- quality
- delivery
- service
- price
- product range
- innovation
This list is based on the criteria for customer selection defined by Hill and the criteria for evaluating supplier performance defined by Smith and Weiters. The framework highlights problems and possible causes; it is then necessary to design and implement solutions to those causes. The main strength of the Effectiveness Framework lies in its tracing of causality of end-customer requirements back through supply chains, identifying and analyzing critical activities at each link in the chain. The framework was not intended to be strong in design methods as there are already many available.

Rather it provides focused analysis, the results of which can be used with existing design methods. By tracing back up the supply chain, across organizational boundaries, problems which previously may not have been evident are highlighted.

This differs from approaches which react to known problems.

With the exception of Porter's value chain analysis, no other methodology explicitly focuses on end-customers and supply chains.

<table>
<thead>
<tr>
<th>Main stages of the effectiveness framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand the network</td>
</tr>
<tr>
<td>Identify strategic chains</td>
</tr>
<tr>
<td>Examine players in each strategic chain</td>
</tr>
<tr>
<td>Trace back end-customer requirements</td>
</tr>
<tr>
<td>Identify causes of satisfaction and dissatisfaction of end-customers</td>
</tr>
<tr>
<td>Analyze causes</td>
</tr>
<tr>
<td>Design and implement improvements</td>
</tr>
<tr>
<td>Measure Performance</td>
</tr>
</tbody>
</table>

**Push Systems and Pull Systems**

In Push systems, there is a central decision maker who possesses continuously or periodically updated information about inventories and sales at all relevant facilities. This information is used to decide (i) when to place orders with an outside supplier, (ii) in what quantities, (iii) when to transfer stock from the upper to the lower echelon and (iv) how to allocate the released stock among the retailers.
In a Pull system, it is each outlet which places orders with the depot on the basis of its own local information (inventory level and shipments outstanding). The warehouse responds passively to these orders and fills them on a first-come-first-serve basis as long as sufficient stocks are available. The depot decides on all orders to the outside supplier, either on the basis of its own inventory position only, or on that of all facilities.

Factors in Supply Chain Management

Supply chain management differs significantly from classical materials and manufacturing control in four respects:

1. The supply chain is viewed as a single process. Responsibility for the various segments in the chain is not fragmented and relegated to functional areas such as manufacturing, purchasing, distribution and sales.

2. Supply chain management calls for and in the end depends on strategic decision making. "Supply" is a shared objective of practically every function in the chain and is of particular strategic significance because of its impact on overall costs and market share.

3. Supply chain management call for a different perspective on inventories which are used as a balancing mechanism of last, not first, resort.

4. A new approach to systems is required--integration rather than interfacing.

Safety Stocks

Most of the research literature on safety stocks in manufacturing systems uses a common model for representing the behavior of the manufacturing system. All manufacturing systems operate with significant investments in inventory. This inventory consists of raw material and parts stock, work-in-process inventory, and end-item inventory. These inventories are needed for many reasons.

A certain portion, called pipeline stock, is due to processing or transit times. Another portion, cycle stock, is due to the fact that production and material handling activities occur in batches.

A third component is anticipation of high-demand periods for a seasonal product line; this inventory results when it is not economic for the production system to adapt its production rate to match demand over a medium-term planning horizon. These components of the inventory are completely predictable and explainable: the average pipeline stock depends only on the production volumes and processing/transit times; the average cycle stock
depends only on the production volumes and production batch sizes; the anticipation stock at any point in a seasonal cycle is the cumulative difference between the aggregate production rate and the aggregate demand rate.

Furthermore, it is clear how to affect these inventories. To reduce the pipeline stock, we need to reduce the batch sizes. To reduce the anticipation stock, we plan aggregate production so that it tracks aggregate demand more closely. If the manufacturing system operated in a deterministic world, and if there were always adequate short-term capacity, this would be the only inventory needed by the manufacturing system.

Needless to say, this is anything but the case. Indeed, for most manufacturing systems, inventory in excess of the pipeline, cycle, and anticipation stocks is very significant. This excess inventory, the safety stocks, is needed in a manufacturing system because of uncertainties in the requirements, production, and supply processes, and because of the inflexibility of the manufacturing system.

A manufacturing system uses safety stocks to maintain satisfactory performance, in terms of customer service and production costs, in the face of the various sources of uncertainty and in light of its own inability to respond adequately to short-term fluctuations.

Safety stocks are "excess" inventories held beyond the minimum inventory level that would be possible in a deterministic and uncapacitated world. The need for safety stock is also due to the inflexibility of manufacturing systems. Manufacturing systems typically consist of multiple production stages, requiring multiple resources and producing multiple products. A particular product may require processing at several stages, and must compete for production resources at each stage with other products.

Although there is not a large literature on safety stocks in manufacturing systems, there are several distinct approaches that have been proposed and studied. The vast majority of these approaches start from the paradigm given above, and can be roughly categorized into exact analyses that attempt to characterize rigorously the optimal inventory policies, and approximate models that attempt to provide good and implementable solutions.
### Actions to improve Supply Chain Performance

<table>
<thead>
<tr>
<th>Supplier Performance</th>
<th>PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use common components and subassemblies in many products (to pool risk of stockouts)</td>
<td>Reward good performance (base on ship date, not delivery date)</td>
</tr>
<tr>
<td>Follow industry standards (to increase part availability)</td>
<td>Measure transportation performance separately</td>
</tr>
<tr>
<td>Share information with strategic partners</td>
<td>Subcontract inbound freight handling</td>
</tr>
<tr>
<td></td>
<td>Source locally (to shorten lead times)</td>
</tr>
<tr>
<td></td>
<td>Review stocks more frequently</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Manufacturing</th>
<th>PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower tolerances</td>
<td>Remove bottlenecks</td>
</tr>
<tr>
<td>Pool engineering change orders</td>
<td>Size buffers appropriately</td>
</tr>
<tr>
<td>Use standard processes</td>
<td>Reduce setups</td>
</tr>
<tr>
<td>Produce a generic product</td>
<td>Shorten cycle times</td>
</tr>
<tr>
<td></td>
<td>Introduce self-managed work teams</td>
</tr>
<tr>
<td></td>
<td>Install buffer capacity</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Customer Demand</th>
<th>PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design for localization</td>
<td>Change transportation mode</td>
</tr>
<tr>
<td>Customize products in software, not hardware</td>
<td>Implement better data systems</td>
</tr>
<tr>
<td>Manage delivery expectations (service requirements)</td>
<td>Introduce improved forecasting techniques</td>
</tr>
<tr>
<td></td>
<td>Subcontract distribution operations</td>
</tr>
<tr>
<td></td>
<td>Build near customers</td>
</tr>
</tbody>
</table>

Pitfalls of Supply Chain Inventory Management and their symptoms

1. **No supply chain metrics**
   - independent and disconnected individual sites
   - incomplete metrics
   - performance measures not tracked
• no attention to measures tracked

2.- **Inadequate definition of customer service**
• inadequacy of line-item fill rate measure
• no measures for response times
• no measures for lateness
• no measures for backorder profile

3.- **Inaccurate delivery status data**
• delays in providing delivery information
• inaccurate delivery information

4.- **Inefficient Information systems**
• inadequate linkage among database at different sites
• proliferation of operating systems for the same function at different sites
• delays and inaccuracies of data transfer

5.- **Ignoring the impact of uncertainties**
• no documentation or tracking of key sources of uncertainties
• partial information on sources of uncertainties

6.- **Simplistic Inventory stocking policies**
• stocking policies independent of magnitudes of uncertainties
• static stocking policies
• generic and subjective stocking policies

7.- **Discrimination against internal customers**
• no service measures of internal customer
• low priority for internal orders
• inappropriate incentive systems
• jockeying for priority among different internal divisions

8.- **Poor coordination**
• no coordination among supplying divisions to complete an order
• no system information among multiple supplying divisions
• independent shipment plans

9.- **Incomplete shipment methods analysis**
• no consideration of inventory and response time effects

10.- **Incorrect assessment of inventory costs**
• omission of obsolescence and cost of rework
• no quantitative basis for inventory holding cost assessments

11.- **Organizational Barriers**
• independent performances measures and incentive systems at different sites
• barriers between manufacturing and distribution

12.- **Product-process design without supply chain consideration**
• no consideration of manufacturing and distribution in product-process design
• no consideration in design for customization and localization
• organizational barriers between design and the supply chain
13. - **Separation of supply chain design from operational decisions**
   - chain decisions without consideration of inventory and response time efficiencies

14. - **Incomplete supply chain**
   - focus on internal operations only
   - inadequate understanding of operational environment and needs of immediate and ultimate customers

Inventory Myths

"Sophisticated techniques and organizational discipline will provide more accurate sales forecasts"

"Japanese techniques, such as *Just in Time*, will all but eliminate inventory problems"

"Inventory provides the necessary buffer to protect manufacturing from seasonal and business cycle variations"

"Local presence is a key element of our service--you can't sell from an empty wagon"

"Distributors, as independent businessman, provide local availability and entrepreneurial inventory management"

"Local dealers need to be backed up by readily available regional stocks"

"Modern information systems and control methods will all but eliminate obsolete and slow-moving inventories"

**Supply Chain Total Cost/Value**

Interfunctional total cost is the core concept of logistics.

It was first formally implemented in the 1940's between physical functions such as traffic and warehousing. The history of the field shows extensions of the idea into many other functions. Given the rise of strategic alliances, supply chains, and partnerships, it is appropriate to look at a greatly expanded *interfirm total cost* concept as a critical opportunity area in the quest for competitiveness and value added management.

Traditional distribution costs included all activities starting at the finished goods end of the production line and ending with delivery to the customer. The evolution of materials management since the 1970's brought pre- and post-production flows closer together. But
successful application of the supply chain concept and strategic alliances of firms now require a look into the firm's entire procurement production-logistics processes in addition to those of customers. The supply concept consists of actively managed channels of procurement and distribution. It is the group of firms the add value along product flow from original raw materials to final customer.

It concentrates upon relational factors rather than transactional ones. The supply chain view includes firms that cooperate in such areas as research and development and produce design, and often conduct multiple firm joint analyses all with the quest of making the final product at overall lesser total cost and/or with a greater set of values than competing sets of supply chain firms.

A total cost view from materials to the ultimate customer

Traditional total cost systems tend to be limiting from two standpoints. Logistics analyses have typically started with a completed product and extended throughout the firm's distribution system. These analyses usually ended at the final shipping point from the firm, or they included channel analysis with related costs and markups. In the 1980's, direct product profitability (DPP) projected this analysis through to the final store sales point. This scope is limited and tends to be static in application through periodic special studies at specific points in time. Another limiting factor is that basic budgeting and many information systems are functional in orientation. That is, the process of collecting, processing and reporting has been centered around activity functions.

This is often creates "functional chimneys" in the firm whereby information is collected, aggregated, and reported upward in the firm according to individual functions and groups in which they are housed. The information tends no to follow the horizontal flow of materials into, through, and out of the firm that would provide a single total cost measure of past and current flows and give managers decision-making information for future flows. Total costs in these contexts are often seen in special studies, such as benchmarking efforts, but they are not visible nor easily usable to the manager on a daily basis.

For customer satisfaction all costs and factors that affect costs and create value should be captured in a total cost/value model. The next variables provide a hierarchy of costs and other factors that build upward from raw materials through manufacturing, distribution, to final marketing and selection and use by the ultimate customer. It is composed of basic costs and value elements that combine into ten key strategic and management areas.
1. Traditional Basic Input Costs
2. Direct Transaction Costs
3. Supply Relational Costs
4. Landed Costs
5. Quality Costs/Factors
6. Operations/Logistics Costs
   • receiving and make-ready costs
   • lot size costs
   • production costs
   • logistics chain costs
7. Indirect Financial Costs
8. Tactical Input Factors
9. Intermediate Customer Factors
10. Strategic Business Factors

The measurement of these variables help to reduce interdepartmental boundary and enhancing interfirm cooperation. It recognizes that the supplier and customer are not adversaries. The "competition" in this situation is against other sets of firms. These elements help direct firm's attention to the set of cost and value attributes that lead to the primary demand of the final sale and derived demand in the chain up to that sale.

This is just the beginning of my research in logistics, and supply chain management. These ideas helped to understand what is going on in this matter, and I feel very satisfied with the consensus that this topic, -helped with the coordination by Information Technologies- will be an important research study and primary element of competitiveness in the 21st century.
4. PROCESS HANDBOOK IN ACTION

Project Overview

This thesis examines the role of IT in managing supply chains and performing logistical analysis to develop logistics systems of the future. In particular, I have chosen to study the interactions throughout the value chain of an actual brewery in Mexico, Cuauhtemoc Moctezuma. The operations of this brewery mirror the operations of many firms in this industry.

Using the Process Handbook Methodology within the framework of the Checkland Methodology, I have attempted to reinvent the supply chain management system of the Cuauhtemoc Moctezuma Brewery (CMB) -- creating an organization which both addresses current issues and positions the company for growth and success in the future. There are seven steps in the Checkland Methodology process: I define the problem, structure the problem, define the ideal model, structure the ideal model, compare the problem with the ideal model, define feasible and desirable changes, and develop plan for implementing changes. This paper includes the first five steps of the methodology: I define the problem of my specialty area; I define, in depth, the nature of the problems at the Cuauhtemoc Moctezuma Brewery; I design my concept of an ideal model; I map the new processes with the ideal concepts in mind; and I compare the new processes with my ideal concept. I have used the Process Handbook Methodology to gain a deeper level of insight concerning the interactions of and the relationships between activities performed in the Cuauhtemoc Moctezuma Brewery, as well as activities to be performed in our "organization of the 21st century."

Process Documentation Methodology

The objective of the methodology is to represent and codify organizational processes and structures, in a graphic way, at varying levels of abstraction.

1. Determine according to the application that will be given to the document, the abstraction level of the processes which one wants to achieve. This is, determine how specifically (detail level) the processes will be represented.
2. Create a structure, content and format to obtain a process description of each of the processes to be documented. Try to obtain as much information as possible, and return to this step as many times as necessary.

A proposed form is the following:

<table>
<thead>
<tr>
<th>Process name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Necessary information for the process to be done:</td>
</tr>
<tr>
<td>Who sends or where this information comes from:</td>
</tr>
<tr>
<td>Transformation process done to this information:</td>
</tr>
<tr>
<td>Outputs of the transformation process:</td>
</tr>
<tr>
<td>Users of these outputs:</td>
</tr>
<tr>
<td>Necessary resources to perform the process:</td>
</tr>
<tr>
<td>Activities or subactivities of the process:</td>
</tr>
<tr>
<td>Alternative ways of performing these activities:</td>
</tr>
<tr>
<td>Who participates in performing the process:</td>
</tr>
<tr>
<td>Specific and technical information (data) concerning the process:</td>
</tr>
</tbody>
</table>

3. Using the above format describe a general vision of the desired process (es) and subprocess (es).

4. For each and everyone of the processes and subprocesses to document the following should be defined, it is recommended to follow the order presented:
   a) Sequence of activities.
   b) Ways to perform the activities.
   c) Activities decomposition.
   d) Dependencies between activities and kind of dependencies.
   e) Existing coordination processes to manage dependencies.

5. To represent the processes, process diagrams or maps should be created using the simbology presented further.

Note: Activities should be represented in the diagrams, not functions or responsible of the activities, do not take into consideration the department in which the activity is performed to determine the dependencies.
Simbology for the Process Handbook Methodology

**Activity**

A is the main activity of the process title

A is the first activity performed in the process

A is the final activity of the process, it represents the process which will use A's outputs

**Decomposition**

B and C are activities needed to perform A. B and C are subactivities for A, necessary to have A as a result

**Specialization**

B and C are alternative specializations of A. (They are not necessarily dependent between them, they are options)
Justification of Using Checkland Methodology

Peter B. Checkland is a Professor of University of Lancaster in England. He is one of the pioneers of Systems Engineering in the world. The Systems Engineering discipline has two schools; the soft and the hard; the qualitative and the quantitative. The former one is
led by the British, mainly by the University of Lancaster and more recently, the University of Hull. The latter is led by MIT, Professor Jay Forrester with Systems Dynamics.

Why did I chose this methodology? Checkland Methodology has the following characteristics:

1) It is a Systems Engineering Methodology, and then, it uses the framework of Systems thinking.

2) It is holistic; that means that it considers a whole system, as well as the factorial interactions among the different subsystems.

3) It includes the principle of “Ideal Design”. The ideal Design pretends to re-invent the system from scratch. But also, includes the comparisons between both system, the current and the re-invented, to plan, from this point the implementation program.

4) The symbiosis between Checkland and Process Handbook is suitable because Checkland steps 2 and 4 can be mapped with that approach. Normally, these two steps would be mapped using “systemic maps Cause-Effect” (like the ones used in System Dynamics).

Logistics

"Logistics, a long used in operations-intensive area, has suddenly become very strategic," says Robert Sabath, VP of Mercer management consulting. Many companies are beginning to consider logistics as a source for their competitive advantage in the future. What is logistics? Logistics consists of all activities in support of an organization’s prime mission. These activities include material management, material storage, scheduling, transportation, packaging distribution, systems design, logistics information, support systems management, systems engineering, life-cycle engineering, and customer service.

The challenge of logistics is that it transcends functional boundaries and inherently requires integration, communication, and coordination. As a result, methodology technologies (such as KANBAN) and information technologies (such as Electronic Data Interchange) are the “keys to unlocking a myriad of golden opportunities.” However, one must keep in mind that the challenges of Supply Chain Management (SCM) are exacerbated when dealing with a perishable product, such as beer.
I specifically look at the value chain of the Cuauhtemoc Moctezuma Brewery (CMB), from brewery suppliers to domestic distributors.

![SUPPLIER] → [BREWERY] → [DEALER]

The concepts and processes defined for this brewery are based on these product objectives: availability, freshness, and cost. Therefore the analysis and recommendations are generically applicable to any system with similar objectives.

**Description of the Existing Process.**

The CMB supply chain is complex. It involves dozens of suppliers, seven plants, and over 600 domestic distributors (dealers). Each of the plants centrally produce a different beer, but dealers receive and distribute all CM beers. The existing system is not meeting freshness, availability, and cost objectives.

The current process, which uses a sophisticated information system to track inventory levels, is based on a “push” philosophy. Push implies that materials are ordered, beer is brewed, then product is delivered. This sequence of events is based on forecasts of demand for each product. Forecast errors are then adjusted for in the next iteration. Demand forecasts are based on sophisticated heuristics using historic seasonal data. These forecasts are then consolidated with existing inventory data available on the real-time information system. Such a system is inherently inaccurate since all operations are based on forecasts which are themselves inherently inaccurate. Thus, beer is pushed to the dealers with the hope that the amount pushed is the amount consumed. Variations result in either excess beer or insufficient beer. Excess beer will: lose freshness if not sold in time, require extra storage space, have a capital carrying cost. Unavailable beer will: drive customers to purchase available competitor beer and dissatisfy dealers and customers.

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>Push versus Pull -- Inventory Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAKE → Push</td>
<td>SELL</td>
</tr>
<tr>
<td>MAKE → Pull</td>
<td>SELL</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following excerpts illustrate some of the key dependencies, one in the current system and the second in an invented system. The excerpts have been simplified for clarity.
CURRENT SYSTEM (PUSH)

Supplier

Dealer

Route

Transport

Plant

Transport

Retailer

Customers

Information Flow
The arrows in this figure indicate flow dependencies between various activities in the current Cuauhtemoc Moctezuma Process. Notice that the "brew beer" activity "depends on" the "procure inputs" activity. In other words, you can't brew anything without the proper ingredients. Also, notice how there are dependencies which cross functional boundaries. These are critical dependencies which can often indicate novel interactions and sometimes severe inefficiency in a particular operation.
Shared Resource: (excerpt from Electronic KANBAN Pull System - Innovative Example, triggering different brands)

The arrows in this figure illustrate shared resource dependencies between three of the activities decomposed from the “manage brewing process” activity that exists in an invented process. Notice that all three of these decomposed activities “depend on” the resources and activities needed to “access historic data.”
I used both the Process Handbook Methodology and the Reality Tree Method to analyze the Existing System.

The Reality Tree is one of the tools of Theory of Constraints. Theory of Constraints was developed by Elijah Goldratt. Its focus is in finding the bottlenecks (constraints) of a process, and then, produce/work to the pace of the bottlenecks. In order to find these
constraints, the reality tree spells out the problems exposed in a brain-storm atmosphere, and locks for interactions of each one, finding the root causes. It adds, to the systemic map cause-effect, two elements: $\circ$, that means two or more "problems" cause simultaneously another problem; $\Box$, means a negative cycle is produced by the interaction. The Reality Tree starts by the depicting the main goals of the ideal system. In the case of the brewery, the goals are availability, freshness, and cost.

The Cuauhtemoc Moctezuma Push System does have some merits. Cuauhtemoc Moctezuma is an actual brewery in Mexico which uses a push system for production. They have a Logistics group which continually generates forecasts for short term and medium activities. The produce a Shipping Plan, Production Plan, and a Materials Plan, as well as general forecasts of sales volume other statistics in order to anticipate the companies growth. CMB has an information system which tracks much of the pertinent data needed to make the necessary forecasts. However, there is great inefficiency in handling the distribution, evaluation, and modification of the proposed plans. The generally bounce around from department to department in order to receive the necessary authorizations. In an ideal transaction the proposed plan may only change hands a "couple of times", but that is still a "couple of times" too many. Ultimately, these delays in authorization adversely affect the production, shipping, etc. -- the daily operations. Notice how everyone "depends on" the Logistics group for information. Essentially, the Cuauhtemoc Moctezuma Brewery has not made the paradigm shift from "company focused" to "customer focused".
Summary of Key Dependencies

Cuauhtemoc Moctezuma Push System
December 7, 1994

Process Map 2 - Cuauhtemoc Moctezuma Push System

The process map gives us both an intuitive feel for, and a detailed analysis of the existing system. Intuitively, there are too many dependencies. If the entire map was placed on the same page, it would look like spaghetti. In terms of detailed analysis:
• There are too many activities within the decomposition of the Short Term and Long Term Forecast activities.

• There are too many dependencies on the Forecast generated, short term and medium term plans for Shipping, Production, and Materials are independently based on the Forecasts.

• These plans then independently flow to respective activities in the Value Adding Processes (Make Beer and Ship Beer), yet the system is one and there are interdependencies between Make Beer and Ship Beer.

Essentially I am using Historical Data to generate Forecasts with complex heuristics. These Forecasts (two types) are then used for the independent development of Short Term and Medium Term Plans, for three Functions (Shipping, Production, and Materials) -- independently. But the map shows that although these three Functional plans are dependencies for respective Activities, the Activities in fact are themselves Interdependent. Meaning I am taking a Shared Resource - Historical Data, creating three types of plans to drive three functions that are all linked by one for one Flow Dependencies. This inherently will create missynchronization.

The Functions (activities) -- Arrange Transportation, Brew Beer, and Process inputs will allow Flow at different rates -- thus causing Shortages, and Overstocking (Availability and Freshness). The map shows the complexity and unreasonable nature of such a system, the real world problems depict the manifestations of the complexity and unreasonable nature of the system. Pushing three parts of the same inter-related system, at different speeds inherently creates disorder and imbalance.

With that premise in mind, “pulling products from suppliers” would be a more feasible way of doing business.

**Conceptual Model (Ideal Model)**

The ideal system must be aligned to support freshness, availability, and cost. These objectives are related. High inventories decrease freshness and increase costs. Late deliveries, and insufficient supply result in missed sales and expedited freight costs.

Such a system requires philosophical changes in logistics methodology, changes that align the system to the customer. A pull-based methodology will allow supply to be based and
tied directly to actual dealer requirements. Kanban is one way of achieving a more closely aligned relationship with the customers.

Kanban is a production-system, consumption-driven information tool to synchronize the different elements in the value chain. Kanbans are commonly used like visual devices to trigger or to authorize a preceding operation (It triggers the replenishment of consumed goods). These Kanbans are placed in the containers of the utilized products, when the reorder point is reached, the Kanban triggers the preceding process by authorizing production.

The challenge of the ideal model, to address critical issues and continue to add value to the company, is substantial. The new model must minimize inventories, minimize product throughout time, and ensure availability, while efficiently managing costs.

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>THEORY</th>
<th>REAL</th>
<th>PLANNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAKE Push</td>
<td>Low</td>
<td>High</td>
<td>Forecasting</td>
</tr>
<tr>
<td>MAKE Pull</td>
<td>Low</td>
<td>Low</td>
<td>Demand</td>
</tr>
</tbody>
</table>

**Structure Invention**

I will try to map 5 different innovations for the CMB, all of them are based in the Pull philosophy:

Manual Kanban, Electronic Kanban, Promotion Kanban, MicroBrewery and Third Party Distributor.
OPERATIVE VISION SYSTEM

- Plant
- Transport
- Customers
- Retailer
- Supplier
- Dealer
- Route

Information Flow
Supply Chain Management / Logistics
Process Specialization

December 7, 1994

Process Map 3 - Process Specialization
Manual Pull KANBAN

Manual KANBAN Pull System
December 7, 1994

Access Historic Data

Process Map 4 - Manual KANBAN Pull System
Electronic Pull KANBAN

Electronic KANBAN Pull System
December 7, 1994

Process Map 5 - Electronic KANBAN Pull System
System with Promotion

Promotion KANBAN Pull System
December 7, 1994

Process Map 6 - Promotion KANBAN Pull System
This is a decomposed activity of "Make Beer"

Process Map 7 - Promotion Process Activity Group
Decentralized Micro Brewery System

Maintain KANBAN System

Trigger materials replenishment via electronic messages to supplier

Trigger production via electronic messages from the dealers

The average flow time is inversely proportional to the number of microbreweries.

Deliver pallets of goods to dealers per electronic instructions

Process Map 8 - Decentralized Micro Brewery System
Comparisons of the Conceptual Model

Telling the future is not a science yet. Thus, determining the best solution requires a great deal of foresight, insight, instinct and luck. But the process handbook methodology gives us a process for doing both intuitive and detailed analysis of systems, and thus facilitates my ability to generate new processes. The current Cuauhtemoc Moctezuma Push System and the five alternative systems I have introduced (Manual KANBAN Pull System, Electronic KANBAN Pull System, System with Promotions, Decentralized MicroBrewery System, Third Party Distribution System) are only a subset of the possibly boundless realm of innovative organizations.
1. Cuauhtemoc Moctezuma Push System
   - It is a push system.
   - It lacks real coordination among processes.
   - It requires too much inventory.
   - It is forecast-driven.
   - It fosters inaccurate forecasts.
   - It requires four major plans (sales forecast, shipping plan, production plan, materials plan).
   - The forecasts are generated independently.
   - It works with a one month window of operation.
   - It requires many people to "push" the system.
   - Marketing and the plant do not coordinate their activities.


   The Manual Kanban system requires the physical cards be placed, moved, replaced, and removed through a chain of successive stations. The physical cards or Kanbans serve as a triggering mechanism. This trigger initiate a particular activity. Each Kanban card contains all the relevant information for a particular order (product name, quantity, unique number, indicator like "1 of 6 cards", etc.).

   For example, take the case where a dealer or retailer initiates the process by requesting more goods. The dealer fills out the Kanban card with name of the product they want, and the quantity to be sent, etc. A truck arrives at the scheduled time, delivers goods previously ordered with the original Kanban, picks up "returnable" and new Kanban cards, then the truck returns to the warehouse. The new Kanban card are used to fill the customers order as well as to prompt the plant to produce once the trigger level has been reached.

   Notice that with a Pull System, the information dependencies are Reversed. Instead of information flowing downstream (toward the final product), information is flowing upstream (towards the raw materials, or Inputs).

   The Manual KANBAN Pull System is a better than the current "push-system." It drastically reduces the amount of time, money, and effort needed for planning. The only forecasting needed is long-term planning for things like capital investment, mergers, acquisitions, etc. The demand driven response to the market allows inventory levels to drop, while still guaranteeing availability of product. With lower inventory levels, the
products turn-over more frequently resulting in product freshness (less shelf-time). Also the overhead associated with inventory is reduced.

- It is a pull system.
- Activities are demand-driven and triggered through the whole value chain.
- No production or movement is authorized without a trigger.
- It reduces inventory levels.
- It introduces the concept of visual factors.

3. Electronic Pull KANBAN

The Electronic KANBAN Pull System is based on an information technology infrastructure which spans the whole “value-chain”, from supplier to retailer. The key benefit being “up-to-minute” information. Kanbans are submitted electronically. The “digital Kanbans” are more reliable, and easier to track.

The Electronic KANBAN Pull System revolutionizes the manual system with information technologies. This electronic system accomplishes the same qualitative goals, however, with the intervention of IT, everything can be done faster, and more efficiently. By using “digital Kanbans” rather physical Kanban cards, information can be efficiently distributed to a much larger audience. For instance, in the manual system, the production manager would have to fill out a report to give to the district manager in response to a question about production statistics (A similar process would take place for manager in other departments.). However with an information system, the district manager and the production manager can have the same information at the finger-tips. This is good for both managers and the company as well. The production manager spends less time on reporting, leaving time for more important activities. The district manager has access to more information for less effort. The company as a whole has less “paper-trails” to maintain.

Transferring of information (the Kanbans) happens faster because it is electronic. The preceding operation does not have to wait for the Kanban Card to return on a truck (a delay of several hours or days). This implies that the safety stock of Inventory can be shorter by the Transit Time. If I am talking , several days of Beer for a 10,000 case a day plant -- this means lots of space, and money dedicated to hold this safety stock. Thus the electronic system Lowers the Trigger Level for Inventory because the Inventory needed to supply the system during Transit Time is no longer necessary.
• It is a pull system.
• Activities are demand-driven and triggered through the whole value chain.
• No production or movement is authorized without a trigger.
• It reduces inventory levels.
• It introduces the concept of visual factors.

4. System with Promotion

The system with promotion gives Marketing the power to determine additional levels of production. The extra production would be used for advertisement or goodwill campaigns (such as sponsoring a sporting event, musical event). The Promotion System allows for smooth and successful intervention into the logistics systems, and provides an additional production feature for the customers. To represent this I decomposed Marketing one level further.
• It is a pull system.
• Activities are demand-driven and triggered through the whole value chain.
• No production or movement is authorized without a trigger.
• It reduces inventory levels.
• It introduces the concept of visual factors.
• It links Marketing and Logistics areas in a concurrent engineering atmosphere, which means that after the development of a new product or a new promotion, the “promotion kanbans” are triggered through the value chain.

5. Decentralized Micro Brewery System

The goal of the Decentralized MicroBrewery System is to put the product closer to the customers. Novelties of this implementation could be special brews which conform to the tastes of the customers in the region.

The innovation of this system is that it conflicts with the Economies of Scale argument for a Centralized Brewery. But when one considers Volume and Time complexities, it can be feasible. I also represented the Volume and Time element with Notes. Essentially, this system has strong marketing, and logistical simplification implications.

6. Third Party Distribution System
In the Third Party Distribution System, there would be a central but not necessarily centralized transportation group which both coordinates distribution and satisfies retailers and suppliers.

The Third Party Distribution systems provides a unique view of the way things could be. This system addresses the issues from a different perspective with regard to supply chain management. The bottom line is that the beer is still available, fresh, cost less to produce, but how do the dealers receive their shipments. True, in this system, there is the possibility that the “transportation-coordination group” (TCG) may have to maintain a fairly large inventory. However, in the future, think of many breweries, many TCGs, and many retailers all tied together by shared databases. Each unit of production would be tracked through to point of sale. More importantly, for each unit sold at the retailer level the information would be propagated back through the system inheriting various attributes (such as who me sold me to the retailer, who delivered me, who created me, etc.?). With this kind of information, “digital contracts”, and related aids, the whole supply chain could be managed on-line.

With a third party system broaden the scope of beverages supplied to include multiple parties, even competitor breweries. As a result I leverage Economies of Scale by storing multiple types of goods in the same warehouses. The pull system keeps such product complexity manageable; such a concept would be too complex for a push system because it would involve forecasts for every beverage supplied.

**Deeper Analysis**

In the following chapters, I will go deeper in mapping the Current Cuauhtemoc Moctezuma Push System as well as the New Operative Vision, which reflects my proposal to the Top Management of Inventing the New Organization.

These maps will be depicted based on the framework agreed by Supply Chain Group of the 15.579 Organizational Lab.

Summarizing, I will map as follows:

- **Framework**
  - Logistics System Map
  - The Logistics System
  - Flows within the Logistics Pipeline with Cerveceria’s Activities

- **Current Logistical Processes Maps**
  - Current Logistical Processes Global Level
• Forecast Sales
• Calculate Inventories and Shipments Plan
• Master Production Plan
• Monthly Production Program
• Weekly Production Program
• Forecast Materials
• Calculate Material Requirements
• Transport Sequencing
• Program Can Shipments
• Calculate Purchases of Non-Returnable Bottle and Other Materials
• Purchases Master

**Operative Vision Maps**
• Global Operative Vision
• Replenish Retailer
• Replenish Dealer
• Elaborate Production Program
• Material Requirement

Brief Conclusion of PROCESS HANDBOOK METHODOLOGY

Applying the Process Handbook Methodology to our Structured Thesis group project was both rewarding and agonizing. Determining the necessary level of detail to gain valuable insight was a constantly evolving task. Each time I reviewed the maps, new ideas were generated which were not explicitly reflected on the process map. Fortunately, this instability laid the foundation for very constructive arguments about our 21st century organizations. It was very useful to have the process map as a visual cue to help understand each others’ thoughts. The process maps provided common ground for a team with members from different backgrounds and expertise.

There were a few concepts which I feel are useful which the Process Handbook does not clearly represent: Volume/Quantity, Time, Start/Finish. For a person unfamiliar with a particular process, this information can be very helpful. I am trying to overcome this, adding some symbology insights to the Methodology, as it can be seen in the Chapter of methodology.

**Brief Conclusion of LOTUS NOTES**

The use of technology in “15.579--Inventing the Organizations of the Future, Organizational Lab” was very refreshing. The hands-on experience with technology has provided us with useful insight on the capabilities and deficiencies of various technologies.
5. EXISTING PROCESSES  DEEPER ANALYSIS

Framework

Logistics System Map
LOGISTICS DIVISION MAP

LOGISTICS

Procurement

Production Control

Packaging

Exportation

Transport

Plants

Planning

Marketing

Sales

PRODUCT LOGISTICS

Distributor

This symbol represents that the entity is out of our system.
Activities like MOVEMENT, TRANSPORTATION, STORAGE are ways of managing these flow dependencies.
DECOMPOSITION OF THE LOGISTICS SYSTEM
(GENERIC FLOWS WITHIN THE LOGISTICS PIPELINE)
FORECAST SALES

* Logo 4 is a file where inventories and sales are captured
PROCESS RESPONSIBLE

Ing. Alejandro Avilés Nava, Product Logistics Chief.

PROCESS OBJECTIVE

The objective of the process is to generate a forecast at Distributor-Brand Level for the following 14 months. This forecast will be used to generate the Production Program ITSOL, to establish the inventory levels and generate the proposals to the plants.

PROCESS DESCRIPTION

From Production Control the inventories and sales captured in Logo 4 are received and checked, if errors are found, the information is returned to the plants so it can be corrected. After correcting the errors, the plants send the information again so that the sales, inventories and shipments can be integrated. A history is generated from them.

Next, a State Forecast in hectoliters is generated for the following 9 months (from month N to N+8), which is disaggregated according to the participations that are forecasted at State-Brand Level, in the same way, a Region Sales Forecast is generated for the next 15 months (N to N+14).

The normal sales are checked to make the necessary adjustments, so the State-Brand forecast can be disaggregated to Dist-Brand Level. The participations are adjusted to the desired one at region level so a definitive forecast at Dist.-Brand can be generated, which is then used to calculate the Inventories and Shipments Plan.

TECHNICAL INFORMATION ABOUT THE PROCESS

- It is run monthly.
- It takes about 10 days to be completed.
- It is programmed in COBOL and FORTRAN.
- It runs in VMS environment in VAX DIGITAL equipment.
<table>
<thead>
<tr>
<th>INFORMATION</th>
<th>FROM</th>
<th>TRANSFORMATION ACTIVITY</th>
<th>OUTPUT</th>
<th>RESOURCES (Access Via)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales and Inventories (from LOGO-4)</td>
<td>Production Control (Plant)</td>
<td>Check Sales and Inventories</td>
<td>Checked Sales and Inventories</td>
<td>File</td>
</tr>
<tr>
<td>Master Outgoing Program of Plants</td>
<td>Statistics</td>
<td></td>
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</tr>
<tr>
<td>Checked Sales and Inventories</td>
<td>Check Sales and Inventories</td>
<td>Integrate Information</td>
<td>Integrated Sales, Shipments and Inventories</td>
<td>File</td>
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<tr>
<td>Integrated Sales, Shipments and Inventories</td>
<td>Integrate Information</td>
<td>State-Volume Forecast (Hlts)</td>
<td>State-Volume Forecast (Hlts)</td>
<td>File</td>
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<tr>
<td>State-Volume Forecast (Hlts)</td>
<td>Forecast at State-Vol. Level</td>
<td>Forecast at State-Brand Level (%)</td>
<td>Forecast at State-Brand Level (%)</td>
<td>File</td>
</tr>
<tr>
<td>Integrated Sales, Shipments and Inventories</td>
<td>Integrate Information</td>
<td>Forecast Brand Participations of Brands in the States</td>
<td>Forecasted Brand Participations of Brands in the States</td>
<td>File</td>
</tr>
<tr>
<td>Forecast at State-Brand Level (%)</td>
<td>Forecast at State-Brand Level (%)</td>
<td>Disaggregate Forecast State-Brand-Vol. Level</td>
<td>Disaggregated Forecast State-Brand-Vol. Level</td>
<td>File</td>
</tr>
<tr>
<td>Integrated Sales, Shipments and Inventories</td>
<td>Integrate Information</td>
<td>Generate Region Level Forecast</td>
<td>Total Region Forecast</td>
<td>File</td>
</tr>
<tr>
<td>Integrated Sales, Shipments and Inventories</td>
<td>Integrate Information</td>
<td>Modify Normal Sales</td>
<td>Actualized or Modified Normal Sales</td>
<td>File</td>
</tr>
<tr>
<td>Disaggregated Forecast State-Brand-Vol. Level</td>
<td>Disaggregate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required Changes</td>
<td>Product Logistics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Region Forecast</td>
<td>Generate Region Level Forecast</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INFORMATION</td>
<td>FROM</td>
<td>TRANSFORMATION ACTIVITY</td>
<td>OUTPUT</td>
<td>RESOURCES (Access Via)</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>-----------------------------</td>
<td>------------------------------------------------</td>
<td>-------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Total Forecast Region</td>
<td>Generate Region Forecast</td>
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<tr>
<td>Actualized Normal Sales</td>
<td>Modify Actualized Sales</td>
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<tr>
<td>Dist-Brand Forecast</td>
<td>Disaggregate Forecast Dist-Brand Forecast</td>
<td>Generate Dist-Brand Forecast</td>
<td>Dist-Brand Adjusted Forecast</td>
<td>File</td>
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<tr>
<td>Sales and Participations Region Level</td>
<td>Product Logistics</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Proposed Inventories and Sales (Proposed I&amp;S)</td>
<td>Distributors</td>
<td>Run Inventories Filter (in Plant)</td>
<td>Shipments Proposal (Previous I&amp;S)</td>
<td>File</td>
</tr>
<tr>
<td>Previous I&amp;S</td>
<td>Controller Plant</td>
<td>Check Previous I&amp;S (in Distributors)</td>
<td>Answer to Previous I&amp;S</td>
<td>File</td>
</tr>
<tr>
<td>Answer to Previous I&amp;S</td>
<td>Distributors</td>
<td>Check Answer to Previous I&amp;S</td>
<td>Definitive Shipments Plan</td>
<td>File</td>
</tr>
</tbody>
</table>
CALCULATE INVENTORIES AND SHIPMENTS PLAN

Define Sale Days (for changes of new dist or brands)

Integrate Forecasts and Initial Inventories

Generate Inventories Plan

Update Inventories Plan at Dist Brand Level

Generate Shipments Plan

Generate Reports

Progress Predictions

* Special Cases*

Define Factors for Sale Days

Determine Rejections because of Missing Sale Days for the Dist

Obtain Inv Ship and Forecast (Defini-awk) N N+1

Obtain Dist-Brand Adjusted Forecast N+2 to N+14

Calculate Sale Days by Dist-Brand

Usability Dependency

They are obtained from Sales Forecast

Calculate Sale Days

Calculate Final Inventory

Obtain Sales Forecast and Initial Inventories by Plant

Obtain Shipments (Ship = Final Inv * Sales + Initial Inv)

Usability Dependencies

* This activity is not performed regularly only when there are changes in the distributors (dealers) or new products.
PROCESS RESPONSIBLE

The person in charge of the process is Ing. Alejandro Avilés Nava, Product Logistics Chief.

PROCESS OBJECTIVE

The basic objective of this process is to create an inventories and shipments plan which will be used as input information to perform the production program.

PROCESS DESCRIPTION

In order to calculate the Inventories and Shipments Plan, it is necessary to obtain the sales forecasts that are generated by Logistics and the initial inventories from a file which is obtained from the plants when the definitive is calculated. With this information the necessity of having to do any modifications to the distributors sale days is verified and the Inventories Plan is generated.

Once that the inventories plan is done, the Shipments Plan is calculated, which is further used to elaborate the Production Program with the system known as ITSOL.

USERS

Production Programming is the main activity that uses the outputs of Calculating the Inventories and Shipments Plan.

TECHNICAL INFORMATION ABOUT THE PROCESS

- This process has been done approximately for 10 years.
- It is run monthly, even if some of its activities are seldom performed.
- It is run on VMS Environment in VAX Digital equipment.
<table>
<thead>
<tr>
<th>INFORMATION</th>
<th>FROM</th>
<th>TRANSFORMATION ACTIVITY</th>
<th>OUTPUT</th>
<th>RESOURCES (Access Via)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inv., Shipments and Forecasts of N and N+1 months</td>
<td>Calculate the Definitive</td>
<td>Integrate Forecasts and Initial Inventories</td>
<td>Integrated Forecasts and Inventories</td>
<td>File</td>
</tr>
<tr>
<td>Dist-Brand Adjusted Forecast</td>
<td>Forecast Sales</td>
<td>Integrate Forecasts and Initial Inventories</td>
<td>Integrated Forecasts and Inventories</td>
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<tr>
<td>Inv. and Forecasts from N+1 to N+14</td>
<td>Forecast Sales</td>
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<tr>
<td>Sale Days by Dist. Factors to Apply to Sales Day</td>
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<td>Rejections because of Missing Sale Days for Dist. Sale Days Dist-Brand</td>
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<td>Integrated Forecasts and Inventories</td>
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<td>Generate Inventories Plan</td>
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<td>Inventories Plan</td>
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<td>Generate Inventories Plan</td>
<td>Inventories Plan Dist-Brand Level</td>
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<tr>
<td>Inventories Plan Dist-Brand Level</td>
<td>Generate Inventories Plan Dist-Brand Level</td>
<td>Generate Shipments Plan</td>
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<tr>
<td>Shipments Plan</td>
<td>Generate Shipm. Plan</td>
<td>Generate Reports</td>
<td>Monthly Reports</td>
<td>File</td>
</tr>
</tbody>
</table>
PROCESS RESPONSIBLE

Ing. Héctor Villalobos, Product Logistics Chief.

PROCESS OBJECTIVE

The basic objective of this process is to generate a Master Production Plan, which will be used to generate the Monthly Production Program, and give a global expectancy vision of the next 12 months production.

PROCESS DESCRIPTION

This process requires to obtain the following information:
- Final estimate inventories at plants month N (National and Exportation information).
- Sale and Demands Forecasts by a Dist-Brand (Definitive).
- Exportation Forecasts.

This information is captured in the computer system to generate a report named ITSOL. This report is used to generate the Monthly Production Program. To generate Production Plan, the next activities are required:
+ Calculate Total Production
+ Determine Help Requirements
+ Consider Final Inventories at factories
+ Consider Final Inventories at distrtributors
+ Consult Sale Days in factory.

To calculate the Total Production, the next activities are required:
* Determine Own Production
* Determine Help Production

This activities have the following subactivities: calculate productivity, determine shifts, obtain beer demand, assign production lines.

USERS

This activity is used to generate the monthly production program and serves as base to compare the plan with real operation.
TECHNICAL INFORMATION ABOUT THE PROCESS

- This process has been done approximately for 10 years.
- It is run monthly.
- It takes one day to make it.
- It is programmed in COBOL, FORTRAN and has interfaces with LINEO software.
- It is run on VMS environment in VAX DIGITAL equipment.

### MASTER PRODUCTION PLAN

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<tr>
<th>INFORMATION</th>
<th>FROM</th>
<th>TRANSFORMATION ACTIVITY</th>
<th>OUTPUT</th>
<th>RESOURCES (Access Via)</th>
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<tbody>
<tr>
<td>Historical Information about Production Line Efficiency</td>
<td>Plant</td>
<td>Calculate Productivity Lines Production Productivity</td>
<td>File</td>
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<tr>
<td>Historical Information about Production Line Efficiency</td>
<td>Plant</td>
<td>Determine Shifts Lines Production Shifts</td>
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<tr>
<td>Beer Demand</td>
<td>Sale Forecast</td>
<td>Assign Production Lines Beer Production by Production Lines</td>
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<tr>
<td>Beer Production by Production Lines</td>
<td>Product Logistics</td>
<td>Determine Self Production Self Production Report</td>
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<tr>
<td>Self Production</td>
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<tr>
<td>Total Production</td>
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<tr>
<td>Factory and Dist. Inventory</td>
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<td>Consider Final Inventory Final Inventory Report</td>
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<tr>
<td>Sale Days. (Min Inv.) in Factory</td>
<td>Plant</td>
<td>Consult Sale Days Sale Day for each Product</td>
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<tr>
<td>Final Estimate Inventories at Factories month N (National and Exportation)</td>
<td>Plant</td>
<td>Generate Production Plan Production Plan</td>
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</tr>
<tr>
<td>Demand and Sale Forecasts by Dist-Brand (Definitive)</td>
<td>Sale Forecast</td>
<td>Generate Production Plan Production Plan</td>
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<tr>
<td>Exportation Forecasts</td>
<td>Sale Forecast</td>
<td>Generate Production Plan Production Plan</td>
<td>File</td>
<td></td>
</tr>
</tbody>
</table>
MONTHLY PRODUCTION PROGRAM

- Master Production Plan
  - Obtain final inventories
  - Obtain Plant Inventory

- Obtain Forecast for Demand and Sales of the Brand-Presentation (Definite)
  - Obtain Exportation Forecast
  - Obtain National Forecast

- Administrate Productivity and Efficiency

- Calculate Beer Demand
  - Obtain Historical Information about Production Efficiency Lines
  - Determine Schedules

- Assign Lines

- Determine the Help that can be given

- Generate Monthly Production Program Reports
- Calculate Material Assignments

NOTE: "Definite" is the real forecast after some modifications.
PROCESS RESPONSIBLE

Ing. Carlos Taboada, Production Control Manager

PROCESS OBJECTIVE

The objective of this process is to generate a Monthly Production Program to obtain real information of the activities in Plant during the month N+1, and to serve as a base and comparison reference to elaborate the Weekly Production Program.

PROCESS DESCRIPTION

This process is requires the following information:

- Final Inventories in Plant.
- Forecast for Demand and Sales of Brand-Presentation level (National and Exportation).
- Obtain Beer Demand.
- Obtain historical information about efficiency production by line.

This information is captured in the computer system and it is simulated. The objective of this job is to determine the behavior of the system in order to determine management productivity and efficiency, determine shifts, assign lines by shift and determine helps that can be given to other plants.

This information is used to generate the monthly production program and with this, determine the material requirements and the weekly production program.

USERS

This activity is used to generate the weekly production program and serve as a base to compare monthly plan with real operation.

TECHNICAL INFORMATION ABOUT THE PROCESS

- This process has been done approximately for 10 years.
- It is run monthly, even if some of its activities are seldom performed.
- It takes one day to be completed.
- It's programmed in COBOL, fortran and has interfaces with LINDO software.
- It's run on VMS environment in VAX DIGITAL equipment.
<table>
<thead>
<tr>
<th>INFORMATION</th>
<th>FROM</th>
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<th>RESOURCES (Access Via)</th>
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<tbody>
<tr>
<td>Factory Inventories</td>
<td>Plant</td>
<td>Obtain Factory Inventories</td>
<td>Factory Inventories</td>
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<tr>
<td>Record Factory Inventories</td>
<td>Plant</td>
<td>Obtain Final Inventories</td>
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<tr>
<td>National and Exporting Forecasts</td>
<td>Sale Forecast</td>
<td>Obtain forecast for Demand and sales of Brand-Presentation level (Definitive)</td>
<td>Forecast of Demand and Sales of Brand-Presentation level (Definitive)</td>
<td>File</td>
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<tr>
<td>Historical Information about Production Lines Efficiency</td>
<td>Plant</td>
<td>Obtain Historical Information about Production Lines Efficiency</td>
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<tr>
<td>Lines Efficiency</td>
<td>Plant</td>
<td>Determine Shifts</td>
<td>Shifts by Production Line</td>
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<tr>
<td></td>
<td></td>
<td>Assign Production Lines</td>
<td>Assignment of Shifts by Production Line</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Determine Help that can be given</td>
<td>Help that can be given</td>
<td>File</td>
</tr>
<tr>
<td>Beer Demand</td>
<td>Sale Forecast</td>
<td>Determine Help that can be given</td>
<td>Help that can be given</td>
<td>File</td>
</tr>
<tr>
<td>Assignment of Production Lines</td>
<td>Plant</td>
<td>Determine Help that can be given</td>
<td>Help that can be given</td>
<td>File</td>
</tr>
<tr>
<td>Self Production and Help Production</td>
<td>Plant</td>
<td>Productivity and Efficiency Management</td>
<td>Monthly Production Program Report</td>
<td>File</td>
</tr>
<tr>
<td>Monthly Production Program</td>
<td>Plant</td>
<td>Calculate Material Requirements</td>
<td>Material Requirements</td>
<td>File</td>
</tr>
</tbody>
</table>
PROCESS RESPONSIBLE

Ing. Carlos Taboada, Production Control Manager

PROCESS OBJECTIVE

The basic objective of this process is to generate and distribute the Weekly Production Program report to the involved personnel, in the production area. At the same time this is used to modified the monthly production program when it is required.

PROCESS DESCRIPTION

The main constraint to perform this process is to have made the monthly production program. The following information is requires:

- Determine number of week, starting and finish Date.
- Determine the amount to produce and the Brand-Presentation by Shift/Production line

The weekly production program, and the observations by shift are captured in the computer system, with the objective of validating the capture with the weekly schedule plan.

When the weekly schedule plan is validated the definitive weekly production program is made. This report is required to determine the production sequence by brand-presentation in a production shift run.

This final report is distributed to the respective users.

USERS

This activity is used in the Factory to generate daily program production and serve as base to modify the weekly program production as needed.

TECHNICAL INFORMATION ABOUT THE PROCESS

- This process has been done approximately for 10 years..
- It is run weekly, even if some activities are seldom performed.
- This process run in the computer production system.
### WEEKLY PRODUCTION PROGRAM

<table>
<thead>
<tr>
<th>INFORMATION</th>
<th>FROM</th>
<th>TRANSFORMATION ACTIVITY</th>
<th>OUTPUT</th>
<th>RESOURCES (Access Via)</th>
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<tbody>
<tr>
<td>Monthly Production Program</td>
<td>Plant</td>
<td>Obtain Monthly Production Program</td>
<td>Monthly Production Program Report</td>
<td>File</td>
</tr>
<tr>
<td>Monthly Production Program Report</td>
<td>Plant</td>
<td>Determine number of Week, Starting and Finish Date</td>
<td>Number of Week, Starting and Finish Date</td>
<td>File</td>
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<tr>
<td>Monthly Production Program Report</td>
<td>Plant</td>
<td>Determine the Amount to Produce and the Brand-Presentation by Shift/Production Line</td>
<td>Amount to Produce and the Brand-Presentation by Shift/Production Line</td>
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</tr>
<tr>
<td>Number of Week, Starting and Finish Date</td>
<td>Plant</td>
<td>Elaborate Weekly Production Schedule</td>
<td>Weekly Production Schedule</td>
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<tr>
<td>Amount to Produce and the Brand-</td>
<td>Plant</td>
<td>Record Weekly Production Program</td>
<td>Weekly Production Program</td>
<td>File</td>
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<tr>
<td>Presentation by Shift/Production Line</td>
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<td>Validate the record with the Weekly Schedule Program</td>
<td>Validated Weekly Schedule Program</td>
<td>File</td>
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<td>Validated Weekly Schedule Program</td>
<td>Plant</td>
<td>Conclude Definitive Production Program</td>
<td>Definitive Weekly Production Program</td>
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<td>Definitive Weekly Production Program</td>
<td>Plant</td>
<td>Determine Production sequence by Brand-Production in a Production-Shift run</td>
<td>Production sequence by Brand-Production in a Production-Shift run</td>
<td>File</td>
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<tr>
<td>Production Sequence by Brand-Production in a Production-Shift run</td>
<td>Plant</td>
<td>Generate Weekly Production Program Report</td>
<td>Weekly Production Program Report</td>
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<tr>
<td>Weekly Production Program Report</td>
<td>Plant</td>
<td>Hand Weekly Production Program for Users</td>
<td>Users make the daily production plan with the Weekly Production Program Report</td>
<td>File</td>
</tr>
</tbody>
</table>

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PROCESS RESPONSIBLE

The process responsible is Ing. Alejandro Avilés Nava, Product Logistics Chief.

PROCESS OBJECTIVE

With the process of forecasting materials the input information to calculate purchases of each material in each plant is calculated for the following 3 months (Calculate Material Requirements).

PROCESS DESCRIPTION

From Product Logistics the Demand and Production Plan by Plant-Line-Brand for the next 12 months is received, and the same takes place with Exportation.

With this information the bottle return is calculated having as a base the real % of bottle return which is defined with information obtained from Product Logistics. With this same information the material consumptions are calculated, having as a base a reposition % and the damage factors.

With the material inventories and remnants (liquidations) in plants and the inventory levels other calculations are made for the material requirements.

USERS

The main activity that makes use of Forecast Materials outputs is Calculate Material Requirements.

TECHNICAL INFORMATION ABOUT THE PROCESS

- The process has been done for approximately 7 years.
- It is run monthly.
- It takes aprox. 2 days to be performed.
- It runs in VMS environment is VAX Digital equipment.
<table>
<thead>
<tr>
<th>INFORMATION</th>
<th>FROM</th>
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<th>RESOURCES (Access Via)</th>
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<td>Production and Demands</td>
<td>Exportation</td>
<td>Unite Productions and Demands</td>
<td>Productions and Demands</td>
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<td>Production Filter</td>
<td>Production Control</td>
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<tr>
<td>Productions and Demands by Plant-Line-Brand</td>
<td>Program Production</td>
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<tr>
<td>Reposition %</td>
<td>Prod. Control</td>
<td>Calculate Consumptions</td>
<td>Consumptions</td>
<td>File</td>
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<td>Damage Factors</td>
<td>Prod. Control</td>
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<tr>
<td>Production and Demands</td>
<td>Unite Productions and Demands</td>
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<tr>
<td>Bottle Return</td>
<td>Define Bottle Return</td>
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<tr>
<td>Sales, Shipments and New Products</td>
<td>Product Logistics % Return</td>
<td>Define the Real Bottle Return</td>
<td>Real Bottle % Return</td>
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<tr>
<td>Demand without Exportation</td>
<td>Unite Productions and Demands</td>
<td>Calculate Bottle Return</td>
<td>Bottle Return</td>
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<tr>
<td>Bottle % Return</td>
<td>Define Bottle % Return</td>
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<td>Consumptions</td>
<td>Calculate Consumptions</td>
<td>Calculate Material Requirements</td>
<td>Material Requirements</td>
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<tr>
<td>Bottle Return</td>
<td>Calculate Return</td>
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<td>Inventories and Liq.</td>
<td>Unite Inventories and Liquidations from Plants</td>
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<tr>
<td>Inventory Levels</td>
<td>Define Inventory Levels</td>
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</table>
PROCESS RESPONSIBLE

Ing. Jesús Venecia, Production Control Manager

PROCESS OBJECTIVE

The objective of this process is to Calculate Material Requirements needed for the production of month N+1, assign suppliers and generate Purchase Orders.

PROCESS DESCRIPTION

This process is elaborate by one person. To Calculate Material Requirements. The following information is needed:
- Materials Forecast.
- Inventories and Remnants in Plant
- Consult Master Materials Plan.

With the Materials Master Plan purchases of each material can be calculated and Estimated Final Inventory and can be confronted with the Goal Inventory.

After this, it is necessary to redefine purchases considering the suggestions for modifications and making the purchases forecast for month N+1.

Following, it is important to assign the suppliers for each material and generate the respective purchase orders.

USERS

This information is used by Materials Logistics, suppliers and transportation.

TECHNICAL INFORMATION ABOUT THE PROCESS

- The process has been done approximately for 7 years.
- It’s run monthly.
- It takes three days to be completed.
- It’s programmed in COBOL and run on VMS environment in VAX DIGITAL equipment.
<table>
<thead>
<tr>
<th>INFORMATION</th>
<th>FROM</th>
<th>TRANSFORMATION ACTIVITY</th>
<th>OUTPUT</th>
<th>RESOURCES (Access Via)</th>
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<td>Material Forecast</td>
<td>Materials Logistics</td>
<td>Obtain Material Forecast Information</td>
<td>Material Forecast Report</td>
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<td>Inventories and Remnants in Plant</td>
<td>Plant</td>
<td>Check Inventories and Remnants in Plant</td>
<td>Purchase of each Material</td>
<td>File</td>
</tr>
<tr>
<td>Inventories and Remnants in Plant</td>
<td>Plant</td>
<td>Check Inventories and Remnants in Plant</td>
<td>Material Forecast Report</td>
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<tr>
<td>Master Production Plan</td>
<td>Product Logistics</td>
<td>Determine an Estimate of Final Inventory</td>
<td>Estimated Final Inventory</td>
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<td>Estimated Final Inventory</td>
<td>Materials Logistics</td>
<td>Confront Goal Inv. versus Estimated Final Inventory</td>
<td>Confrontation between Goal Inventory and Estimated Final Inventory</td>
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<tr>
<td>Inventories and Remnants in Plant</td>
<td>Plant</td>
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<tr>
<td>Purchase of each Material</td>
<td>Materials Logistics</td>
<td>Consult Materials Master Plan</td>
<td>Materials Master Plan</td>
<td>File</td>
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<tr>
<td>Confrontation between Goal Inventory and Estimated Final Inventory</td>
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<tr>
<td>Materials Master Plan</td>
<td>Materials Logistics</td>
<td>Redefine Purchasing</td>
<td>Purchasing Redefine</td>
<td>File</td>
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<tr>
<td>Suggestions for Modifyate Purchases</td>
<td>Materials Logistics</td>
<td>Develop a Purchase Forecast for month N+1</td>
<td>Purchase Forecast for month N+1</td>
<td>File</td>
</tr>
<tr>
<td>Purchase Forecast for month N+1</td>
<td>Materials Logistics</td>
<td>Redefine Purchasing</td>
<td>Redefined Purchases</td>
<td>File</td>
</tr>
<tr>
<td>Redefined Purchases</td>
<td>Materials Logistics</td>
<td>Assign Supplier</td>
<td>Purchases by Supplier</td>
<td>File</td>
</tr>
<tr>
<td>Purchases by Supplier</td>
<td>Materials Logistics</td>
<td>Generate Purchase Orders</td>
<td>Purchase Orders</td>
<td>File</td>
</tr>
</tbody>
</table>
NOTE SABAP is a product replenishment system.
PROCESS RESPONSIBLE

Ing. Enrique Horacio Hinojosa, Transport Manager

PROCESS OBJECTIVE

The basic objective of this process is to generate a Sequencing Transport Program to assign Shipments by Transport Entities.

PROCESS DESCRIPTION

This process is done by a single person. The first thing that is needed is to receive the Requestment Program by Plant (SABAP) with the objective of assignment the transport entities.

In order to perform this activity the following is needed:

* Consult the transport entities catalogue
* Consult the destinies catalogue
* Assign the base equipment for transport operation

Once that these is done, the sequencing program is generated. This activity needs to consider the following:

* Consult the standard time route
* Assign shipments by transport entities
* Program maintenance

Finally, given that the sequencing program suffers modifications with the real operation, for example, when a shipment is delay, it is necessary to performed a shipments re-assignation out of the standard or estimated time.

USERS

The main users of this activity are transportation personnel.

TECHNICAL INFORMATION ABOUT THE PROCESS

- It is run monthly.
- It is completely performed in the computer in SIF environment.
<table>
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<tr>
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<td>Requestments by Plant</td>
<td>Plant</td>
<td>Receive Requestments Program by Plant</td>
<td>Requestments Program by Plant</td>
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<tr>
<td>Entities Catalogue</td>
<td>Transport</td>
<td>Consult Transport Entities Catalogue</td>
<td>Entities Catalogue Report</td>
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</tr>
<tr>
<td>Entities Catalogue Report</td>
<td>Transport</td>
<td>Consult Destinies Catalogue</td>
<td>Destinies Catalogue</td>
<td>File</td>
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<tr>
<td>Destinies Catalogue</td>
<td>Transport</td>
<td>Assign Base Equipment for Transport Operation</td>
<td>Assigned Base Equipment for Transport Operation</td>
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<tr>
<td>Requestments Program by Plant (SABAP)</td>
<td>Plant</td>
<td>Assign Shipments by Transport Entities</td>
<td>Assigned Shipments by Transport Entities</td>
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</tr>
<tr>
<td>Estimate Route Time</td>
<td>Transport</td>
<td>Consult Estimate Route Times</td>
<td>Estimate Route Times Report</td>
<td>File</td>
</tr>
<tr>
<td>Destinies Catalogue</td>
<td>Transport</td>
<td>Assign Shipments by Transport Entities</td>
<td>Assign Shipments by Transport Entities</td>
<td>File</td>
</tr>
<tr>
<td>Shipments to Transport Entities out of Standard Time Report</td>
<td>Transport</td>
<td>Re-assign Shipments to Transport Entities out of Standard Time</td>
<td>Re-assigned Shipments to Transport Entities out of Standard Time</td>
<td>File</td>
</tr>
<tr>
<td>Assigned Shipments by Transport Entities</td>
<td>Transport</td>
<td>Program Maintenance</td>
<td>Programmed Maintenance</td>
<td>File</td>
</tr>
<tr>
<td>Re-assigned Shipments to Transport Entities out of Standard Time</td>
<td>Transport</td>
<td>Generate Sequencing Program</td>
<td>Sequencing Program</td>
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<tr>
<td>Programmed Maintenance</td>
<td>Transport</td>
<td>Generate Sequencing Program</td>
<td>Sequencing Program</td>
<td>File</td>
</tr>
</tbody>
</table>
PROGRAM CAN SHIPMENTS

Weekly Production Program
Obtain Damage Factors
Convert Production to Can Requirements
Generate Purchase Orders (Requirements)
Calculate Inventories and Transits
Define Inv Level of Empty Cans in Plants
Generate Shipments Program
Check Medium and Long Term Plans Together with Famosa
Define Can Movement Interplants
Obtain Plant Inventories by Day
Obtain Production Program of Plants by Day
Obtain Real Productions by Plant
Obtain Initial Inv Reception and Consumptions by Plant
Obtain Estimate Production Plan by Plant

*This Activity is performed by Famosa can supplier. Logistics coordinates this process.
**This activity is not performed regularly, only when necessary.
PROCESS RESPONSIBLE

The process responsible is Ing. Carlos González, from Material Logistics.

PROCESS OBJECTIVE

The basic objective of the process is to generate a can shipping plan in order to determine what kind of can and in what amounts it should be sent to each of the plants.

PROCESS DESCRIPTION

The Production Program is converted to can requirements used the predefined damage factors. These requirements are used to generate a firm order for N+1 month and a tentative one for N+2 to N+12 months. With the firm order the purchase orders are assigned.

The purchase orders, inventories and transits from the transportation units and the inventory level of empty cans in plants are necessary to generate the Can Shipments Program, once the real productions, initial inventories, receptions, consumptions and the estimate production program are obtained from the plants.

On the other hand, the tentative order that was previously generated is checked together with Famosa, can supplier.

In some special cases, it is necessary to define the can movement interplants having previously obtained the plant inventories and the production program in days.

USERS

The purchase orders are used by Famosa to program can shipments to the different plants.

TECHNICAL INFORMATION ABOUT THE PROCESS

- The process has less than a year operating the current way in which Famosa leads the process.
- It is run weekly.
- Planning activities until the assignment of the purchase orders requires one day aprox., the operation since the shipments program requires two hours per week.
- Excel is used to run this process.
## PROGRAM CAN SHIPMENTS

<table>
<thead>
<tr>
<th>INFORMATION</th>
<th>FROM</th>
<th>TRANSFORMATION ACTIVITY</th>
<th>OUTPUT</th>
<th>RESOURCES</th>
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<tbody>
<tr>
<td>Production Program Damage Factors</td>
<td>Program Production</td>
<td>Convert Production to Can Requirements</td>
<td>Can Requirements</td>
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<tr>
<td>Can Requirements</td>
<td>Convert Production to Can Requirements</td>
<td>Generate Firm Order and Tentative Requirements Order</td>
<td>Firm and Tentative Order</td>
<td>Fax</td>
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<tr>
<td>Firm Order</td>
<td>Generate Firm Order</td>
<td>Assign Purchase Orders</td>
<td>Purchase Order</td>
<td>File</td>
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<tr>
<td>Purchase Order Real Productions</td>
<td>Purchase Orders</td>
<td>Generate Shipments Program</td>
<td>Shipments Program</td>
<td>Fax</td>
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<tr>
<td>Initial Inv., Receptions and Consumptions</td>
<td>Plant</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Estimate Production Plan</td>
<td>Plant</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Inventories and Transits</td>
<td>Calculate Inventories and Transits</td>
<td></td>
<td></td>
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<tr>
<td>Inv. Level of Empty Cans</td>
<td>Plant</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Medium and Long Term Plans (Tentative Order)</td>
<td>Generate Tentative Req. Order</td>
<td>Check Plans together with Famosa</td>
<td>Checked or Modified Plans</td>
<td>Fax</td>
</tr>
<tr>
<td>Plant inventory by Day</td>
<td>Plant</td>
<td>Define Interplant Can Movements</td>
<td>Interplant Can Movements</td>
<td>Telephone</td>
</tr>
<tr>
<td>Production Plan by Day</td>
<td>Plant</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CALCULATE PURCHASES OF NON-RETURNABLE BOTTLE AND OTHER MATERIALS

Production Program

Calculate Material Consumptions

Unite Plant Inv and Remnants

Define Real Inventory Levels

Define Production Days of Final Inventory

Calculate Purchases of Bottle and Other Materials (Purch=Monthly Req + Final Inv - Initial Inv)

Generate Purchase Orders to suppliers

Follow-up shortages Replacements
PROCESS RESPONSIBLE

The responsible of this process is Ing. Luis Carlos Elizondo, from Material Logistics.

PROCESS OBJECTIVE

The basic objective is to assign the purchase of bottle requirements and other materials to the corresponding suppliers.

PROCESS DESCRIPTION

The Production Program is used to calculate the consumptions for the following materials: bottle, can lids, plastic, covers, boxes, divisors, lids, hermetic caps, small baskets, trays and labels.

Meanwhile, the inventories and liquidations send by the plants are united and the real inventory levels and the production days of the final inventory are defined.

With all the above information the purchases of bottle and other materials are calculated, using the next formula:

\[ \text{Purchases} = \text{Monthly Requirements} + \text{Final Inv.} - \text{Initial Inv.} \]

With the previously calculated purchases, the purchase orders are generated to the corresponding suppliers.

USERS

The purchase orders are sent to the corresponding suppliers.

TECHNICAL INFORMATION ABOUT THE PROCESS

- The process has been done for aprox. 10 years.
- It is run monthly.
- It takes aprox. 5 days to be completed.
<table>
<thead>
<tr>
<th>INFORMATION</th>
<th>FROM</th>
<th>TRANSFORMATION ACTIVITY</th>
<th>OUTPUT</th>
<th>RESOURCES</th>
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<tbody>
<tr>
<td>Production Program</td>
<td>Program Production</td>
<td>Calculate Material Consumptions</td>
<td>Material Consumptions</td>
<td>File</td>
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<tr>
<td>Inventories and Liquidations from Plants</td>
<td>Plant</td>
<td>Unite Inventories and Liquidations (Remnants)</td>
<td>Inventories and Liquidations</td>
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<td>Inventory Levels</td>
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<td>Define Real Inventory Levels</td>
<td>Real Inventory Level</td>
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<tr>
<td>Final Inventory</td>
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<td>Define Production Days of Final Inv.</td>
<td>Production Days</td>
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<tr>
<td>Inventories and Liquidations</td>
<td>Unite Inventories and Liquidations</td>
<td>Calculate Purchases of Bottle and Other Materials</td>
<td>Purchases</td>
<td>File</td>
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<tr>
<td>Production Days</td>
<td>Define the Real Inventory Levels</td>
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<tr>
<td>Material Consumptions</td>
<td>Define Production Days for Final Inv.</td>
<td>Calculate Material Consumptions</td>
<td></td>
<td></td>
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<tr>
<td>Purchases</td>
<td>Calculate Purchases of Bottle and Other Materials</td>
<td>Generate Purchase Orders to Suppliers</td>
<td>Purchase Orders</td>
<td>File (With co. of same group)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fax (Not same gp.)</td>
</tr>
</tbody>
</table>
PURCHASE MASTER

This Subactivity is going to be incorporated to the Purchase Master Calculation

Calculate Purchase Master and Inventories → Suppliers Assignment → Truck loading

Add Inventories to Purchases for every Supplier → Calculate Materials Consumption Daily

Calculate Purchases Increase → Complete Truck Loading

Generate Purchase Orders

Make Modification to the Purchase Master

Obtain initial Inventories and Remnants in Plant

Calculate Goal Inventory → Make Consumption Adjustments

Calculate Actual Month Modifications

Calculate Estimate Consumption for Next Month

Calculate Consumption Forecast

Determine Purchases and Inventories

Calculate Definitive Purchases

Validate Definitive Purchases

Plant Information

Take in Consideration Suppliers Distance → Take in Consideration Ordering Frequency

Take in Consideration Material Types → Establish Goal Inventory
PROCESS RESPONSIBLE

Ing. Carlos González, Materials Logistics Manager

PROCESS OBJECTIVE

The objective of this process is to elaborate the Purchase Master Plan needed for the Material Forecast and to Calculate Material Requirements, and to serve as a future perspective of the inventories and material consumptions behavior of one year.

PROCESS DESCRIPTION

This process requires the following information:

- Initial Inventories and Remnants in Plant.

This information is used to calculate Inventories and purchases Master that include the Initial Inventory and the Remnants in Plant to make adjustments in the consumptions. This information is required to calculate modifications in the N+1 month.

With the modifications, estimated consumptions can be calculate in the N+1 month N+1, consumptions forecast and determine purchases and inventories. To determine purchases and inventories is necessary establish the Goal Inventory.

The following information is required to establish the Goal Inventory:

+ Suppliers distance
+ Ordering frequency
+ Material Types

The next activity is to calculate and validate the Definitive Purchases.

To make suppliers assignation the Purchases and Inventories Master information are necessary, and the next procedure is Truck loading (this activity is not executed at this moment, but it will be incorporated soon) and it requires the following activities to be done:

+ Add inventories to purchases for every supplier
+ Calculate daily materials consumption
+ Calculate purchases increase
+ Complete Truck loading
+ Make modification to Purchase Master
+ Validate Definitive Purchases

**USERS**

This activity is used by Material Logistics and Transportation. The information is required to calculate Materials Forecast, Materials Requirement and Truck Loading.

**TECHNICAL INFORMATION ABOUT THE PROCESS**

- This process has been done approximately for 7 years.
- It is run monthly, even if some of its activities are seldom performed.
- It takes 3 days to be completed.
- It is programmed in COBOL and run in VMS environment in VAX DIGITAL equipment.
<table>
<thead>
<tr>
<th>INFORMATION</th>
<th>FROM</th>
<th>TRANSFORMATION ACTIVITY</th>
<th>OUTPUT</th>
<th>RESOURCES</th>
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<tbody>
<tr>
<td>Distance from Suppliers Ordering Frequency Material Types</td>
<td>Materials Logistics</td>
<td>Establish Goal Inventory</td>
<td>Goal Inventory</td>
<td>File</td>
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<tr>
<td>Initial Inventories and Remnant in Plant</td>
<td>Plant</td>
<td>Obtain Initial Inventories and Remnants in Plant</td>
<td>Initial Inventories and Remnant in Plant Report</td>
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<tr>
<td>Initial Inventories and Remnant in Plant Report</td>
<td>Plant</td>
<td>Make Consumption Adjustments</td>
<td>Consumption Adjustments</td>
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<tr>
<td>Consumption Adjustments</td>
<td>Materials Logistics</td>
<td>Calculate Actual Month Modifications</td>
<td>Actual Month Modifications</td>
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<td>Actual Month Modifications</td>
<td>Materials Logistics</td>
<td>Calculate Estimate Consumptions for next Month</td>
<td>Estimate Consumptions for next Month</td>
<td>File</td>
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<tr>
<td>Actual Month Modifications</td>
<td>Materials Logistics</td>
<td>Calculate Consumptions Forecast</td>
<td>Consumptions Forecast</td>
<td>File</td>
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<td>Actual Month Modifications</td>
<td>Materials Logistics</td>
<td>Determine Purchases and Inventories</td>
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<td>File</td>
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<tr>
<td>Goal Inventory</td>
<td>Materials Logistics</td>
<td>Determine Purchases and Inventories</td>
<td>Purchases and Inventories</td>
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<tr>
<td>Purchases and Inventories</td>
<td>Materials Logistics</td>
<td>Calculate Consumptions Forecast</td>
<td>Definitive Purchases</td>
<td>File</td>
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<tr>
<td>Definitive Purchases</td>
<td>Materials Logistics</td>
<td>Validate Definitive Purchases</td>
<td>Validated Definitive Purchases</td>
<td>File</td>
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<tr>
<td>Purchases and Inventories Master</td>
<td>Materials Logistics</td>
<td>Suppliers Assignment</td>
<td>Assigned Suppliers</td>
<td>File</td>
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<td>Material Inventories</td>
<td>Plant</td>
<td>Add Inventories to Purchases for every Supplier</td>
<td>Added Inventories to Purchases for every Supplier</td>
<td>File</td>
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<td>Added Inventories to Purchases for every Supplier</td>
<td>Materials Logistics</td>
<td>Calculate Materials Consumption for next Month</td>
<td>Daily materials Consumption</td>
<td>File</td>
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<tr>
<td>Daily materials Consumption</td>
<td>Materials Logistics</td>
<td>Calculate Purchases Increase</td>
<td>Purchases Increase</td>
<td>File</td>
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<td>Purchases Increase</td>
<td>Materials Logistics</td>
<td>Complete Truck Loading</td>
<td>Completed Truck Loading</td>
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<td>Truck Loading Completed</td>
<td>Materials Logistics</td>
<td>Make Modifications to the Purchases Master</td>
<td>Modified Purchase Master</td>
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<td>Validate Definitive Purchases</td>
<td>Validated Definitive Purchases</td>
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<td>Materials Logistics</td>
<td>Generate Purchase Orders</td>
<td>Purchase Orders</td>
<td>File</td>
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<tr>
<td>Suppliers Assignment</td>
<td>Materials Logistics</td>
<td>Truck Loading</td>
<td>Loaded Truck</td>
<td>File</td>
</tr>
</tbody>
</table>
GLOBAL OPERATIVE VISION

1. Receive Replenishment (Follow up of Action)
2. Plant asks for Direct Material Replenishment
3. Calculate Material Requirements
4. Weekly Production Program
5. Monthly Production Plan
6. Program Finished Product Shipments by Day
7. Program Inv and Interplants Help
8. Establish Sales Plan
9. Dealers Orders
OPERATIVE VISION
ELABORATE PRODUCTION PROGRAM

Program Production N+1

Define Weekly Production Perspective

Develop Monthly Production Plan

Obtain Seasonal Inventory

Determine Interplant Helps

Obtain Demands from Cover Areas (Own Production)

Define Reorder Level for each Product

Define Minimum Inventory, Operating Level for each Product

Define Batch Sizes by Product

* This activity is only performed when help is needed.
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NEW APPROACH FOR THE ECONOMIC ORDER QUANTITY MODEL (EOQ/ELZ).

c=unit cost;

h=inventory carrying cost;

i=interest rate;

D=average demand;

A=one set up cost;

I=average inventory;

TC=total cost in a T period;

D=Q/T; frequency n=1/T

TC=material cost+inventory carrying cost+total set up cost in T;

TC= cD + hI + An;

TC= cD + icQ/2 + AD/Q; to obtain Q', we derivate over Q

\[ d(TC)/dQ = 0 + ic/2 - AD/Q^2 \]

(the cost curve is obviously parabolic with a minimum value because of the tradeoff between c and A);

so, if d(TC)/dQ= 0, we obtain Q', the minimum value of Q

\[ Q' = \sqrt{2AD/ic} \]

let's analyze the wrong assumptions of the "machinery age" in the ELZ:

1. Q and D are different, this generates inventory,
2. A is considered constant and is related with the set up time, A will force Q to be high and ic to be low, but we have control over A, and not over ic.

3. Constant A will fight for volume, no variety, because it does not want set up changes in machines.

Then, the thing is not to find $Q'$ any more, but A in terms of time. If we want $Q'$ as small as is possible, then, $Q' = D$ and

$$A = D \frac{ic}{2},$$

Thus, we know what should be the size of A (in terms of time) for the setup.

**NEW APPROACH TO PRODUCTIVITY THROUGH THE REDUCTION OF THE SETUP TIME**

<table>
<thead>
<tr>
<th>SET UP</th>
<th>PROCESS</th>
<th>LOT</th>
<th>RATIO</th>
<th>UPTIME</th>
<th>% Prod.</th>
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<tbody>
<tr>
<td>90 min</td>
<td>1 min</td>
<td>100</td>
<td>$\frac{90}{100}$</td>
<td>1/1.9</td>
<td>52%</td>
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<tr>
<td>90 min</td>
<td>1 min</td>
<td>500</td>
<td>$\frac{90}{500}$</td>
<td>1/1.18</td>
<td>84%</td>
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<tr>
<td>90 min</td>
<td>1 min</td>
<td>1000</td>
<td>$\frac{90}{1000}$</td>
<td>1/1.09</td>
<td>91%</td>
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<td>90 min</td>
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<td>10000</td>
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<td>99%</td>
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<tr>
<td>9 min</td>
<td>1 min</td>
<td>100</td>
<td>$\frac{90}{100}$</td>
<td>1/1.009</td>
<td>99%</td>
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</tbody>
</table>