Quality Improvement in the Instant Ginger Drink Making Process

by

Ms. Orawan Surachalermkul

A Final Report of the Six-Credit Course
CE 6998 - CE 6999 Project

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
in Computer and Engineering Management
Assumption University

March 2004

Quality Improvement in the Instant Ginger Drink Making Process

by
Ms. Orawan Surachalermkul

A Final Report of the Six-Credit Course
CE 6998 — CE 6999 Project

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
in Computer and Engineering Management
Assumption University

March 2004

Project Title	Quality Improvement in the Instant Ginger Drink Making Process
Name	Ms. Orawan Surachalermkul
Project Advisor	Dr. Akajate Apikajornsin
Academic Year	March 2004

The Graduate School of Assumption University has approved this final report of the six-credit course, CE 6998 — CE 6999 PROJECT, submitted in partial fulfillment of the requirements for the degree of Master of Science in Computer and Engineering Management.

Approval Committee:

(Dr. Akajate Apikajornsin)
Advisor

(Prof.Dr. Srisakdi Charmonman)
Chairman

(Dr. Chamnong Jun thi panich)
Dean and Co-advisor

(Assoc.Prof. Somchai Thayarnyong)
CBE Representative

March 2004

ABSTRACT

This project uses the principle of seven quality improvement tools to solve the problem in "Quality improvement in the instant ginger drink making process", a study of quality in fresh ginger of Bangkok Instant Drink Co., Ltd.

From the study, the important factors are quality, inventory, cost and delivery respectively. Corresponding with those factors, the company has to purchase the raw material in the in-cultivation that affects the storage problem.

This project studies and recommends the solution of the storage problem by transferring the process of transforming the raw material before storage in the warehouse.

The accomplishment of this project will be advantageous for the company in order to develop the instant ginger drink making process.

ACKNOWLEDGEMENTS

I am indebted to the following people and organizations. Without them, this project would not have been possible.

I wish to express sincere gratitude to my advisor, Dr. Akajate Apikajornsin. His patient assistance, guidance, and constant encouragement have led me from the project inception to the project completion. I would like to thank many instructors in Computer and Engineering Management (CEM) faculty for all the knowledge they imparted to me.

I would like to thank the manager of Bangkok Instant Drink Company Limited, for his comments and advice and also thank the factory staff for giving the information.

Special appreciation is due to my family for their fervent and continuous encouragement. Above all, I am forever grateful to my parents whose willingness to invest in my future has enabled me to achieve my educational goal.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

I. INTRODUCTION

1.1 The Significance of the Study

In today's business climate, market differentiation requires instant adaptation to new processes and the power to sense and predict change early — before it impacts outcomes. In the midst of increased competition, increased pressure for profits and more dynamic work environments, how can manufacturers deliver products that customers value? How can they create and sustain value across the supply chain? And how do they manage demands for market innovation, synchronize dispersed supply networks, and extend service levels beyond the product's life? To surmount these obstacles, they need to focus on the major key drivers of value across the enterprise, that is quality.

Quality is the basic customer decision factor for an explosively growing number of products and services today — whether the buyer is a housewife, industrial corporation, a government agency, a department store chain, or a military defense program. Quality has become the single most important force leading to organizational success and company growth in national and international markets. The return-on-investment from strong and effective quality programs is providing excellent profitability results in firms with effective quality strategies. This is demonstrated by substantial increases in market penetration, by major improvements in total productivity, by much lower costs of quality, and by stronger competitive leadership.

Success in the implement of this business strategy varies widely however, among the organizations of the world. More than at any time in memory, buyers perceive that the products of certain companies are significantly higher in quality than those of their competitors and they buy accordingly. A wider variation of effectiveness than ever

before also exists among the quality programs of companies. Some are strong in depth and in commitment. Others deal in half measures and try to meet fundamental quality requirements with the fireworks display of one-time quality encouragement programs or through dusting off the application of a few traditional quality-control techniques. Because of the wide variation in quality results, the search for the genuine key to success in quality has become a matter of deep concern to management of companies the world over. And experience is disclosing a fundamental basis for achieving this success.

The business of instant-ginger drink manufacture is highly competitive. There are many entrepreneurs who increase the market. So quality improvement is the major key to success and survival in today's rapidly changing world. To complete in today's global market, domestic markets and international markets must provide world-class quality products and services that satisfy the customers at a competitive price. Quality improvement begins with an in-depth understanding of customers and processes. Continuous quality improvement is the only path to increase customer satisfaction, market share, profits, and success in today's rapidly changing global economy.

This project is to study and recommend improvement in instant-ginger drink making process in order to solve the harvesting of fresh ginger problems of increasing quality of products and reduce the cost. From studying the status of the factory and quality problem of the factory, I proposed possible alternatives to the owner to reestablish or to reengineer the current manufacturing system in order to achieve maximum benefits of quality control. So I planned the project by determining the objective, scope, steps of study for fulfillment of the predetermined objective and deliverables.

In this project, the instant-ginger drink manufacturer has solved the quality improvement and **I** use our objective as the significance of quality control in the study.

1.2 Project Objectives

I did this project by studying and recommending improvement in the harvested period of fresh ginger. And **I** also studied and gathered the related information of quality in the system for probably analyzing the data and determining solution, conclusions and recommendations. This project is aimed at recommending quality improvement in instant-ginger drink making process in order to create customer satisfaction and high confidence in the company's finished goods.

1.3 Project Scopes

This project focuses on the possible alternatives in instant-ginger drink quality improvement for reducing the number of waste and nonconforming finished goods by using quality control. And this project covers only the instant ginger drink making process in "Bangkok Instant Drink Co., Ltd." In addition, the project recommends the quality improvement in the instant-ginger drink making process. Then I will study the factory's actual status, instant-ginger drink making process and manufacturing process.

II. LITERATURE REVIEW

Today, our daily lives and schedules depend totally upon the satisfactory performance and operation of products and services. It has explosively increased customer demand for greater durability and reliability in product and services. While today's buyers continue to purchase with strong attention to price, unlike the buyers of only a few years ago, they place increasingly high emphasis upon quality, expecting acceptable products at any price level. It is quality as well as price that sells today, and quality that brings customers back for the second, third, and fifteenth time.

2.1 The Meaning of "Quality"

First of all, we must understand the meaning of quality first. When the expression "quality" is used, we usually think in terms of an excellent product and service that fulfills or exceeds our expectations. These expectations are based on the intended use and the selling price.

According to ANSI/ASQC Standard A3-1987, quality is the totality of features and characteristics of a product or service that bear on its ability to satisfy stated needs or implied needs. These needs involve safety, availability, maintainability, reliability, usability, economics (price), and environment. The stated need is the explicit need. For example, the stated need of studying is graduation. On the other hand, the implied need is a hidden need, one that is not necessarily expressed, and is basically just expected or assumed. For instance, while the expressed need is graduation, the implied need is the increase in knowledge. Quality is a customer determination, not an engineer's determination, nor a marketing determination. So the quality is customer satisfaction, fitness for use or compliance with specifications. It can only be achieved if it is planned and managed to be achieved.

Product and service quality can be defined as the total complex product and service characteristics which the product and service in use will meet the customer satisfaction such as reliability, serviceability and maintainability, etc. It is very important to recognize this fact because the key requirement for establishing what is to be the quality of a product requires the balance of the various individual quality characteristics. The product requires the balance of the various individual quality characteristics. The product must have appearance suitable to customer requirements so it must be attractive. Another essential element in defining the term of quality is quality control that will provide additional explanation in the next part.

2.2 Quality Control Concept

Quality control is discussed from a business point of view in the terms of the economics of profitability, of market leadership and of productivity and cost control. It is considered in the managerial terms of organization, participative management, and strategic planning as well as of the system's approach to quality. In addition, quality control is examined by starting with the purchasing actions from vendor selection for supplier quality, manufacturing planning, process control, and automation to equipment capability evaluation and final product assurance. So quality control refers to the use of specification and inspection of completed parts, subassemblies, and products to design, produce, sustain, and improve the quality of a product and service.

With production processes equipped with quality control functions, the manufacturer can analyze the outcome of the process. This will facilitate evaluation of the products and their conformation to the standards. If the products do not comply with the standards, then the defect must be corrected. Then corrective action will be taken to support the correction plan.

Quality control (QC) concerns the techniques and activities which sustain quality to specified requirements and improve the quality of a product and service. It is the practical means of securing product and service quality as laid out in a product specification. Quality control may be viewed as a subset of quality assurance although quality control was used first. The basis of quality control is inspection. An important outcome of this statement is that quality control is an 'after the fact' activity which measures product that has not been produced for customer satisfaction. In other words, defects are detected through postproduction inspection by a QC system and not prevented. Quality control involves integrating the following related techniques and activities:

(1) Establishing a standard for the product or service based on the customer needs, requirements, and expections.

(2) Ensuring conformance to these standards, poor quality is evaluated to determine the reason why the parts or services provided are incorrect.

(3) Taking action if there is a lack of conformance to standards. These actions may include sorting out the product to find the defects. In service industries, actions may involve the customer and correcting the situation.

(4) Implementing plans to prevent future nonconformance. These plans may include design of manufacturing changes, in service industry they include procedure changes.

These four activities work together to improve the production of product or provision of service. Utilization of these activities provides the customer with the best product or service at the lowest cost. The aim should be continued quality improvement.

2.3 Significant Seven Quality Improvement Tools and Techniques

The proper use of analytical and statistical tools can often mean the difference between success and failure, the screen tools are proper for the quality improvement. The screening quality improvement tools are used more often. In this project we will select the form of failure to be the collecting data, then the Pareto diagram as a tool for categorizing the type and number of failure in the production line. After that we verify the root cause by using the cause and effect diagram. Normally the quality improvement tools are presented in many types and we can select each that is proper to use because it will help you to clarify the cause and the problem.

The seven quality improvement tools are the following: -

(1) Flow chart

(a) Description

A flow chart is a diagram that shows all the major steps of a job operation or process. Preparing a flow chart is one of the first things to do in analyzing a process. It uses a set of standard symbols to document the process steps, presenting them in a pictorial fonnat that is easy to understand.

Through flow charting, employees can better understand the processes for which they are responsible. The flow chart demonstrates how the different steps in a process are related to each other. It provides insight for identifying value-added activities, control points, data-collection points, insufficiencies in the workflow and obvious key points in the process. It is also an excellent training tool for new employees.

(b) Applications

(i) To analyze relationships between sequential activities

(ii) As a technique for fully understanding a problem

(iii) As a source of information for problem identification and resolution

(iv) To analyze customer or supplier activities

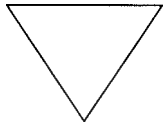
Symbol	Meaning
O	Operations (treat, assemble, and value adding)
	Movement / Transportation (receiving, shipping)
	Storage
	Inspection
D	Delay (temporary storage or work in process, Waiting for operation)
	Direction of flow

Figure 2.1. Standard Flow Chart Symbols.

(c) Making steps of flow chart

(i) Bring together representatives from all departments responsible for the process so they can perform the analysis together.

(ii) Title the chart with the name of the process analyzed. If there is more than one, draw the diagrams on separate charts and number them sequentially.

(iii) List sequentially all major steps involved in the process. In some cases it may be easier to start at the end of the process and work towards the beginning. However, the flow is always shown beginning at the top-left corner of the chart. Make sure that process boundaries are clearly defined.

(iv) Using the set of symbols shown in Figure 2.1, draw a flow diagram. Concentrate on major processes so that the flow chart will fit on a single page if possible. The chart should represent the way things are, not the way they are supposed to be.

(v) When processes are complex, create second and third flow charts as necessary to adequately break down all major processes into the component parts.

(2) Pareto analysis

(a) Description

Vilfredo Pareto (1848 — 1923) found that there were a few people with a lot of money, and many people with little money. This unequal distribution of wealth became an integral part of the economic theory.

A Pareto diagram is a vertical bar chart that displays the relative frequency of the various categories of the problem. Data are classified in descending order from left to right, as shown in Figure 2.2. In this case, the data classifications are types of field failure. Other possible data classifications are problems, causes, types of non-conformities, and so forth.

The vital few are on the left and the useful many are on the right. When the other category is used, it is always on the far right. The vertical scale is dollars, frequency, or percent. Pareto diagrams can be distinguished from histograms by the fact that the horizontal scale of a Pareto is categorical, whereas the scale for the histogram is numerical.

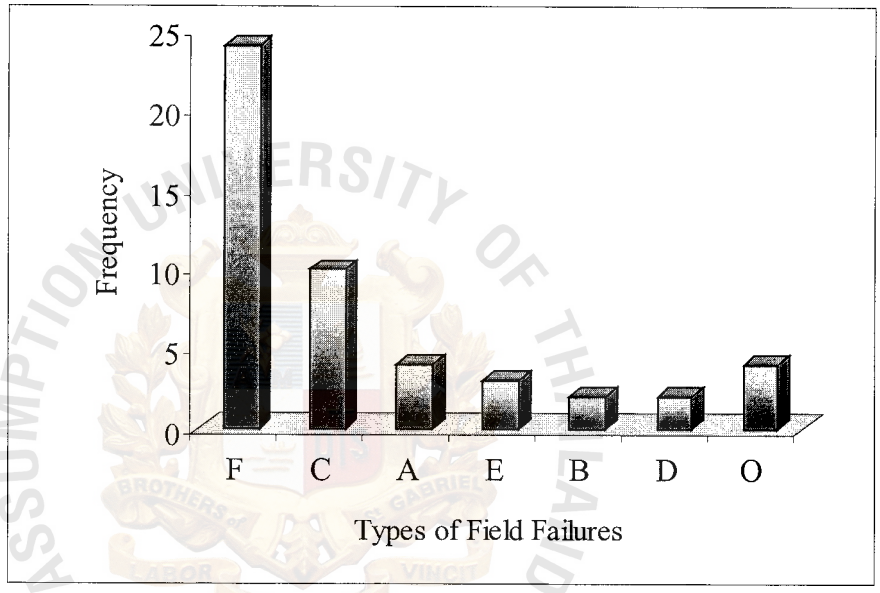


Figure 2.2. Example of Pareto Diagram.

Pareto diagram is usually accompanied by a cumulative line, as shown in Figure 2.3. This line represents the sum of the data as they are added to gather from left to right. Two scales are used: The one on the left is either frequency or dollars, and the one on the right is percent. Pareto diagrams are used to identify the most important problems. Usually, 80% of the total results from 20% of the items. The focus of problem solving and process improvement is generally on the vital few or the contribution should be 80 —

20% rule. The cumulative percentage scale must match with the dollar or frequency scale such that 100% is at the same height as the total dollars or frequency. See the arrow in Figure 2.3. It is noted that a quality improvement of the vital few, of say 50%, is a much greater return on investment than a 50% improvement of the useful many. It is easier to make a 50% improvement in the vital few.

(b) Application

(i) Display causes of problems in order of importance.

(ii) Verify root causes of problems.

(c) Steps for Pareto diagram

(i) Determine the method of classifying the data: by problem, cause, type of nonconformity, and so forth.

(ii) Decide if dollars (best) or frequency is to be used to rank the characteristics.

(iii) Collect data for an appropriate time interval.

(iv) Summarize the data and rank order categories from largest to smallest.

(v) Compute the cumulative percentage if it is to be used.

(vi) Construct the diagram and find the vital few.

(vii) Title the graph and briefly write the source of the data on which the graph is based. With quality control, the source of the data must be clear.

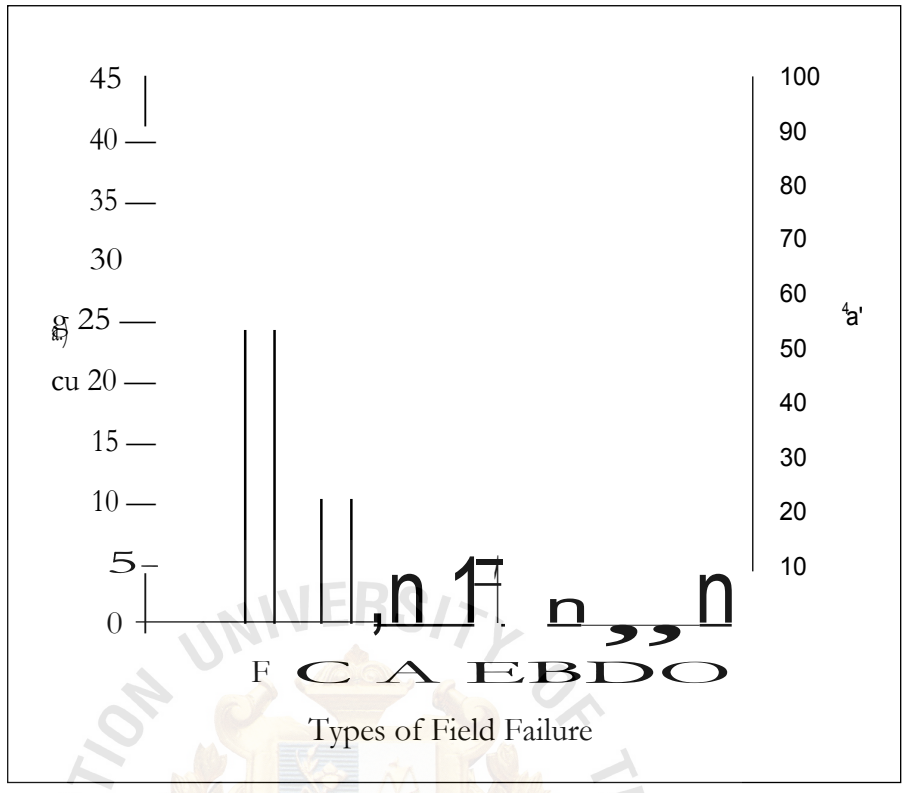


Figure 2.3. Example of Cumulative Line.

(3) Check Sheet

(a) Description

A Check Sheet is a list of causes of quality problems with the number of defects resulting from each cause. The main purpose of check sheet is to ensure the data that is collected carefully and accurately by operating personnel. Data should be presented in such a form that it can be quickly and easily used and analyzed. The form of the check sheet is individualized for each situation and is designed by the project team. Checks are made on a daily and weekly basis, and some checks, such as temperature, are measured.

Check sheets are used to record data. They are therefore used in every project stage that includes data collection so we could have put them anywhere in our sequence and be correct. The best check sheets are simple to use and visually display the data in a format that can reveal underlying patterns. It should be user-friendly and, whenever possible, include information on time and location.

(b) Application

Gather data on the number of occurrences of various issues, problems, inputs, outputs, or outcomes during specified time periods. Record occurrences of a variety of activities such as work or inspection in a variety of categories such as shift or machine during a sampling time period. Count errors or failure by type during a time period.

Items	A	B	C	D	E	F
	✓✓✓✓ ✓✓	✓✓✓✓	✓	✓✓✓✓	✓✓	✓✓✓ ✓✓✓✓

Figure 2.4. Example of Check Sheet.

(4) Histogram

(a) Description

A Histogram is a bar chart showing the frequency of occurrence of causes of defects. The histogram graphically shows the process capability and the relationship to the specifications and the nominal. It also suggests

the shape of the population and indicates if there are any gaps in the data. It is, like Pareto chart, a graphic representation of frequency table. A histogram is created by dividing raw collected data into equal intervals. The number of measurements falling into each interval is counted and bars are then constructed so that their heights are proportional to their frequency of occurrence. The histogram thus produced graphically illustrates three characteristics of these raw data that are the central tendency or average, the range and the shape of the data. Usually the data fall into a bell-shaped curve called the normal distribution.

(b) Applications

(i) Display and compute process variability with expected variability.

(ii) Determine the variables produced with the same median, mean and variability.

(c) Steps to constructing a histogram

(i) Identify and define data to be collected

(ii) Construct a data-collection sheet

(iii) Collect data

(iv) Locate the smallest and the largest measurements

(v) Calculate range

(vi) Select a number of intervals

(vii) Determine class interval size

(viii) Determine class limit end points

(ix) Tally measurements by class intervals

(x) Draw bars and labels

(5) Scatter diagram

(a) Description

The scatter diagram is a graphical method of determining the relationship between the cause and effect through pattern analysis and shows how two process variables relate to each other. Suppose salt content of cheese is an important quality characteristic. To see what factors influence this characteristic, you measure both the salt content of pieces of cheese and the time it stayed in a salt bath of known salinity. For each piece of cheese, there is a pair of measurements: salt content and time in the bath. Instead of making two separate dot plots, you can combine the two: indicating time along the horizontal axis (sometimes called the X axis) and salt content along the vertical axis (sometimes called Y axis). You place points where the values of each pair intersect (see Figure 2.4). The shape of the resulting scatter of points tells you if the two factors are related. If they are unrelated, the points will be randomly scattered around the graph. If larger values of one occur with larger values of the other, the points will group towards a line running from lower left to upper right. If larger values of one are associated with smaller values of the other, the points will cluster on a line running from upper left to lower right.

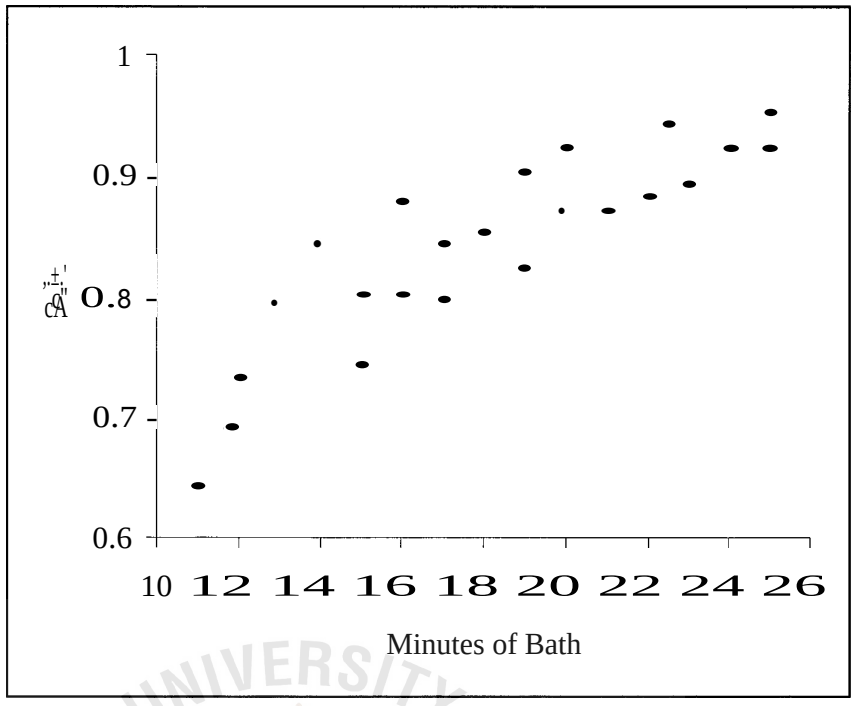


Figure 2.5. Example of Scatter Diagram.

(b) Applications

(i) Plot suspected causes versus undesirable effects in support of cause-and-effect analysis.

(ii) Compare a series of paired variables to determine if a relationship exists.

(iii) Indicate whether additional analysis is warranted to determine the exact nature of a cause-and-effect relationship (i.e., to predict the relationship by fitting a line or curve to the data points).

(c) General steps for constructing a scatter diagram

(i) Identify dependent and independent parameters and take measurements 50 — 100 which would be useful.

(ii) Draw the axes and plot the points. The independent factor should be on the horizontal axis.

(iii) Draw a best-fit line through the points.

(iv) Analyze the resulting scatter diagram.

(6) A Cause-and-Effect or Fishbone Diagram

(a) Description

The cause-and-effect diagram, also called a "Fishbone Diagram" because of its appearance, allows you to map out a list of factors thought to affect a problem or desired outcome. A chart identifies and organizes possible cause of problems, or factors needed to insure success of some effort. The problem, situation, or event is listed on the right. Branches off the central arrow indicate the main categories of items. Use of this format allows people to easily see the relationship between factors. This type of diagram was invented by Kaoru Ishikawa, and hence is also called an "Ishikawa diagram." It is an effective tool for studying processes and situations, and for planning.

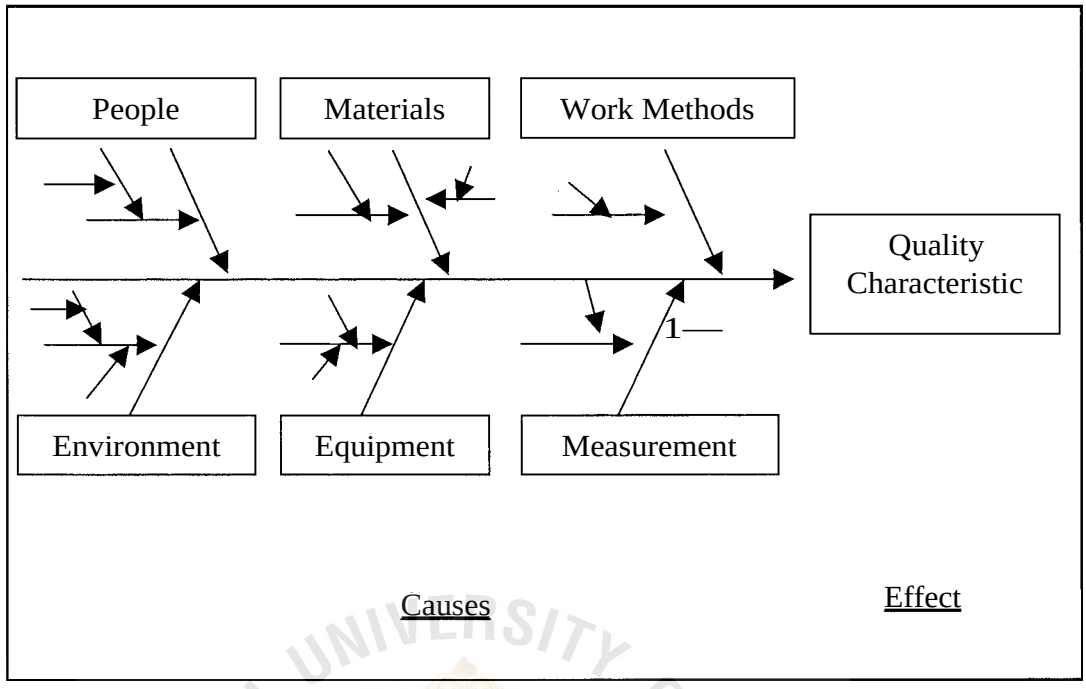


Figure 2.6. Example of Cause-and-Effect Diagram.

A cause-and-effect diagram is essentially a pictorial display of a list. See Figure 2.5. Each diagram has a large arrow pointing to the name of a problem. The branches off the large arrow represent main categories of potential cause (or solutions). Typical categories are equipment, personnel, method, materials, and environment. You can customize these categories to fit the processes. Smaller arrows, representing subcategories (list items), are drawn off each main branch.

(b) Applications

(i) Analyzing actual conditions for the purpose of product or service quality improvement, more efficient use of resources, and reduced costs.

(ii) Identify root causes, or key drivers, contributing to some effect, or measurable outcome.

(iii) Elimination of conditions causing nonconforming product and customer complaints.

(iv) Standardization of existing and proposed operations.

(v) Education and training of personnel in decision making and corrective action activities.

(c) Making a cause-and-effect diagram

(1) Determining the quality characteristic. This is something we would want to improve and control. Clearly state and identify the effect to be analyzed.

(ii) Draw the diagram structure with the effect in a box at the right side of the head of the fish. The several factors that may be causing the problem, direct a branch arrow to the main arrow. It is recommended to group the major possible cause factors of dispersion into such items as raw materials, equipment, method of work, measuring method, etc. and each individual group will form a branch.

(iii) Onto each of these branch items, write in the detailed factors which may be regarded as the causes; these will be like twigs. Onto each of these, write in even more detailed factors, making smaller twigs for defining and linking the relationships of the possible causal factors which should lead to the source of the quality characteristic. One must check to make certain all the items that may be causing dispersion are included. Group members must speak openly with one another to adequately construct the cause and effect diagrams. If the relationships of

causes to effects are properly illustrated, then the diagram is complete.

Control Charts

(a) Description

A Control chart is monitoring of a production process using the statistical quality control techniques. The UCL and LCL or upper and lower control limits, respectively indicate how much variation is typical for the process. Points that fall outside the limits or into particular patterns indicate the presence of a special cause of variation, a cause that deserves investigation. The control chart is a time plot with one extra feature. It also indicates the range of variation built into the system. The boundaries of this range are marked by upper and lower statistical control limits, which are calculated according to statistical formulas from data collected on the process.

Control charts help you distinguish between variation inherent in a process (variation from a "common cause") and variation arising from sources that come and go unpredictably ("special cause"). Points that occur outside the control limits are signals of special causes of variation, meaning it should be relatively easy to track down that source and prevent its recurrence. Data points that stay within the control limits indicate that most variation is coming from common causes. If all points stay within the control limits, the only way to make improvements is to fundamentally change some aspect of the process (materials, procedures, equipment, training, etc.) Control limits only indicate what the process is capable of doing and can only pinpoint possible problems with the process. They do

not help correct the problem. The operator, instead, is responsible for rectifying the problem or initiating the corrective action.

(b) Applications

(i) Determine whether or not the current process is stable or in control and is capable of meeting expectations or specifications.

(ii) Decide whether the process has changed due to special causes and will require adjustment to perform normally.

(iii) Provide a baseline of data for process improvement (i.e., a change in the process to alter common causes) in order to reduce variation and increase productivity by shifting the process mean.

2.4 Quality Management

Quality Management is the process of identifying and administering the activities needed to achieve the quality objectives of an organization. One useful way to illustrate the basic elements of quality management is to draw a parallel to a well-established function, namely finance.

Finance management is accomplished by the use of three managerial processes: planning, control, and improvement. Some key elements of these three processes are shown in Table 2.1. The same three processes apply to quality. The three financial processes provide a methodical approach to addressing finance; the three quality processes provide a methodical approach to addressing quality. The particular importance is that each of the three quality processes can be further defined in a sequence of activities. Table 2.2 summarizes these sequences.

Table 2.1. Financial Processes.

Process	Some elements
Financial planning	Budgeting
Financial control	Expense measurement
Financial improvement	Cost reduction

The three processes of the quality trilogy are interrelated. The interrelationship is applied to one of the two components of the quality definition and freedom from deficiencies. It is of uncommon importance. For example, note the graphic distinction between the noisy sporadic quality problem and the muted chronic waste. The sporadic problem is detected and acted upon by the process of quality control. The chronic problem requires a different process, namely, quality improvement. Such chromic problems are traceable to an inadequate quality planning process.

For the trilogy of quality processes to be a successful framework for achieving quality objectives, it is necessary that the processes rest on a foundation of inspirational leadership and environment and practices, strongly supportive to quality. Without such a quality "culture," the trilogy of quality processes cannot be fully effective. These elements have an impact on people at all levels.

Table 2.2. Processes for Managing Quality.

Quality planning	**Quality control**	**Quality improvement**
Establish quality goals	Choose control subjects	Prove the need
Identify customers	Choose units of measure	Identify projects
Discover customer needs	Set goals	Organize project teams
Develop product features	Create a sensor	Diagnose the causes
Develop process feature	Measure actual performance	Provide remedies, prove that the remedies are effective
Establish process controls, transfer to operations	Interpret the difference	Deal with resistance to change
	Take action on the difference	Control to hold the gains

III. OVERVIEW OF OPERATIONS OF INSTANT-GINGER DRINK MANUFACTURE

This part is designed to give you a brief of the company profile, the factory's actual status and working condition, operation of the instant-ginger drink manufacturing and instant-ginger making process in order to know the factory's statement of problem and the important reasons of the project's objective about quality improvement.

3.1 Company Profile

Name	Bangkok Instant Drink Co., Ltd.
Location	Bangkok, Thailand
Type of business	Producer and distributor of instant-ginger drink and instant-chrysanthemum drink.

Bangkok Instant Drink Co., Ltd. was established in 1977. Ginger and chrysanthemum are the local materials. From the company's experience of more than 20 years with high technology in production, the products still have scent and natural flavor. The products are satisfactory and acceptable to the customers. Furthermore, these can support the agriculturists in Thailand to be employed and to promote ginger and chrysanthemum agriculture, and these can reduce the number of unemployment.

3.1.1 Objectives of the company

(a) To provide the high confidence and acceptable products for customer satisfaction in both domestic and international markets.

(b) To develop business in order to increase profits and to reinforce the stability of the company

(c) To make a step forward to global standard.

3.1.2 Business Plan (Strategies)

(a) To emphasize the channel of distribution.

(b) To make a step forward to global standard by developing and completing the global market.

(c) To produce mostly ginger for its affiliated company.

3.1.3 Marketing Plan

The marketing plan of the company is continuous quality development and quality improvement of product for high quality and standard. All customers of the company are in the domestic market. The company will give high priority and more importance to the affiliated company.

3.1.4 Product

Ginger is a pungent, aromatic spice produced from the rhizome (an underground root or stem) of a tropical herbaceous plant from the family Zingiberaceae. Its other names are Khing, Khing klaeng, Khing daeng, Khing phueak, Cochin ginger, and etc.

Botanical Description:

It is a low herb, having horizontal, white or pale yellow, fleshy and aromatic rhizome; and leafy stem. Leaves are lanceolate, 12-20 by 1.5-2 cm; tapering gradually to the apex; narrowing to base and clasping the stem by their long sheaths. Inflorescences are borne separately on a bladeless leaf-sheath; consisting of flowers zygomorphic, with bracts and bracteoles subtending the flowers, bracts closely pressed against each other; calyx shortly 3 lobed; corolla tubular, divided into 3 subequal lobes; fertile stamen one only; very rarely flowers. Fruit is a dehiscent capsule.

Ecology and Distribution:

Pieces of the fresh rhizome will grow if planted in a well-drained compost. Until the first shoot appears, the compost should be kept moist and then, while the plants are growing strongly, they should be kept well watered. As the leaves start to die, towards the end of the year, watering should be reduced and the rhizomes allowed drying out. It is unlikely that the rhizomes will be suitable for cooking or that the plants will flower.

Propagation:

Ginger probably originated as part of the ground flora of tropical lowland forests, where may of its wild relatives are still to be found. In its cultivation, the ginger plant requires a consistently warm and moist climate, brilliant sunshine, and heavy rainfall. It thrives best at lower elevations up to about 2.500 feet in the tropics, in rich, well-tilled sandy loam. Generally, it needs high temperatures, for at least part of the year.

The best soil for ginger is a light, free, sandy loam. Stiff clays or coarse sands are quite unsuitable for its cultivation. Wet sandy ground does not suit it either. The ideal ground for ginger is good garden soil, rich in humus, light and well worked, friable and fairly dry.

They are propagated by division of the rhizomes. These should be planted at the distances of about 30 x 20 cm, the depth of 5-10 cm. Water should be given sparingly until the shoots have well developed.

Harvest Season (for Bangkok Instant Drink Company only):

(1) July — August

Green ginger is in demand and the harvesting is done even earlier, at four — six months' maturity. It is likely for fresh consumption. The production is about 3,000 kgs./rai.

(2) January — February

The ginger crop becomes ready for harvesting within eight months of planting. The rhizomes are harvested when the leaves turn yellow and start drying up. The plant is strong enough to be harvested for the next process of production. The production is about 4,000 — 5,000 kgs./rai. Mostly the plants are spicy and they are suitable for instant-ginger drink.

The Advantages (Applications):

For aiding the treatment of colds, coughs, colon and stomach spasms, constipation, indigestion and gas problems, heartburn, headaches, motion sickness, morning sickness, nausea and sinus.

3.2 The Process of Operation of the Company

3.2.1 Ordering Raw Materials

The company will order raw materials for production in order to sell the products to the customers.

3.2.2 Inspection of Quality of Raw Materials

When the company buys the raw materials from the agriculturist, the company will check and inspect the raw materials according to the company's standard. However, if they have real standard quality, the company will keep it in the factory for production.

3.2.3 Production

When the raw materials pass inspecting quality, they will be used in production of all kinds of products indicated by the master production schedule (MPS).

3.2.4 Inspection of Quality of Finishing Products

After finishing production, the company will check and inspect all kinds of products to see whether they have standard according to the company's conditions or not. If the products have standard according to the company's conditions, the company will keep them in the warehouse for distribution.

3.3 Instant-ginger drink Making Process

Process of making instant-ginger drink

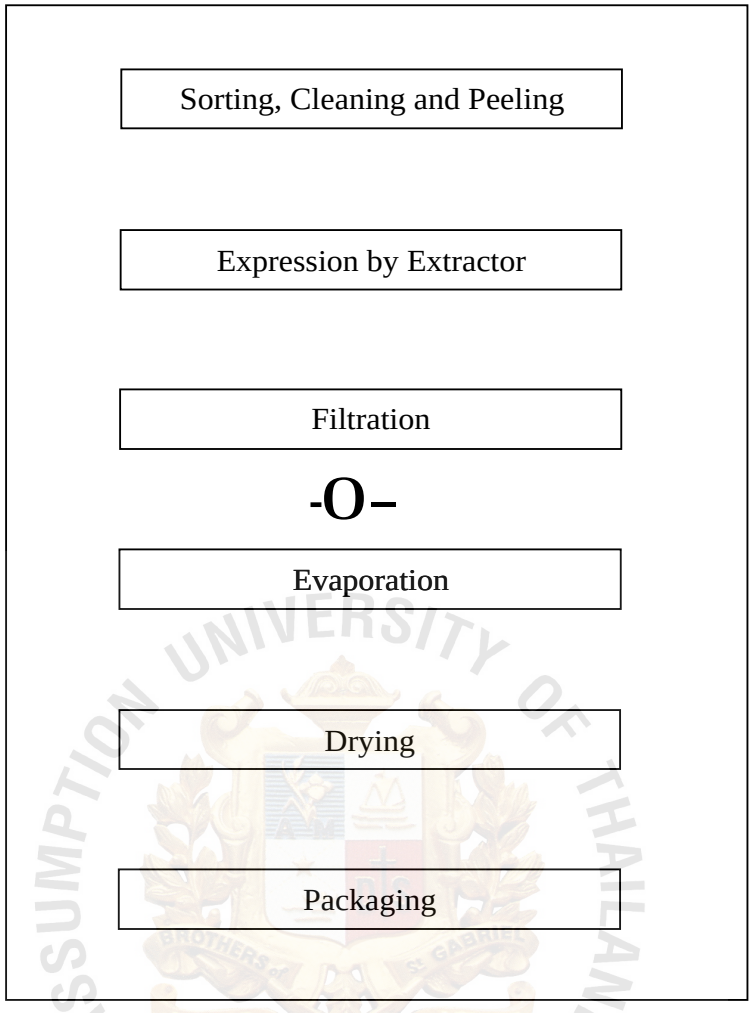


Figure 3.1. Instant Ginger Drink Making Process.

3.3.1 Sorting, Cleaning and Peeling

Manual sorting by color is still widely used.

Cleaning is the unit operation in which contaminating materials are removed from the plant and separated to leave the surface of the plant in a suitable condition for further processing. Cleaning should take place at the earliest opportunity in a food process both to prevent damage to subsequent processing equipment by stones, bone or metals, and to prevent time and money from being spent on processing contaminants which are then discarded. Wet cleaning is the

method for removing soil, dust and etc. from root crops by spray washers and brush washers.

Peeling is used in the processing of many roots to remove unwanted or inedible material, and to improve the appearance of the final product. Stationary blades are pressed against the surface of rotating roots to remove the skin

In ginger processing, the company buys the raw materials (the plants) from the agriculturists in a large quantity. Then the company starts the process of sorting, cleaning and peeling the plants. After that they take the plants to the expression process.

3.3.2 Expression

The main application of expression are in the extraction of components of the plant materials either for direct consumption or for use in subsequent processing. The materials are located within the cell structure of the plants and it is necessary to disrupt the cells in order to release them.

In ginger processing, the press should remove the maximum quantity of juice, without substantial quantities of solids. Then, boil down the juice from clear juice to thick juice and go to the next process.

3.3.3 Filtration

Before going to the filter process, we have to add the flavor into the thick juice (liquid) according to the company condition of each flavor.

Filtration is the removal of small amount of solid particles from the liquid food by passing it through the filter medium.

In ginger processing, they take the thick juice for each flavor to the filter medium in order to remove the small amount of solid particles from the thick juice (liquid juice).

3.3.4 Evaporation

Evaporation, or concentration by boiling, is the partial removal of water from liquid food by boiling off water vapour.

Evaporation is used to pre-concentrate food (for example; milk, tea and coffee) prior to drying, freezing or sterilization and hence to reduce their weight and volume. During evaporation, sensible heat is transferred from steam to the liquid food, to raise the temperature to its boiling point.

In ginger processing, the evaporation is to remove water from the thick juice by boiling off water vapour.

3.3.5 Drying

Dehydration (or drying) is defined as 'the application of heat under controlled conditions to remove the majority of the water normally present in a food by evaporation' (or in the case of freeze-drying). The main purpose of dehydration is to extend the shelf life of foods by a reduction in water activity. This inhibits microbial growth and enzyme activity, but the processing temperature is usually insufficient to cause their inactivation. Drying causes deterioration of both the eating quality and the nutritional value of the food. The design and operation of dehydration equipment aim to minimize these changes by the selection of appropriate drying conditions for individual foods.

Spray dryers, a fine dispersion of pre-concentrated food is first 'atomized' to form fine droplets and then sprayed into a co-or counter-current flow of heated air in a large drying chamber. Spray dryers may also be fitted with fluidized bed facilities to finish powder taken from the drying chamber.

3.3.6 Packaging

Packaging is an important part of all food processing operations. The functions of packaging are containment, protection and convenience. The package should be aesthetically pleasing, have a functional size and shape, retain the food in a convenient form for the customer without leakage, possibly act as a dispenser which opens easily and recloses securely, and be suitable for easy disposal, recycling or re-use.

For the packaging for ginger-instant drink, the company will divide into 2 forms for serving their sales: glass bottles and sachets.

3.4 Statement of Problem in the company's factory

From studying the company's actual status and working condition, operation of the company and instant-ginger process, I use the information to list the situation of quality in the company's factory. The various problems in the factory are caused by an inappropriate quality control system. The situation of the company's factory is summarized as follows:

(1) The customers including both affiliated factories and outside customers, frequently blame the quality of the company's products because the products have low quality standard.

(2) Because raw materials are fresh ginger and the company's product is instant-ginger drink, the company has problems about harvesting the fresh ginger in order to process for the instant-ginger production.

IV. STATEMENT OF QUALITY PROBLEMS AND METHODOLOGY

Nowadays, the business of instant-ginger drink industries is highly competitive. There are many instant-ginger drink manufacturers increasing in the market. So the way to survive or run the business in this situation is to produce products that have the cheap price but high quality. Quality is the key to success in today's rapidly changing world and for customer satisfaction. The way to make the product at cheap prices is by reducing the cost which is the way to purchase the raw materials (fresh ginger) in the right harvesting period as the quality of these purchased materials becomes increasingly important. However, these can control the quality standard of fresh ginger. We are talking about quality control which creates high confidence and customer satisfaction.

Quality control for customer satisfaction is customer—defined quality because the customer is the king. The key to an effective quality control is its focus on the customer both internally and externally. An excellent place to start is by satisfying the internal customers. We must listen to the "voice of the customer" and emphasize to design good quality and prevent defects. Do it right the first time and every time, for customer satisfaction is the most important consideration. All the above statements are the ideas about quality control in a business survival era. So the project uses this idea for the basis of all analysis.

To make appropriate quality control system, it is necessary to know firstly the situation of problems that the company encounters. When we already know all the quality problems, we can use the technique tools to solve the causes of the problems. The exploration of the situation of quality problems are developed with further details in the following:

4.1 Analysis of the Situation of Quality Problems

The cultivation of ginger in Thailand can be divided into 2 periods:

(a) In-cultivation period is the beginning of the rainy season during April — May and the plant can use the water in this season for growing up. The kind of ginger in this season are the small plants and spicy-taste flavor plants and old plants. They should keep them until eight — twelve months before harvesting. The harvesting period is during January — February.

(b) Out-cultivation period is during the winter season from January — February. The ginger is the young plant. It should be harvested about four — six months. The harvesting period for this kind of ginger is July — August.

The production of ginger that the company harvests in both periods (in-cultivation and out-cultivation) is not consistent. Because the quality of the product and cost of the raw materials are not to the company standard, I use the information of the fresh ginger purchasing of the company to consider which is the best reason.

Table 4.1 The purchasing of raw materials (fresh ginger) in 2000.

Period	**Quantity**	**Cost**
In-cultivation	50,000 kgs. / year	15 baht / kg.
Out-cultivation	10,000 kgs. / year	10 baht / kg.

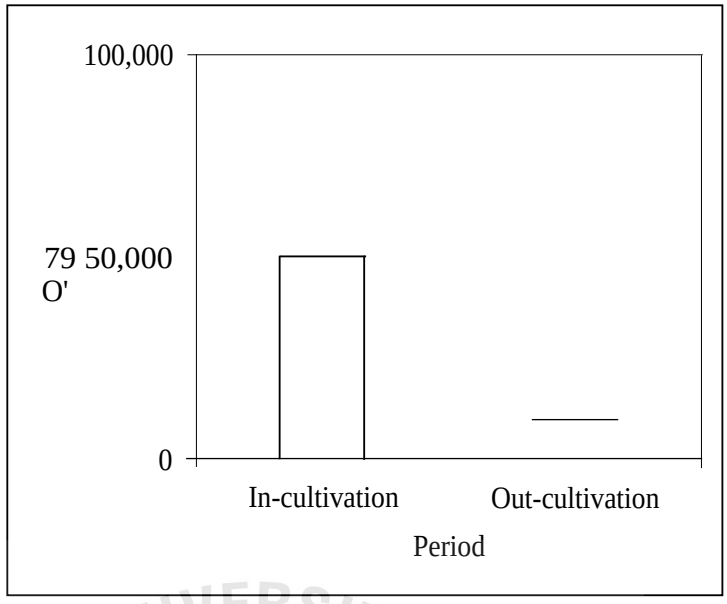


Figure 4.1. Histogram for Comparison quantity between In & Out Cultivation.

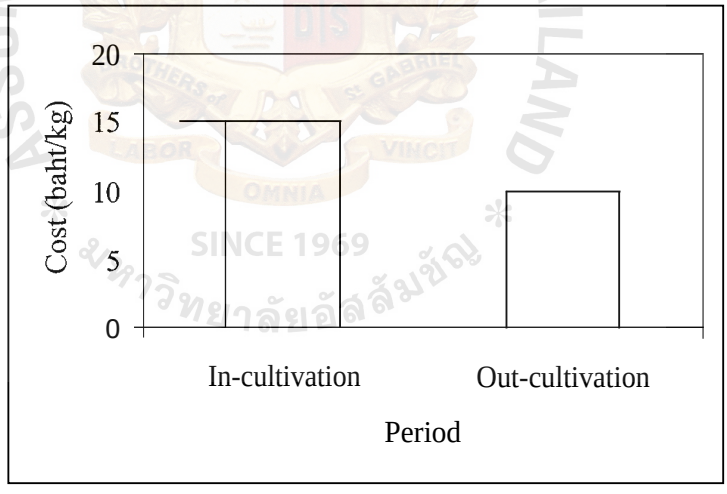


Figure 4.2. Histogram for Comparison Cost/kg between In & Out Cultivation.

Considering the first histogram we obviously recognize that the in-cultivation period has the highest quantity product per year. So I choose the in-cultivation period to study and analyze. In the second histogram, we recognize

that the in-cultivation period has the highest cost per kilogram. So I choose to study in the in-cultivation period of the second histogram.

From the related information of the company, I analyzed many possible problems including the following:

(a) Storage problem: The storage problem is greatly influenced by the amount of quantity stored in the factory; as a result, as the raw materials are the fresh ginger in the form of rhizome, it is a major problem of this company.

(b) Flavor and scent of product problem: Flavor and scent of products are a serious problem that affects directly the customers satisfaction and the company standard. The customers complain about the flavor and scent of products. They expect the flavor of products that they buy should be spicy and hot; and the scent of the products should be good. On the other hand, the group tester in the company also tests the products and the out-coming result is the same as the customers' complaint. It means that the products are nonconforming. It is also a major problem of this company.

(c) Cost problem: The cost of the product is high when the company purchases the raw materials in the in-cultivation period. This problem will be ignored where the quality of product is concerned. I do not concentrate on this problem.

(d) Delivery problem: Regarding the delivery of the product for the unexpected order by the customer, the company cannot produce and deliver on time because the inventory product is not enough for this unexpected order.

The information associated with possible problems come from the production department report in 2000. If the company does not consider the period of cultivation when purchasing the raw materials, it will cause to 4 main problems as shown in Figure 4.3 below:-

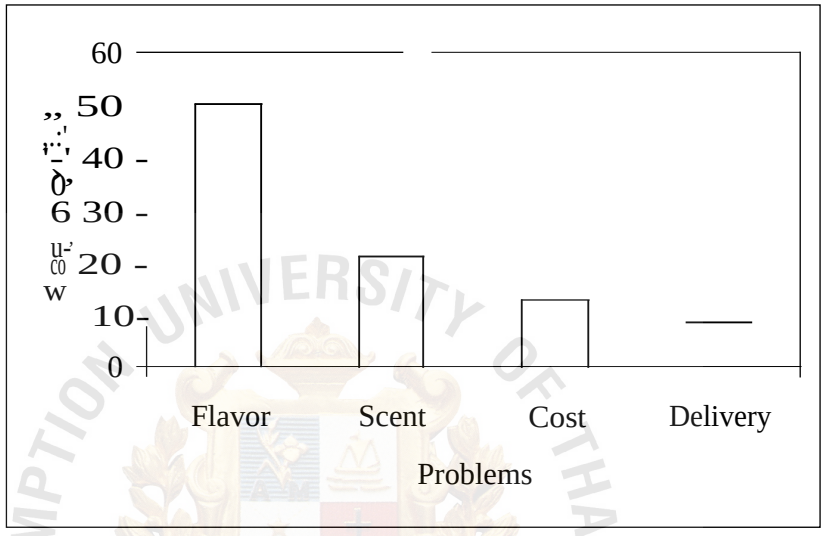


Figure 4.3 Pareto diagram for the problems from the production department report in 2000.

When analyzing the Pareto diagram from the production department report, a Pareto principle is to identify the most important problem by the vital few (20%) and the trivial many (80%). Usually, 80% of the problems are the result of 20% of the causes. One key to improvement is to identify those crucial 20% and focus attention on them. It is noted that a quality improvement of the vital few, of say 50%, has much greater returns on investment than a 50% improvement of the useful many. From Figure 4.3 the vital few are the problems about flavor and scent of the products. We believe that if the company still produces under the

existing process, the company will encounter extremely defective products resulting from non-complying products.

For that reason the flavor and scent of the products are the most important problems in purchasing the raw materials in the in-cultivation period and these are the problems that effect the storage problem in this company because the company wants to satisfy the customer and the company standard. If the company does not handle the defective problem, the company will not survive in this highly competitive industry. The main reason of the quality problems in the products that causes customer dissatisfaction and low company-standard is the non-complying standard.

V. SOLUTIONS FOR SOLVING QUALITY PROBLEM

In Chapter 4, I discussed the important quality problems and the analysis of those problems for identifying their factors. In this chapter I will provide the analysis of possible root causes of quality problems and propose solutions for solving the quality problems.

From the analysis of the quality problem in chapter 4, the company purchased the raw material in both periods (in and out cultivation). It caused the favor and scent of the product problem from the production department's report. The solution of this problem is the company has to purchase the raw material in the right cultivation period that is the in-cultivation because in this period, the raw material (fresh ginger) is aged 8 months and is spicy and has a good scent or is aromatic. This is the qualification that customers need and the company wants. The differences in purchasing method of fresh ginger between the tradition method and the recent method are shown in Table 5.1.

Table 5.1. The differences between purchasing fresh ginger traditionally and recently.

Traditional Method	Recent Method
- Buy fresh ginger during both cultivation period (in and out cultivation)	- Buy fresh ginger only in the in-cultivation period.
- Spicy and non-spicy ginger	- Spicy ginger
- Good and bad scent	- Good scent

Although the cost of fresh ginger in the in-cultivation period is higher than purchasing in the out-cultivation period the result is that the fresh ginger will satisfy the customer needs and the company's desires.

Table 5.2. Strength and weakness of traditional and recent method.

	Traditional	Recent
Strength	- No need to inventory, because we can purchase through the year. - No keeping space to be required.	- Good quality.
Weakness	- Poor quality (mixed quality)	- Need keeping space for inventory.

The second problem is storage problem. It is caused by the purchasing of fresh ginger in a large volume in the in-cultivation period. They need more space to keep it. The solution for this problem is transfoli_ling the fresh ginger from rhizome form into powder form and continue to the next making process.

5.1 The Suggested Solution

Mostly, the problem in this company is caused from the quality of the product. So the quality of the product concern is a very important problem more than the other problems, like cost and delivery. The company has to concentrate on the purchasing of the raw material in the correct cultivation period.

When the company purchases the raw material in the appropriate cultivation period, the company will face the problem of storage. The suggested solution for

the storage problem is transforming the raw materials from rhizome form into powder form before they store as shown in Figure 5.1

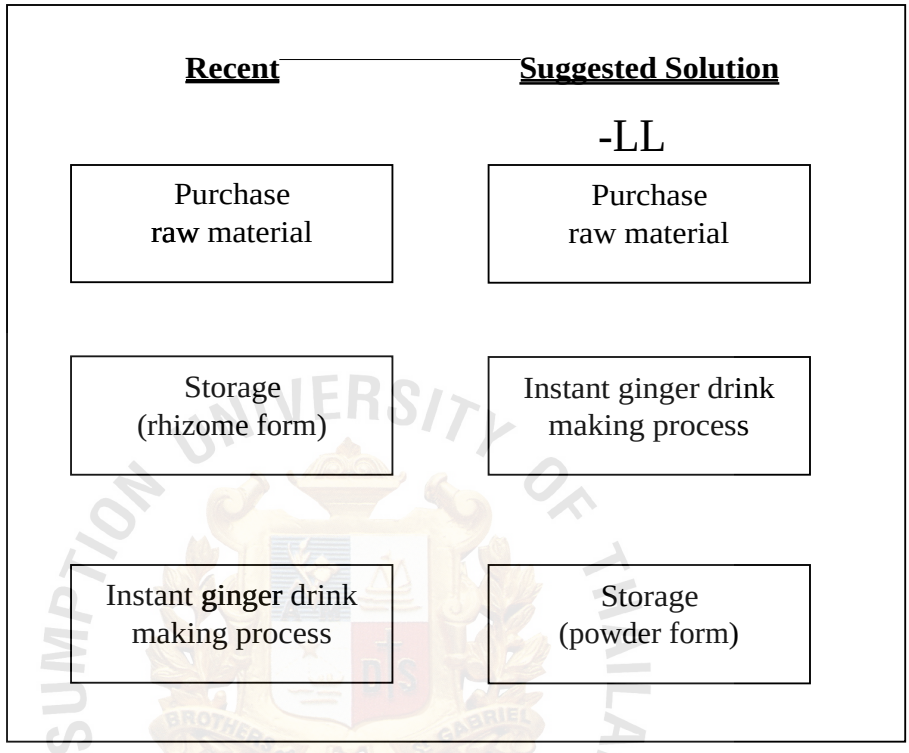


Figure 5.1. Recent and suggested solution for storage products.

5.2 The Solution Trade-off Analysis

Regarding the quality problem, the company has to select the purchasing of the raw material only in the in-cultivation period because the quality of the raw material in this period is the qualification that the customers need and the company wants. The qualifications are spicy flavor and good scent.

From the suggested solution the company can decrease the inventory problem. It takes less space than the traditional method.

The cost problem is not a big one. In the traditional method, the company purchases, stores, and transforms the raw material in the making process. As

mentioned in the suggested solution, the company has just only to transform the raw material before storage. So the cost of transforming the raw material is the same.

In the part of delivery, the company protects the unexpected order. The company has the inventory supply and whenever the unexpected order occurs they can serve this.

The overall trade-off analysis of this project can be summarized as shown in Table 5.3.

Table 5.3. Trade-off analysis.

	Recent	Suggested Solution
Quality	Harvested in only the in-cultivation period, fresh ginger	-
Storage	Storage problem of fresh raw material.	Storage in powder form
Cost	Cost of storage of fresh ginger and transforming cost.	Transfer the transforming fresh ginger process before storage, transforming cost is the same. Storage cost is cheaper than the storage cost of fresh ginger.
Delivery		Able to deliver the unexpected order

VI. CONCLUSIONS AND RECOMMENDATIONS

This chapter presents conclusions and recommendations about quality improvement for the instant ginger drink making process by using the related information from the study of the company's actual status.

6.1 Conclusions

The aim of quality improvement in the instant ginger drink making process in instant ginger drink industry is to study and to gather the related information of quality of goods in the system for probable analyze of the data, determining solution, conclusions and recommendations. Also, it is to study the actual status in the factory's company and quality problems of products in order to create systematic management set and useful solution for solving the causes of quality problem of the products. As a result, the quality improvement will contribute to the production efficiently and decrease the number of failures; waste and non-standard finished goods. Also, it increases the quality assurance for customer.

Seven quality improvement tools are used to determine the major problem in this company and analyze the root causes. The four problems from the production department about the products are flavor, scent, cost and delivery. The major problem in this instant ginger drink making process is the non-complying standard product problem that effects directly on the customer satisfaction and the company standard. The non-complying standard product problem concerns flavor and scent of the product. From the analysis, the major causes result from the cultivation of the raw materials. The season for harvesting is very important for the quality of product.

The successful quality improvement depends on foundation of the quality control system, necessary information and documents and the optimum solution for the current problem.

As a result, the company will get the better product and save cost. The company can solve it by planning to purchase the raw material in the right cultivation period and prepare the space to store it. Moreover, it can create customer satisfaction and high confidence in the company's finished goods as shown in Table 6.1

Table 6.1. The Advantages after Using the Suggested Solutions.

	Advantages After Using The Suggested Solutions
Quality	- Able to satisfy the customer needs and the company standard. - High confidence in the company's finished goods. - Easy to distribute to the global market.
Storage & Inventory	- Inventory ready to send. - Using less space. - Easy to preserve and keep the product
Cost	- Storage cost is cheaper
Delivery	- On time delivery

6.2 Recommendations

The recommendations for the solutions are only the opinion and suggestions for improvement. I hope that these will contribute to the company's production planning.

Regarding the storage of the raw material, the company should prepare the appropriate space or room for storing the raw material in order to keep up the qualification of the product. After the company transforms the raw material from rhizome into powder form, they should be more careful because the powder form is hard to take care.

For the raw material part, the management and the stock preparation section must pay more attention to set a good plan because the cultivation period when the company can purchase the raw material comes only once a year. This way will prevent the problem of raw material going out of stock. The management should inform the objective of sales in that year to the person who has the authority to purchase the raw material.

BIBLIOGRAPHY

English References

1. Armand Vallin Feigenbaum. Total Quality Control, 3rd edition. New York: McGraw-Hill, 1991

2. Douglas C. Montgomery. Introduction to Statistical Quality Control, 3rd edition. New York: J.Wiley, 1997

3. George W. Roberts. Quality Planning & Control and Improvement in Research and Development. New York: Marcel Dekker, 1995

4. Joel E. Ross. Total Quality Management. Kogau Page Ltd, 1994

5. Joseph M. Juran and A. Blaton Godfrey. Juran's Quality Handbook, 5th edition. New York: McGran-Hill, 1999

6. Joseph M. Juran. Juran on Leadership for Quality. Juran Institute Inc, 1989

7. P J Fellows. Food Processing Technology Principles and Practice, 2nd edition. Woodhead Publishing Limited and CRC Press LLC, 2000

8. Thomas J. Cartin. Principle and Practices of Organizational Performance Excellence. ASQ Quality Press, 1999

Thai References

1. 51170 11-111111N. flI LY11^11J11114f15: 1f15 9f117111ZARDIMA51,11J1114

2. fi9,1111115111flititMlflf111. fl551`ITVIMI11If15: ii1afliii.114110Mpfla1l, 2537

Website References

1. http://unitproj.liabrary.ucla.edu

2. http://www.kew.org/ksheets/ginger.html

3. http://www.roxytrading.com/pages/health ginger. asp

4. http://www.spice-box.com/mall/ginger.asp