

Addis Ababa University



Institute of Technology

School of Mechanical Engineering

Industrial Engineering Stream

**Part Family Formation of Ethiopian Cultural Clothing
by using Group Technology Coding System**

By

Bethlehem Nessibu

Advisor: - Professor Daniel Kitaw

Co-Advisor:- Wegene T.

July 2016

Acknowledgement

First and foremost, I would like to thank the almighty God for the completion of this thesis. I would like to express my deepest gratitude to the following people for the completion of this thesis.

I am also grateful to Ass. Prof. Daniel Kitaw, my thesis advisor for his support and encouragement; my co-advisor Wogene T. (PhD. Cand.) for his continuous remarks; Ass. Prof. Wondwosen Tamrat for his critical comment throughout this process and Community of Small and Micro Enterprises that produce cultural clothing around Gulele Sub city; Ejjig Fashion; Adey Laundry; Ashenafi T.; Lidya W.; Hewan T.; Selamawit A. and Meseret T. Last but not least, thank you Kerim T., you made this research possible. I am greatly indebted to you.

Table of Contents

Acknowledgement	2
Abstract.....	6
CHAPTER ONE	7
INTRODUCTION	7
1.1. Background and justification of the Study.....	7
1.2. Statement of the Problem.....	9
1.3. Research Questions.....	11
1.3.1 General Research Question.....	11
1.3.2 Specific Research Questions.....	11
1.4. Objectives of the Study	11
1.4.1 General Objective	11
1.4.2 Specific Objectives	12
1.5. Delimitation/Scope of the Study.....	12
1.6. Significance of the Study	12
CHAPTER TWO	14
REVIEW OF RELATED LITERATURE	14
2.1. Group Technology	14
2.1.1 Part Family.....	17
2.2 Application of Group Technology	30
CHAPTER THREE	31
RESEARCH DESIGN AND METHODOLOGY	31
3.1. Research Design.....	31
3.2. Population and Sampling Techniques.....	31
3.3. Types of Data and Tools/Instruments of Data Collection.....	33
3.4. Procedures of Data Collection	33
3.5. Methods of Data Analysis.....	33
3.7. Ethical Considerations	33
CHAPTER FOUR.....	35
RESULTS & DISCUSSION.....	35
4.1 Types of Products	35
4.2 Descriptive statistics	38

CHAPTER FIVE	49
CONCLUSIONS & RECOMMENDATIONS	49
5.1. Conclusions.....	49
5.2. Recommendations.....	50
5.3. Further Area of Investigation.....	50
References.....	51
Appendices.....	56
Appendix I: Questionnaire in English.....	56
Addis Ababa University.....	56
Institute of Technology	56
Appendix II: Questionnaire in Amharic.....	58
Appendix III: Semi Structured Interview.....	60
Acronyms.....	65

List of Tables

Table 1 Basic Structure of the Opitz Parts Classification and Coding System.....	25
Table 2 Number of SMEs producing cultural cloths in Gulele Subcity (2008 E.C).....	34
Table 3 Descriptive statistics	40
Table 4 Complexity code for special features.....	48
Table 5 DCLASS size code of cultural clothing.....	49
Table 6 DCLASS precision class code	50

List of Figures

Figure 1 Informal arrangement of Tibeb kemis and Netela parts	12
Figure 2 A set of parts with dissimilar features	23
Figure 3 Grouping prismatic parts together	23
Figure 4 Grouping rotational parts together.....	23
Figure 5 Example for Hierarchical structure/Mono-code coding and classification.....	24
Figure 6 Example on Chain-type structure/Poly code for classification and coding method	25
Figure 7 Example for optiz coding system	26
Figure 8 Example for optiz coding system	27
Figure 9 Guideline for Brisch coding System.....	28
Figure 10 CODE system example.....	29
Figure 11 General Guidelines for Multiclass coding method	29
Figure 12 Specific Guideline for Multiclass Coding System.....	30
Figure 13 Guideline for The structure of the MICLASS coding system	31
Figure 14 Guideline for DCLASS coding System.....	31

Figure 15 Positions of General and specific code for DCLASS coding	32
Figure 16 Mulu and Netela Gabi.....	38
Figure 17 Netela Source: www.google.com	39
Figure 18 Tibeb Kemis characters (3 arb dress) Source: http://google.com	40
Figure 19 4arb sized dress.....	42
Figure 20 Sherko tilet.....	43
Figure 21 Difin tilet	43
Figure 22 Zipe sherko tilet.....	43
Figure 23 Tibeb kemis made of silk, cotton and werkezebo.....	44
Figure 24 Hierarchical structure for Blankets of Ethiopian cultural clothing.....	45
Figure 25 DCLASS logic tree.....	47
Figure 26 Cultural Coffee dress with a Dclass code of T03326A4	48
Figure 27DCLASS Logic Tree of special features	49

Abstract

The study took place on small and micro enterprises that produce cultural clothing around Gulele subcity. These enterprises apply an informal ways of grouping for the products they produce. This act results in spending too much time looking for the exact product; estimating inaccurate price; spending too much time negotiating and explaining the characteristics of a certain product, This research mainly focuses on proposing an appropriate classification and coding system for Ethiopian cultural clothing. And it is expected that, application of group technology will assist in minimizing the problems stated above. A sample of 111 small and micro enterprises was studied for this research; in order to understand more about the features of cultural clothing. A questionnaire and a semi-structured interview were conducted to collect the required information regarding the attributes of cultural clothing and the problems that arise from applying an informal way of grouping. Therefore it was possible to create a part family based on the shared characteristics of cultural clothing. This act was assisted by applying DCLASS coding system for Tibeb kemis, Netela and Buluko. It is expected that users will understand the principle of this code and apply it for improvement. The cloths can also be documented for later use, so than producers will save energy and time from preventing duplication of effort when they try to draft previously designed cloth for the second and third time; estimate accurate selling price and minimize the time spent for negotiation. The coding system can also assist them to come up with new designs for the future market. Finally future researchers can apply group technology to the rest of Ethiopian cultural clothing.

Key words: Group Technology, SMEs, Ethiopian Cultural Clothing

CHAPTER ONE

INTRODUCTION

1.1. Background and justification of the Study

Ethiopia is a country that has more than 85 nations and nationalities with their own language, eating, clothing and living <https://www.amu.edu.et/>. Out of the many different special characters of the Ethiopian people, this study focused on one of the cultural clothing (Tibeb) attributes of this country that is currently being produced at Gulele Subcity (a neighborhood in Addis Ababa). Tibeb, one of the traditional clothing, is cherished and worn by most Ethiopians. It is a special garment favored by people all over the country. Its grace is known by the Ethiopian people and appreciated by the world. There are many small and micro enterprises producing cultural clothes mostly around Shiro meda.

Even though the cultural cloth market located around Shiro meda dominates the market in Ethiopia, these cloths don't hold a significant market share in the international business unlike famous Asian cultural clothing. Indian, Chinese and Korean cultural cloths are well known in the international market and are retaining a great amount of market share in the western countries.

The international textile and apparel market, supply exceeds the demand so that textile and apparel industry becomes buyer market and the international price for textile and apparel shows a downward tendency Yared (2010).

The newly designed cultural clothes were designed and produced by handloom weavers and garments. And these products are being sold in different shops around the city. Meanwhile the performance measures of these traditional clothes are affected by quality, flexibility, technology and customers. The above listed factors highly influence the industry's competitiveness in the global market. Since most of the cultural clothing that are currently found in the market are trending fashions. And this fact will affect the industry, because producers are expected to come up with new designs before the current designs start to feel outdated from the customers' perspective. Therefore, improving the performance measures of these fashion firms will highly

increase the competitiveness; profitability and satisfaction of customers in the Global market (Messele Kassaw, 2013).

There are different designs of clothing being produced in these SMEs, as a result this study investigated and group these different types of designs according to their similarity for the selected micro and small enterprises. Since the clothes that are being produced currently are not informally grouped, the price set for similar clothing differs. This thesis is expected to assist the producers in identifying the similarities between different designs of cloths and set an appropriate price for the customers. At the same time different designs of clothing will be documented for later use. This task is expected to increase customer satisfaction and minimizing the amount of time customers spent to choose different features in a single product. In addition the cost of producing the cloths and the respective profit margin can be identified clearly.

Group technology (GT) is drawing increasing attention from manufacturers because of its many applications for improving productivity. GT in cellular manufacturing systems (CMS) is very important to improve productivity for manufacturing industry. Group technology (GT) can be considered as a simplified methodology which categorizes standardized similar entities into groups such as parts, assemblies, process plans, tools, instructions, etc. to reduce the time and energy and to improve the overall productivity for batch type production (Burbidge, 1963). According to (Guerrero, et. al., 2000) a successful implementation of GT could eventually minimize the engineering costs, facilitate cellular manufacturing, quicken product development, improve costing accuracy, simplify process planning, minimize tooling cost and simplify the entire purchasing process. The main precondition in implementing GT is the identification of part families (Kaparthi, et. al.,1991). A part family is a group of parts sharing homogeneous design and manufacturing attributes. Early research in this domain has been devoted primarily on the formation of production-oriented part families in which similarities amongst the parts are principally recognized on the fact of their processing requirements, operation time and operation sequences. Though, these methodologies are inadequate in achieving the needs of other extents of manufacturing. For instance, parts with similar shape, size, dimension or other design characteristics are believed to be clustered in a single family for design justification and elimination of part varieties; however parts which are clustered on the fact of similar routing and the tooling needs are convenient to resolve the process planning issues.

As a result the scope of this domain of research is believed to be expanded and examined to a wider span of part similarities. Part similarities are believed to be identified sooner than the formation of part families. Part attributes such as shape, length/diameter ratio, material type, part function, dimensions, tolerances, surface finishing, process, operations, machine tool, operation sequence, annual production quantity, fixtures needed, lot sizes have been considered as the basis for similarity utilization (Groover, et. al.,1984). The complexity remains in acquiring an appropriate technique which provides an identifying competence of human being, such as identifying patterns in groups, and forming part families with the aid of intelligence (Moon, 1992).

Different articles represent different part family identification techniques based on Complete Linkage (C-Linkage), Single Linkage (SLCA) and K-means clustering algorithms to investigate the nature of similarities and to describe the effectiveness of the techniques in solving the problem in hand (Moon, 1992).

1.2. Statement of the Problem

SMEs that produce cultural clothing are implementing an informal product classification technique. According to the information gathered from semi-structured interview the problem for these cultural cloth producers regarding the implementation of group technology is identified. The recognized problem is that operators will design different types of clothing according to the demand of each customer. While they do this every time a customer wants a slightly modified product or a completely new design, the producers spend too much time. The majority of time they spent is while they describe about the products to their customers and negotiate price. In addition the previously modified or created design is documented neither in a computer nor in a printed format to retrieve for later use.



Figure 1 Informal arrangement of Tibeb kemis and Netela parts

As shown in the above figure, the designs of parts are different. And it will be hard to find the part a customer is looking for.

Because of this practice, parts are not exceptional; the greatest advantage of GT comes through a formal coding system in which each part gets a numeric or alphanumeric code describing the attributes of importance (Nancy, 1984).

In addition (Selamawit, 2016) pointed out that substitute and supporting industries highly affect the competitiveness of this industry. The competitiveness of Ethiopian cultural cloth making industry is also influenced by lack of designed product distribution mechanisms, shortage in supply of appropriate raw materials with fair price and lack of modernized production and machine technology. The key areas whereby problems were identified are low quality, poor knowledge of products by consumers and low demand. Role of government is to follow the demand conditions that affect the competitiveness of the industry. There are good policies that supports the industry but the implementation of the policies is not effective. It was also found out those producers of cultural cloth making industries around Gulele subcity lack sufficient skills to compete.

With the international cultural cloth market being dominated by the Asian cloth makers, the Ethiopian cultural cloth should also be promoted and sold to the foreign market. But before doing that the cloths should be standardized according to their specific design in order to meet

the needs of the customers and set a reasonable price. In order to help this cultural cloth making business, product coding technique of group technology will facilitate in clustering cloths having similar features, materials, dimensions, geometric shape and other characteristics.

Application of GT in small organizations will assist them to achieve process competence and better process control. It will enable them to manufacture highly accurate products and get price advantage on these value added products as they grow through forward integration (Murray, 1984).

1.3. Research Questions

1.3.1 General Research Question

Which coding system can best represent the Ethiopian cultural clothing into part families?

1.3.2 Specific Research Questions

Specific questions of this research are:

- a. How are the products (different designs of cloths) being grouped in the selected SMEs?
- b. What things are missing when the producers' group their product without using group technology?
- c. How is the selected grouping system going to assist the produces' of the cultural cloth making industry for a successful activity?

1.4. Objectives of the Study

1.4.1 General Objective

The main purpose of this project is to select form a part family for Ethiopian cultural cloths having similar features, dimensions geometric shape, materials and other characters. A suitable coding system for the Ethiopian cultural clothes is applied after the characteristics of the cloths made around Gulele Subcity are studied in depth. This study is expected to assist the producers

in identifying the different features of the cultural clothes that makes them similar to each other. After the product design system is studied for the selected SMEs problems regarding classification and coding of product families is conducted. And the appropriate product coding system of group technology is implemented for this specific case.

1.4.2 Specific Objectives

Specific objectives of this thesis are:

- a. Examining the product categorization activities being followed in the SMEs.
- b. To investigate the how the products are grouped in cultural cloth making SMEs and identify the gap between the product family formation techniques of group technology and the one that is currently being applied in the selected SMEs.
- c. Propose an appropriate clustering system through application of group technology that facilitates the producers for a better performance to fill the gap.

1.5. Delimitation/Scope of the Study

There are different manufacturers and designers who design, produce and sell cultural clothing in Addis Ababa. This study focuses on application of group technology, coding system by using the design aspect of Ethiopian traditional clothing. The study area is located at ‘Gulele subcity’ due to the fact it is the main destination for manufacturing and marketing the cultural cloths in Addis Ababa region. In order to have a better understanding about the cultural clothing’s feature, two designers were contacted. Also, out of the variety of Ethiopian cultural cloths, this research focuses on identifying the characteristics of “tibebe kemis”, ‘Netela’, ‘Gabi’ and ‘Buluko’.

1.6. Significance of the Study

The significance of this study is that products that have similar features are identified and grouped into a part family. This grouping procedure will help the buyers and sellers of the market to spend minimum amount of time when selecting a specific design and negotiating price for a certain design of cultural clothing. This is because the codes clearly describe the attribute of that specific cloth ensuring the seller to set true and fair price. The different designs that are

being modified by the cloth makers will be recorded along with the current ones. In addition the cost of making a certain cultural cloth and its respective profit margin will be estimated precisely. It will also avoid duplication of effort, while enhancing simple and timely information retrieval and use of the documented design. In addition the proposed coding system for tibebe, gabi and netela can be adopted to classify and code other cultural clothing of Ethiopia and other textile products. This research will also contribute to the literature of group technology, since it being applied to textile industry. No other previous research on group technology has been applied to textile industry.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

In order to investigate similarities between different designs of products, literature review covers the topics shown below:

- Meanings of group technology
- Meaning of part family
- Different types of product classification and coding schemes
- Application of group technology and literature gap is discussed in this section.

2.1. Group Technology

The concept of Group Technology (Burbidge, 1978) is “based on the simplification and standardization process, which originated at the beginning of 20th century. It emerged as a single machine concept that was created to reduce setup times” (Mitrofanov 1966). Group approach in the design flows of material in the production system based on the idea of group technology which, since the work of Mitrofanov (Mitrofanov, 1965), did not stopped being updated in scientific and expert circles. This philosophy was further extended by collecting machine parts with similar requirements, completely processing them within a machine group or cell (Burbidge, 1936). The ideas for Group approach is adapted from the fact that there is similarity in objects which enter the production process of any company and that in real conditions there is a limited number of forms of these objects. In the core of Group technology set up by Mitrofanov is a “unification of objects with similar characteristics into families”. Based on ideas of Group technology of Mitrofanov, as well as the results of the research made by (Burbidge , 1978), the new approach in production was initiated: Group approach to design of effective industrial structures.

Two different approaches are traced in past literature in order to form part families, first is production flow analysis (PFA) which deals with processing requirements of parts, operational sequences/routings and operational time of the parts on the machines (Burbidge,

1996). Second approach is the part coding analysis (PCA) which utilizes predefined coding schemes to facilitate the process using several attributes of parts such as geometrical shapes, materials, design features and functional requirements etc (Mitrofanov,1966).

PCA is an essential and effective tool for successful implementation of GT concept. A code may be numbers (numerical) or alphabets (alphabetical) or a hybridization of numbers and alphabets (alphanumeric) which are allotted to the parts to process the information (Ham, et. al., 1985). Parts are categorized based on significant attributes such as dimensions, type of material, tolerance, operations required, basic shapes, surface finishing etc. In this approach, each part is assigned a code which is a string of numerical digits that store information about the part. Study of coding systems which depicts either hierarchical structure (monocode), or chain structure (polycode) or hybrid mode structure mixed with monocode and polycode (Singh, et. al., 1996).

Classification and coding is practiced in this study as an essential and effective tool for successful implementation of GT theory. A code can be numbers (numerical) or alphabets (alphabetical) or a combination of numbers and alphabets (alphanumeric) which are assigned to the parts to process the information (Ham et al. 1985). Parts are categorized based on significant characters such as dimensions, type of material, tolerance, operations required, basic shapes, surface finishing etc. and assigned a code which is a string of numerical digits that store information about the part. As a result coding systems represent either hierarchical structure (monocode), or chain structure (polycode) or hybrid mode structure mixed with monocode and polycode (Singh and Rajamani, 1996.) have claimed that part families could be created more realistically by applying the classification and coding due to the advantage of using the manufacturing and design attributes concurrently. Offodile suggested a similarity metric based on the numeric codes for any pair of parts which could be utilized to form efficient part families (Offodile, 1992).

Several coding systems have been developed, e.g. Opitz (Opitz, 1970), MICLASS (TNO. 1975), DCLASS (Gallagher et. al., 1985), and FORCOD (Jung et. al., 1992). Han and Ham (Han, et. al.,1986) have claimed that part families could be established more realistically by practicing the PCA due to the advantage of using the manufacturing and design attributes concurrently. (Offodile, 1992) reported a similarity metric based on the numeric codes for

any pair of parts which could be utilized to an appropriate clustering method such as agglomerative clustering algorithm to form efficient part families.

Clustering analysis is practiced in Cellular Manufacturing System (CMS) as a competent methodology to facilitate the machine/part grouping problems. Various machine/part grouping techniques are developed to solve manufacturing cell formation problems since last forty years, these include similarity coefficient methods, clustering analysis, array based techniques, graph partitioning methods etc. The similarity coefficient approach was first suggested by (McAuley, 1972). The basis of similarity coefficient methods is to calculate the similarity between each pair of machines and then to group the machines into cells based on their similarity measurements. Few studies have been proposed to measure dissimilarity coefficients instead of similarity coefficient for machine-part grouping problems (Prabhakaran, et. al., 2002). Most of the similarity coefficient methods utilized machine-part mapping chart. Few of them are Single linkage clustering algorithm (McAuley, 1972), Average linkage clustering algorithm (Seifoddini, et. al., 1986) etc.

Array based methods consider the rows and columns of the machine-part incidence matrix as binary patterns and reconfigure them to obtain a block diagonal cluster formation. The rank order clustering algorithm is the most familiar array-based technique for cell formation (King, 1980). Substantial alterations and enhancements over rank order clustering algorithm have been described by King and Nakornchai (1982) and Chandrasekharan and Rajagopalan, (1986). The direct clustering analysis has been stated by Chan and Milner (1982), and bond energy analysis is performed by McCornick et al. (1972).

Since the last few decades different approaches are introduced to solve manufacturing cell formation problems, some researchers have proposed to estimate dissimilarity or distance instead of similarity metric (Prabhakaran et al., 2002) for generalized cell formation problems. Few of the agglomerative clustering methods adopted earlier are Single linkage clustering algorithm with similarity metric (McAuley, 1972), Average linkage clustering algorithm (Seifoddini and Wolfe, 1986). Other clustering methods are practiced by Carrie (1973), Chandrasekharan and Rajagopalan (1986a, 1986b), King (1980), King and Nakornchai (1982). The rank order clustering (ROC) algorithm is the most familiar array-based technique for cell formation (King,

1980). Ample alterations and improvements over rank order clustering algorithm have been described by King and Nakornchai (1982) and Chandrasekharan and Rajagopalan (1986a). Rajagopalan and Batra (1975) proposed the application of graph theory to form machine cells. Chandrasekharan and Rajagopalan (1986a) proposed an ideal seed non-hierarchical clustering algorithm and Srinivasan (1994) implemented a method using minimum spanning tree (MST) for the machine-part cell formation problem.

GT assures high-performance production, and provides optimal use of capacities and great flexibility of the entire system. Such systems enable the production in small series with very low costs. When there are a large number of small and medium-sized enterprises, any changes in processing, shaping or any changes of material can be solved within these enterprises either by replacement or purchase of a small number of machines or by including some companies with the required technology in the cluster. By doing so, a very fast reaction to any disorder or any changes is achieved. This indicates that the development processes are carried out simultaneously because each company is performing a task to develop a part of a product for which it is specialized (Slobodan et. al., 2009).

Customers' demands, innovation, new knowledge, technology and materials, cost reduction, environmental concerns and legislation's and legal regulations, drive the evolution of products. Product versions are developed over time in response to these requirements. Derivatives and variations in function, form and configuration lead to new product classes including Series of Products with different Functions, Series of Components with different Configurations and Series of Features with different Dimensions. This gives rise to product families that contain variants of the products and their parts, components and configurations.

2.1.1 Part Family

Parts Family is a concept that was first initiated along with Group Technology (GT), where parts are grouped according to similarities in geometry and/or processing requirements. The purpose is to take advantage of on these similarities to increase the efficiency of many applications such as modeling and design, planning of fixtures and work holders, tools, production processes, parts/machine assignments, parts grouping into batches for production, and production flow management.

Part Features can be either geometric features (such as flat, cylindrical and conical surfaces) or functional features (such as holes, slots/grooves, gear teeth, keyways, pockets, chamfers and threads). Features variations are easily analyzed; for example, holes may vary in dimensions, geometry and shape; they may be round or prismatic, smooth or threaded, stepped or having a constant diameter. The attributes of the geometric and functional features are best-captured at the design level applying variation geometry and parametric modeling techniques that reveal the changes within the features while respecting the geometric and dimensional constraints that express the functional requirements and designers purpose.

Parts/Components are objects that are non-decomposable/non-divisible with no loss of function. It includes both functional and non-functional features. Change at this level leads to parts/components variants within a class. The addition, removal and/or modification of part features require adaptation to these changes in upstream design and analysis applications as well as in downstream manufacturing logical support functions.

One of well known manners of similar parts group formation is classification and coding. Usually other than classification based on geometrical properties of the part, the classification process is carried in classification according to the non-geometrical attributes such as weight, tolerances, etc. (Kuric, 2007). While part similarity measure based on group technology code is useful for finding generally similar parts, these measures cannot be precise for process planning. This is because of the fact that there is no precise relation between process plans and GT codes. The application of GT for machining operations is well established, but a similar approach to forming operations is not well developed (Mielnik, 1991). In the field of sheet metal forming process plan design cannot be observed, as a result significant utilization of the automated process planning systems is compared to the machining processes planning. Usually these are oriented on specific, separate problem of forming technology (for example: sheet metal bending) and preferably are based on generative approach to the process planning Dufrou, (2005), Geiger (1993), Geiger (1997), Gupta (1998), Kang (2002) and Misaki (2003).

Products Families is a concept related to that of the parts families where variations in parts, sub-assemblies and modules produce different instances/members of a product family. The product family includes related products that share some characteristic, components and/or sub-

assemblies. These product families are meant to satisfy a variety of customers' demands and markets.

Three basic types of activities are necessary in applying group technology:

1. Identification of critical part attributes that represent the criteria for part;
2. Family membership;
3. Allocation of parts to created families ; and
4. Retrieval of part family members and associated information.

Classification and coding systems can assist in these tasks by providing a guideline for the classification of parts into groups based on selected part attributes, and by assigning a code to each part (Hyer and Wemmerlov 1984, 1985, Groover and Zimmers 1984). This code assists in information retrieval for that part. A code is a string of alphanumeric characters which, when interpreted, provides information about that part. This is in contrast to a part number, whose purpose is item identification, not description. Although so called significant part numbers contain some meaningful information about parts.

Many commercial and non-proprietary coding systems are in existence (Hyer and Wemmerlov 1985, Gallagher and Knight 1986, Ham et al. 1985). The non-proprietary Opitz system, developed in the 1960s in West Germany, is perhaps the best known. It is applicable to both machined and non-machined parts, and has been widely used in Europe (Opitz 1970, Opitz and Wiendahl 1971).

2.1.1.1 Ways to Identify Part Families

Parts can be classified and grouped into a family by using the following methods (Hyer and Wemmerlov 1984), (Burbidge, 1996), (Kuric, 2007), Peter et. al, (2011), Geiger et.al, (1997) and (Groover and Zimmers 1984)

1. Visual inspection – This is conducted by using best judgment to group parts into appropriate families, based on the parts or photos of the parts.
2. Production flow analysis – This is applied when using information contained on route sheets to classify parts.

3. Parts classification and coding – In this case the process of identifying similarities and differences among parts and relating them by means of a coding scheme will be conducted.

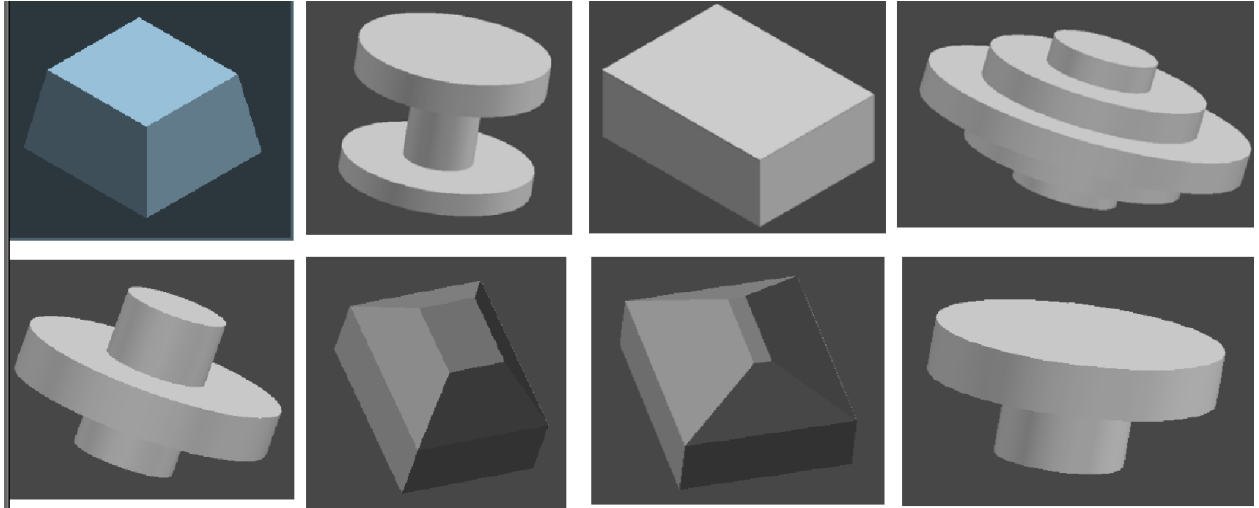


Figure 2 A set of parts with dissimilar features

Then grouping the above dissimilar parts by visual inspection only

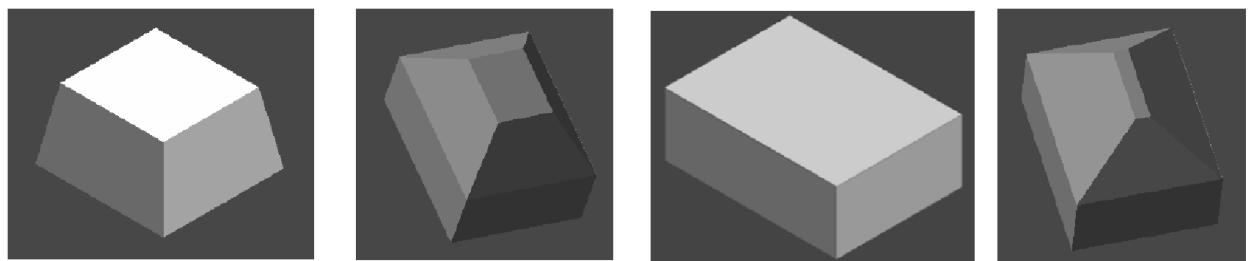


Figure 3 Grouping prismatic parts together

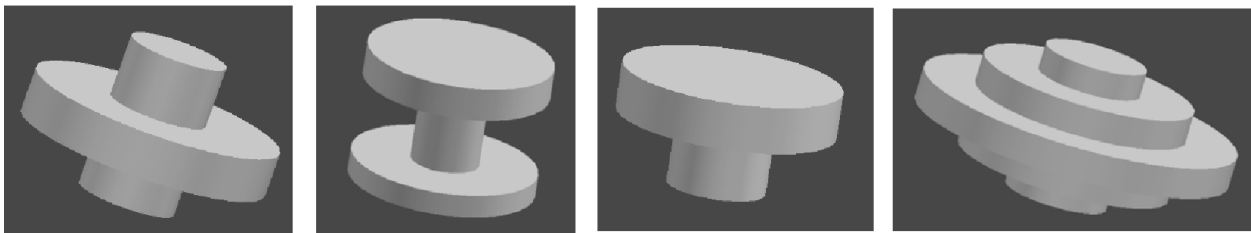


Figure 4 Grouping rotational parts together

Parts Classification and Coding

Most classification and coding systems can be one of the following:

- a. Systems based on part design attributes
- b. Systems based on part manufacturing attributes
- c. Systems based on both design and manufacturing attributes

Part Design Attributes

Products can have different characteristics that makes each different from the other. These attributes are listed below.

- a. Major dimensions
- b. Basic external shape
- c. Basic internal shape
- d. Length/diameter ratio
- e. Material type
- f. Part function
- g. Tolerances
- h. Surface finish

Classification and coding schemes

There are three structures used in classification and coding method of GT.

1. Hierarchical structure/Mono-code: This is one of the classification and coding technique applied for products to form part family. In this case the interpretation of each successive symbol depends on the value of the preceding symbols.

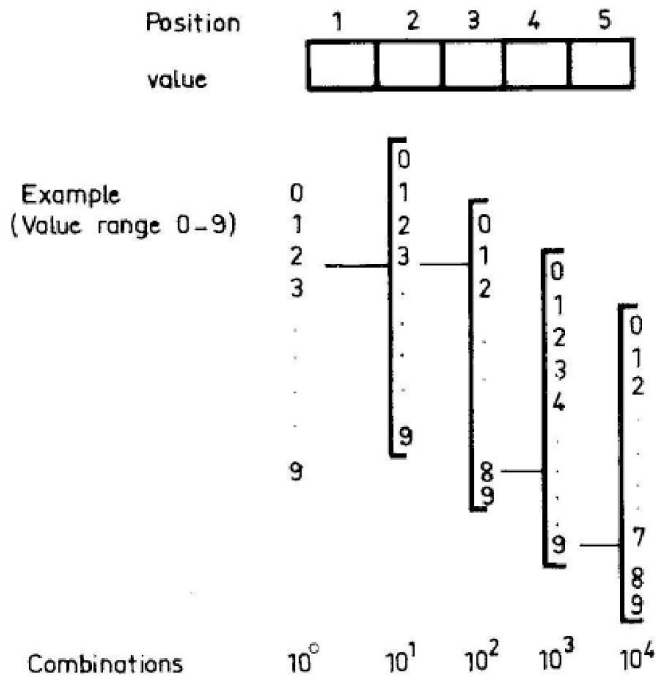


Figure 5 Example for Hierarchical structure/Mono-code coding and classification

- Chain-type structure/Poly code: This is the other type of coding and classification method that is applied to form a part family. In this case interpretation of each symbol in the sequence will not change at all times. The meaning of each symbol does not depend on the value of preceding symbols.

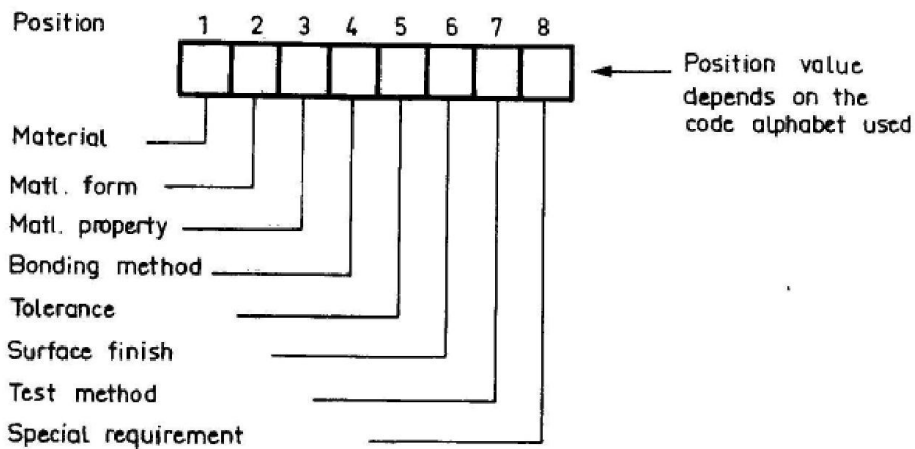


Figure 6 Example on Chain-type structure/Poly code for classification and coding method

3. Mixed-mode structure: It is the combination/hybrid of the above two techniques that is applied to create a part family for products sharing the same attributes.

There are different types of mixed-mode structures; and some of them are listed below.

1. Opitz classification system: Introduced for the first time by the University of Aachen in Germany, nonproprietary, Chain type.
 2. Brisch System: (Brisch-Birn Inc.)
 3. CODE (Manufacturing Data System, Inc.)
 4. MultiClass (OIR: Organization for Industrial Research), hierarchical or decision-tree coding structure
 5. (Brigham Young University)
1. Opitz parts classification and coding system

Table 1 Basic Structure of the Opitz Parts Classification and Coding System

Digit	Description
1	Part shape class: rotation versus nonrotational (Figure 22.1). Rotational parts are classified by length-to-diameter ratio. Nonrotational parts by length, width, and thickness.
2	External shape features; various types are distinguished.
3	Rotational machining. This digit applies to internal shape features (e.g., holes, threads) on rotational parts, and general rotational shape features for nonrotational parts.
4	Plane machined surfaces (e.g., flats, slots).
5	Auxiliary holes, gear teeth, and other features.
6	Dimensions—overall size.
7	Work material (e.g., steel, cast iron, aluminum).
8	Original shape of raw material.
9	Accuracy requirements.

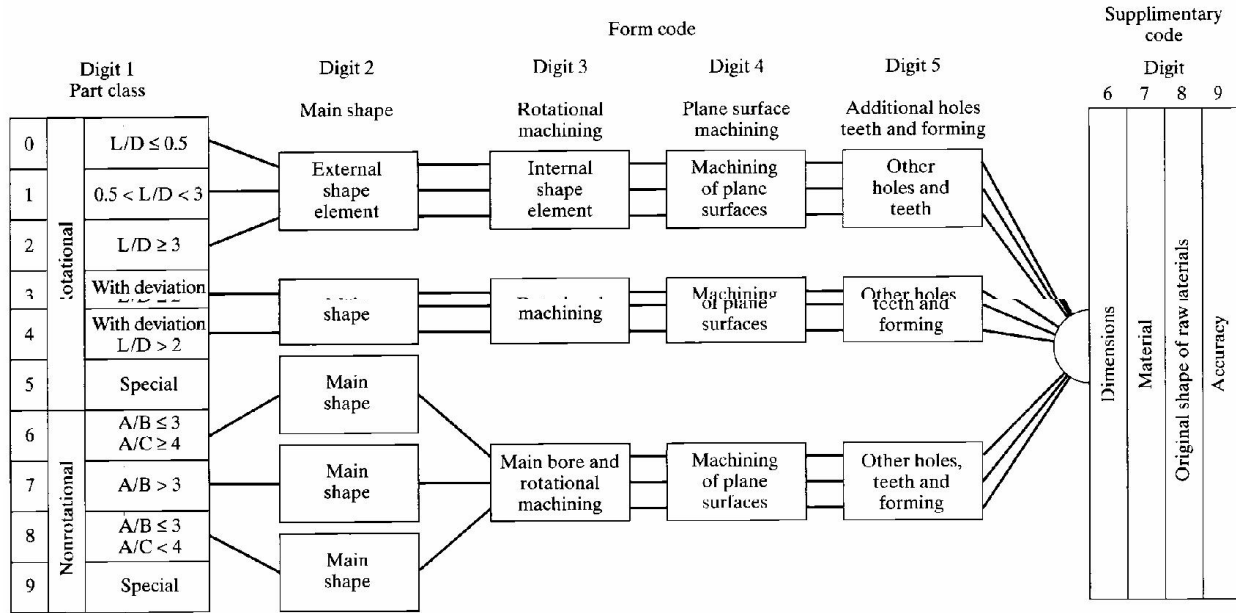


Figure 7 Example for optiz coding system

Digit 1 Part class		Digit 2 External shape, external shape elements		Digit 3 Internal shape, internal shape elements		Digit 4 Plane surface machining		Digit 5 Auxiliary holes and gear teeth			
0 1 2 3 4	Rotational parts	$L/D \leq 0.5$	0	Smooth, no shape elements		0	No hole, no breakthrough		0	No auxiliary hole	
		$0.5 < L/D < 3$	1	No shape elements		1	No shape elements		1	Axial, not on pitch circle diameter	
		$L/D \geq 3$	2	Thread		2	Thread		2	Axial on pitch circle diameter	
			3	Functional groove		3	Functional groove		3	Radial, not on pitch circle diameter	
			4	No shape elements		4	No shape elements		4	Axial and/or radial and/or other direction	
5 6 7 8 9	Nonrotational parts		5	Thread		5	Thread		5	Axial and/or radial on PCD and/or other directions	
			6	Functional groove		6	Functional groove		6	Spur gear teeth	
			7	Functional cone		7	Functional cone		7	Bevel gear teeth	
			8	Operating thread		8	Operating thread		8	Other gear teeth	
			9	All others		9	All others		9	All others	

Figure 8 Example for optiz coding system

2. Brisch System: (Brisch-Birn Inc.)

This is one of the oldest coding systems is developed by E. G. Brisch & Partners in United Kingdom. It is designed so that everyone in an industrial organization can be classified and coded.

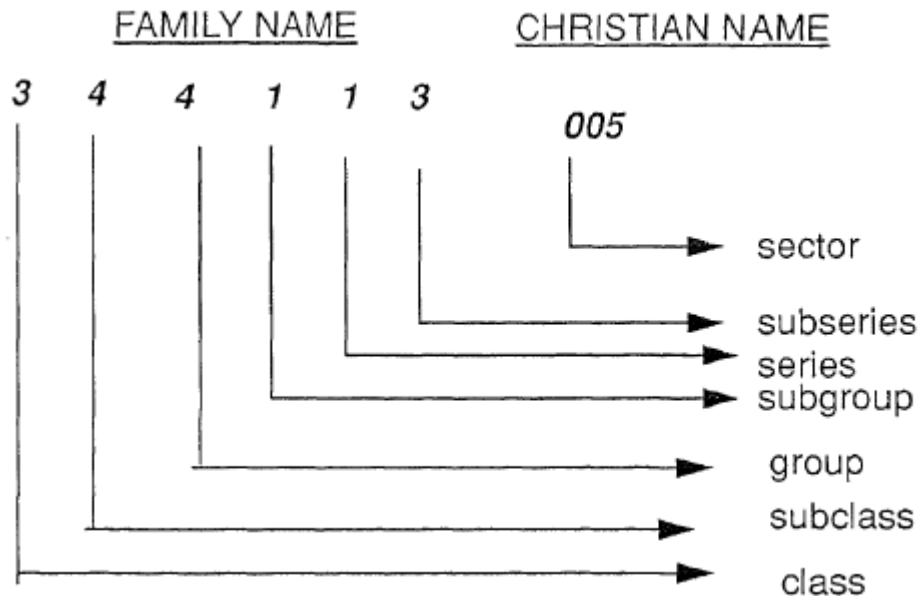


Figure 9 Guideline for Brisch coding System

The above figure indicates the The part described by the number is as follows.

3- Component

4- Not specified, metallic; form regular, straight, round

4-0/D single, long without through going center hole

1-plain

1-O/D—0.5 to 1.0 inch

3-Length—1.0 to 1.5 inch

- 0
- 0-The fifth drawing generated (Christian name)
- 5

3. CODE (Manufacturing Data System, Inc.)

It consists of eight digits. Every digit in eight digit contain 16 possible values (zero through 9 and A to F) which are used to describe the part's design and manufacturing attributes. The initial

digit position indicates the basic geometry of the part is called major division of the CODE system. This digit will be used to specify whether the shape was a cylinder, flat piece, block or other. The interpretation of the remaining seven digits depends on the value of the first digit, but these digits form a chain type structure.

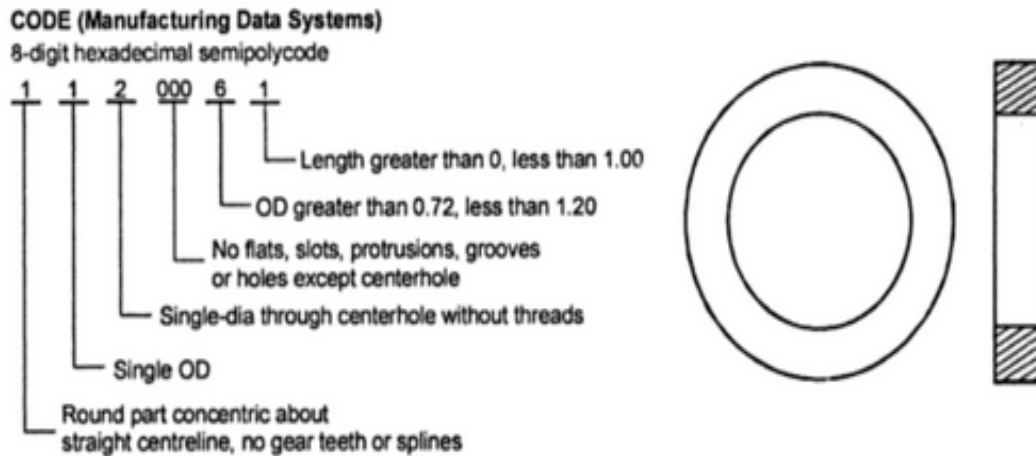


Figure 10 CODE system example

For the above example, the first and 3rd digits represent the basic geometry and principal manufacturing process of the part shown in the above figure. The 4th, 5th and 6th digits represent the secondary manufacturing process, including threads, grooves, slots, etc. And the final two digits indicate the overall size of the part (7th and 8th digits).

4. Multiclass: It was first developed by the Organization for Industrial Research (OIR)

<i>Digit</i>	<i>Function</i>
0	Code system prefix
1	Main shape category
2, 3	External and internal configuration
4	Machined secondary elements
5, 6	Functional descriptors
7-12	Dimensional data (length, diameter, etc.)
13	Tolerances
14, 15	Material chemistry
16	Raw material shape
17	Production quantity
18	Machined element orientation

Figure 11 General Guidelines for Multiclass coding method

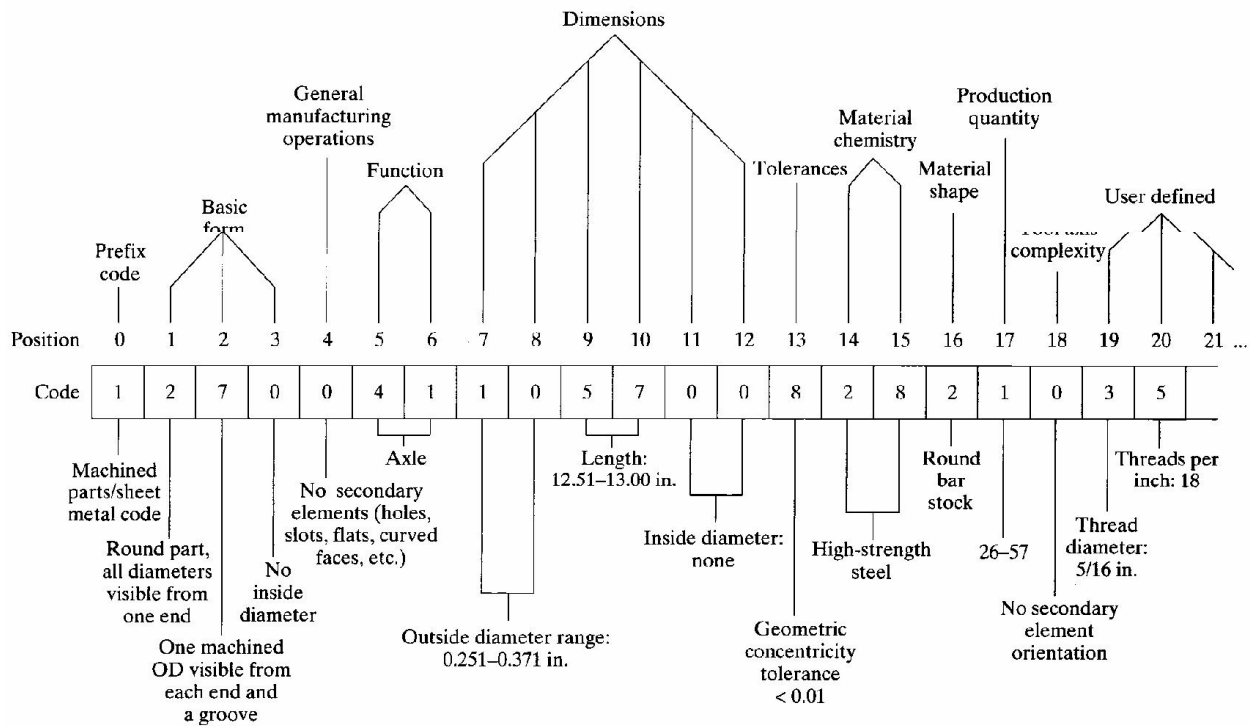


Figure 12 Specific Guideline for Multiclass Coding System

MICLASS System (Developed in the Netherlands): the abbreviation for this coding system is derived from the name Metal Institute Classification System. It is developed to help automate & standardize a number of designs, production and management function. Its application is listed below.

- Standardization of engineering drawings
- Retrieval of drawings according to classification
- Standardization of process routing
- Automated process planning
- Selection of parts processing on particular group of machine tools
- Machine tool investment analysis etc.

This coding method consists a maximum of 30 digits: 1 2 3 4 12 13 14 15 30. Universal Code Special Code (for any part) (for any company or industry including lot size, cost data, time, operation sequence, etc.)

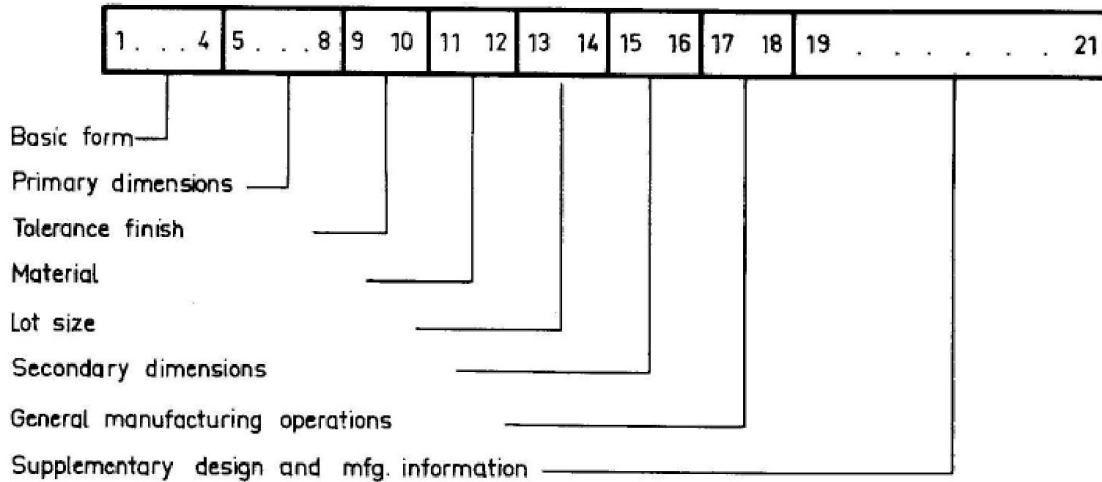


Figure 13 Guideline for The structure of the MICLASS coding system

Basic form: Basic shape (1), Shape element (2 & 3), Location of the shape element (4)

Supplementary design and manufacturing information: Number of outside diameters (19), Number of inside diameters or specific shape (20), Rotational grooves or knurls (21), Close tolerance diameters(22), Splines (23), Gears (24), Sprockets (25), Pitch diameter/diameter pitch (26), Number of teeth(27).

5. DCLASS (Design and Classification Information System)

It is a decision-making and classification system that generates codes for components, material, processes, machines, and tools with a tree-structured system. Each branch of the system represents a condition in which a code is formed at the junction of each branch. The complete code is obtained by taking multiple passes in the decision tree.

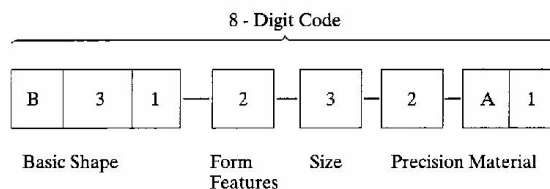


Figure 14 Guideline for DCLASS coding System

In DCLASS coding method there are two categories identified as general codes and specific codes. The general code represents the general attribute of the part, whereas the specific code represents exact information.

General Code (AA BC DD)

The code is a numerical code of constant length and is divided into two groups of six digits each:

$$\begin{array}{ccc} \underline{\text{XXXXXX}} & - & \underline{\text{XXXXXX}} \\ \textit{General Code} & & \textit{Specific Code} \end{array}$$

Figure 15 Positions of General and specific code for DCLASS coding

The first digit (AA) has 10 possible values, the second and third digits (B and C) are combined to give 99 possible subclasses of each item classified, and the last digit (DD) in the general code has 10 possible values.

The general code gives a general description of the part, the type of operation it performs, and other specifications that uniquely identify the product.

Specific Code (XXXXXX)

The specific code provides a more detailed description about a part by categorizing it into subclasses. Some parts do not need the entire 12 digits. The extra digits are reserved for possible future expansion of the company of the company line of products.

2.1.1.2. Benefits of a Well-Designed Classification and Coding System

If a significant amount of part classification and coding data is available on database, then it should begin to access the information before designing a new part. It will reduce new part introduction and take advantage of existing part design possible. And additional advantages of classification and coding system are listed below.

- a. Facilitates formation of part families
- b. Permits quick retrieval of part design drawings

- c. Reduces design duplication
- d. Promotes design standardization
- e. Improves cost estimating and cost accounting
- f. Facilitates NC part programming by allowing new parts to use the same part program as existing parts in the same family
- g. Computer-aided process planning (CAPP) becomes feasible

2.2 Application of Group Technology

Besides testing different hypotheses by assuming an ideal scenario, the philosophy of group technology has been applied in different manufacturing sectors. As a result this section will discuss the main focus areas that GT was applied in previous research. As a result one of the major areas of application for group technology was Sheet metal classification and coding system Peter et. al, (2011), Geiger et.al, (1997), Duflou et. al, (2005) and Peter et.al, (2011) Yosef, (2012). Other areas of application for GT are software application by Katarina et. al., (2012), Spare Parts and Hand Tools, Yosef (2002), Electronics Assembly (Jouni, 2003), Machine shop and supplies machined parts to the parent company (Mayuresh, 2015), and Surgery Scheduling (Wang et. al, 2014). From the above statement a gap on the implementation of GT is identified as not being implemented in textile industry. Therefore, this research is the first in its kind to implement GT in textile industry.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1. Research Design

This mixed research was designed to identify similarities between different designs of cultural clothing. In addition it is designed to investigate how these clothes can be grouped into a part family that represents the clothing's characteristics.

This study adopts a variety of techniques by applying a mixed methodology. The techniques used are both quantitative (in the form of a questionnaire survey) and qualitative (in the form of semi-structured interview). The questionnaire survey gathers data on the characteristics of Ethiopian cultural clothing and related job issues.

The research was based on information gathered through a questionnaire given to producers of Ethiopian cultural clothing of the selected SMEs. In order to reach these respondents, questionnaires were given to the manufacturers by the researcher. The period over which the survey took place was March and April 2016, and samples of 111 respondents were obtained.

The questionnaire was delivered to the respondents in person and they were requested to complete it within a minimum number of days. Data was collected accordingly and regarding appropriate sample size for factor analysis, different rules in the literature are indicated. Comrey et. al., (1992) considered the sample size of 100 as poor, 200 as fair, 300 as good, 500 as very good and 1000 or more as excellent. As a result 111 samples are studied for this research from randomly selected SMEs that produce cultural clothing.

All respondents were males. Regarding appropriate sample size for factor analysis, different literatures indicate that the sample size should at least be 100 Gorsuch (1983) and Kline (1994), and the higher the number of samples the more accurate the sample will represent the entire population.

3.2. Population and Sampling Techniques

This research was studied on 111 different SMEs that produce cultural clothing around Gulele sub city.

Table 2 Number of SMEs producing cultural cloths in Gulele Subcity (2008 E.C)

Name of the site	Number of Enterprises
Kechene Aregawyan Site	7
Kundish Site (Shiromeda)	75
Mintamir Site	32
Mela Engineering Site	7
Gulele subcity Addisu Gebeya Shema Maekel Site	3
Gud Semerita Site	27
Andinet Yimret Site	13
Total	154

Source: Gulele subcity document

The sample for each population was estimated considering 95% confidence interval and 5% error <http://www.research-advisors.com/tools/SampleSize.htm>.

$$n = \frac{N}{1 + N(e)^2}$$

Where **n** is the sample size, **N** is the population size, and **e** is the level of precision or expected error. By using this formula at 95% confidence level and 5% level of precision the sample size was as follows:-

$$n = 154 \div (1 + 154(0.05)^2)$$

n= 111 samples

3.3. Types of Data and Tools/Instruments of Data Collection

The research instrument, developed and used in this study, is a questionnaire having five point likert rating scale 1-Very poor, 2-Poor (disagree), 3-Fair (Neutral), 4-Good (agree), and 5- Very Good (strongly agree). The questionnaire was developed on the basis of literature (Mitrofanov (1966), Burbidge (1996), Offodile, (1992), Singh, et. al., 1996, and Han and Ham (1986)) which identified critical areas of a product feature.

Producers were interviewed by making a basis on a semi-structured interview questions. The semi-structured questions were starters for the conversation. And when they started answering additional questions were included and asked at the scene of the interview session.

3.4. Procedures of Data Collection

Before collecting primary data from the respondents letter for cooperation written from the university was shown to each enterprise. After the letter was approved the questionnaire was given to the enterprises and collected in the next days. The date for submitting the questionnaire was decided by each employee/respondent. Therefore the researcher respected this decision of each respondent and receives the questionnaire as promised.

The semi structured interview was took place when they were handed the questionnaire. Luckily they were all willing to be interviewed at the time of request. And if they were busy, they delegate someone to be interviewed.

In addition observation played its own role when it comes to identifying similar attributes across different designs of cultural clothing. Observing is the substitute term for visual inspection in this case. This is because the characteristic of products is identified by looking at each product. This is one of the methods whereby the unique features or the characteristics that make each product from the other different are identified.

3.5. Methods of Data Analysis

The survey by the questionnaire included items addressing shared similarity of materials, size, shape, process, part family and product coding techniques. As a result the information gathered from the questionnaire was analyzed by using software program Statistical Package for the Social Sciences (SPSS) for statistical analysis.

And the information gathered by the means of semi-structured interview was analyzed to group the products in to family that share similar attributes.

3.7. Ethical Considerations

Since people have the right to not be forced into participating in the study, the researcher gave each respondent a chance to decide whether or not they would like to contribute to the research.

When respondents were answering questions from the questionnaire, the researcher was there to ensure that the respondents be aware of the information collected would be used for an academic purpose only.

The researcher also ensured that participants could respond to the questionnaire at a time that is most convenient for them and stick to the time decided by the respondents.

The researcher ensured that the questionnaires that should be copied to SPSS software for analysis has be answered completely.

CHAPTER FOUR

RESULTS & DISCUSSION

4.1 Types of Products

There are different types of products being produced in these SMEs around Gulele Sub city. The following table shows the characteristics of these products.

- 1 **Gabi: (ጋቢ):** It is a large rectangular piece of thick clothing usually worn in cold weather. There are two types of gabis classified as netela (ኅጠላ ጋቢ) and mulu gabi (ሞላ ጋቢ). The above classification is based on the thickness of each gabi. The mulu gabi is thicker and will warm a person wearing it more than a person who wore the netela gabi.

Size of mulu gabi = 0.85m – 2.75m x 2.9m – 3m

Size of netela gabi = 0.85m – 2.75m x 2.9cm – 3m

The size of 'Netela Gabi' is two times the size of a scarp (1.5m*3.6m) whereas the size of 'Mulu' is four times the size of a scarp (3m*7.2m).



Mulu Gabi(ሞላ ጋቢ) Netela Gabi (ኅጠላ ጋቢ) Source:<http://google.com>

Figure 16 Mulu and Netela Gabi

- 2 **Netela (ኅጠላ):** It is much similar to gabi, except it is usually worn for funerals with black tilet on its border. During funerals it will be worn by bringing the side the netela whereby the tilet is shown on the head. The dominant color of netela worn for other occasions including to church can be any color other than black. Customers can wear the netela with a black tilet

even if it is not for mourning. In this case the side that has tilet will be facing the ground when it is worn. When the netela is worn with a tibeb dress, the tilet for both netela and the dress are identical. Netela is also worn by men and women, and the designs might differ.



Figure 17 Netela Source: www.google.com

- 3 **Scarf (ስ ካ ር ፍ):** It is a small rectangular piece of thin clothing worn around the neck or on top of the tibeb dress. It will have tilet like gabi and netela. What makes it different is only its size. And it is further classified as large and small sized scarp.

Size of small scarp 0.75m*1.8m-2.2m

Size of large scarp = 1.35 – 1.5 * 1.8 – 2.2

6. **Cultural dress/Tibeb kemis (ጥበብ ቀ ማክ):** It is a unique dress that is made by Ethiopians who have the skill of operating a hand weaving machine. The shape of the dress is similar to other dresses that are worn around the world. But the materials these dresses are made of and the aesthetic features included to attract customers is very unique. Tibeb kemis can also be categorized according to its size ranging from 2arb up to 6arb. Arb is a unit used to measure the size of any cultural clothing by the hand weavers around gulele sub city, Addis Ababa. Dresses with a size of more than 4arb are usually worn for special occasions; including wedding.

$1arb = 0.75m * 1.5m$

$2arb = 0.75m * 3m$

$3arb = 0.75m * 4.5m$

$4arb = 0.75m * 6m$

$5arb = 0.75m * 7.5m$

$6arb = 0.75m * 9m$

In addition to the sizes stated above, dresses are also made for little girls. As a result the size will be much smaller when it is made for children.



Figure 18 Tibeb Kemis characters (3 arb dress) Source: <http://google.com>

7. **Table clothing (የ ጠረጴዛ ልብስ)**: The SMEs that produce cultural clothing for people to wear also make very unique table clothing. The shape will be determined according to the shape of the table it is produced for, including rectangular and oval. Its size also varies according to the size of the table. Even if the size of the table clothing didn't have a well known dimension like the above products, the common dimension that producers made so far includes:

$$\text{Size of table clothing} = 0.3m - 0.5m * 1m - 1.5m$$

8. **Cultural Curtain (ጭረጃ)**: This is another type of product that is made by SMEs around gulele sub city. Its dimension is not well known by producers that were studied for this sample. As a result it was difficult to estimate its standard size.
9. **Bed mattress (የ አልጋ ልብስ)**: It is also another type of product produced by sharing the characteristics of Tibeb; because it will have tilet or tilf to make it different from the ones produced in a modern factory.
10. **Pillow (የ ትራስ ልብስ)**: The pillows are of made for bed and sofa. Their size varies according to the size of the actual pillow of the customer.

$$\text{Sixe of pillow clothing} = 0.4m * 0.4m$$

11. **Sofa clothing (የሶፋ ልብስ)**: This is the clothing made for the sofa to cover the main clothing it was made of.

12. **Male trouser (የወንድ ስረ)**: Trousers for male are also being produced.

$$\text{Size of male trouser} = 0.75m * 0.8m$$

In addition to the size indicated above, male's trouser is also made for boys with a much smaller size.

13. **Male vest (ሰረዳያ)**: The vest is also another type of product that is produced in the SMEs both for men and little boys.

14. **T-shirt (ጥሽርጥ)**: T-shirts are produced that match with the tilet of the trouser.

15. **Napkin (ጥጥካግ)**: A It is a square of clothing that is used when food is being eaten to protect peoples' clothes from ruining. It can also be used to wipe mouth or hands.

4. 2 Descriptive statistics

Descriptive statistics (means and standard deviations) for the main study variables are provided in the table below.

Table 3 Descriptive statistics

Descriptive Statistics			
	N	Mean	Std. Deviation
G1: Geometric Shape	111	3.5856	.80304
G2: Geometric Size	111	4.0901	.78102
Pr: Process	111	3.9820	.77439
M: Material	111	4.0270	.79154
S: Similarity	111	3.9730	.82528
C: Product Coding	111	4.1171	.81730
Valid N (listwise)	111		

From the above table the producers' perspective is shown by indicating the mean and standard deviation. For the first question that producers of cultural cloths asked was to indicate the advantage of grouping products having similarity in geometric shapes. Then the mean was found

to be 3.5856 with a standard deviation of 0.80304. These numbers indicate that producers themselves believe that if netelas, tibeb dresses and gabis sharing similar shapers are in a single part family it will save time for both producers and customers of this industry. As stated in the problem statement section of this thesis, one of the problems that producers face was the time it took them while explaining about a certain design of a product, and negotiating the final price. If the parts sharing these characters are grouped together, then it will ease the process of estimating the exact price for the product.

The shapes of the clothes can be generally categorized according to their shapers. For instance, gabi and netela can be grouped as having rectangular shapes. And their tilet can be categorized as 'diamond' shaped or 'flower'.

The second question asked respondents if they think that grouping products that have similarities in geometric size will save them time. Size is also one of the factors that influence the price set for a certain product; the larger the size the higher the price. As a result the producers also think (Mean = 4.0901 and standard deviation = 0.78102) that if their products are grouped together according to the size of the clothing, then it will smoothen the process of explaining why these products are assigned that specific price for the customers. Also, the time that was spent to figure out which size fits a specific customer will be identified.



Figure 19 4arb sized dress

The setup for all products of cultural clothing is almost the same. For instance all types of dresses, netelas and gabis can be produced with a single hand weaving machine. But the arrangements of thread used to produce the clothing differ according to the preferred design. The difference can be specially spotted on the tilet of the clothing. Since tilets are categorized as

Sherko, Zipe Sherko, Difin and Limut, one can visualize the arrangement of threads. Their difference can be spotted by realizing the concentration of each trade in each design.

Limut design of tilet represents tilet made of a single color and material. This is the simplest type of tilet design. Whereas ‘Sherko’ refers to ‘tillet’ made of a combination of different colors of threads and the way these threads area arranged is different than ‘Difin’.



Figure 20 Sherko tilet

As shown from the above figure, the ‘tillet’ is made of two different colors of threads. What makes a ‘sherko’ type design is that the strip lines that are seen on the tilet. These strip lines are indicating the space that is shown between the arrangements of the threads.

In the case of ‘Difin’ type of ‘tillet’ the strip lines found on the sherko design will not be shown here. This is because in the case of ‘difin’ type of ‘tillet’ design the concentration of threads is very high. As a result a space will not be left on the entire design.



Figure 21 Difin tilet



Figure 22 Zipe sherko tilet

And the respondents' answer (mean = 3.90820 and standard deviation = 0.77439) shows that they believe that if cloths sharing the same processing technique are grouped together it will definitely save them time and energy spent with customers.

In addition to its design different the time it will take to produce the different types of tilets varies. 'Limut' will take the shortest time when compared to both 'sherko', 'zipe sherko' and 'difin'. And 'difin' design of tilet will take more time to be completed when compared to both 'sherko' and 'limut'. This is because the concentration of threads is very high and much care is given to complete the design having high quality. Finally 'sherko' will take medium amount of time when it is compared to the other two designs of tilets.

For the fourth question the respondents answered that (Mean = 4.0210 and standard deviation = 0.79154) if the clothes are grouped together by sharing the same materials, it will save time for them and their customers. The material the cultural clothing is made of differs with different factors, such as customers' perception. And the materials used to produce tibeb kemis, netela and gabi are cotton, silk, wool and shiney thread that is commonly known as 'werkezebo'. A certain product can be produced by either one type of material or a mixture of different types of materials.



Figure 23 Tibeb kemis made of silk, cotton and werkezebo

From the above figure it is shown that the above material is made of silk, cotton and shiny material that is commonly known as 'werkezebo'. The other question that producers asked was to asking them if similarities between these products are identified and grouped together, it will save both time and energy. With a mean of 3.9730 and a standard deviation of 0.82528 they agreed. One of the advantages of group technology is to simplify the system by identifying similarities.

And for the last question, the highest mean (4.1171) with a standard deviation of 0.81730 is found. This value indicated that cultural cloth producers of gulele sub city believe that if each product is assigned a code that identifies its characteristics time will be saved. The time duration customers spent looking for a specified design that suits their interest will be minimized. And the time and energy producers exert explaining about a certain product will also be reduced. In addition the time designers spend to come up with a new draft will also be decrease. Because the when the products are coded, they are documented for later use. And designers can refer to these codes to inspire them for a new idea. In addition this act will avoid duplication of effort, since an already created design will not be crafted by another person for the second time.

The collected data through semi-structured interview is organized to form a part family by adopting DCLASS coding system. Before discussing the steps, this section will initially explain the sub elements of each part. For instance, since Netela,Gabi and Buluko have the same general shape they are included in the element called ‘Blankets’ as shown in the figure below. This is further explained in the DCLASS logic tree in the following section of this thesis. The parts shown below have a rectangular basic shape.

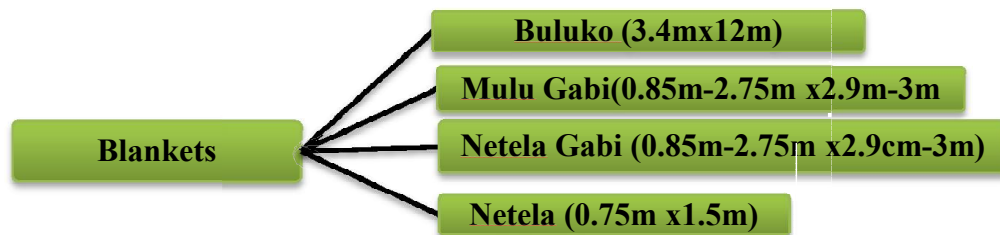


Figure 24 Hierarchical structure for Blankets of Ethiopian cultural clothing

In DCLASS, each branch represents a condition, and a code can be found at the terminal of the respective branch. Multiple passes of the decision tree allow a complete code to be found. The code construction is accomplished using certain roots (N nodes and E nodes). At N nodes, all branches can be true, while at the E nodes, only one branch can be true.

DCLASS system supports generative process planning system. The generative process planning uses DCLASS 's decision-logic for:

- (a) Collection of input parameters
- (b) Decision-logic manipulation
- (c) Sequencing of output codes
- (d) Output of codes and numeric variables used to generate process-plan text
- (e) Identification of production quantity

DCLASS includes mechanisms that can capture, represent, and store input parameters as well as other mechanisms that can execute automatic branching based on the captured parameters. The parameters are then passed to the final section of the user defined decision-logic structure for processing. The final section automatically generates a set of sequence of output codes, which are then translated into discrete units of process plan text. Units of the text are then presented for final editing. The process planner can edit the text if he desires to do so. Texas instrument is successfully using this system as supporting system for the generative process planning.

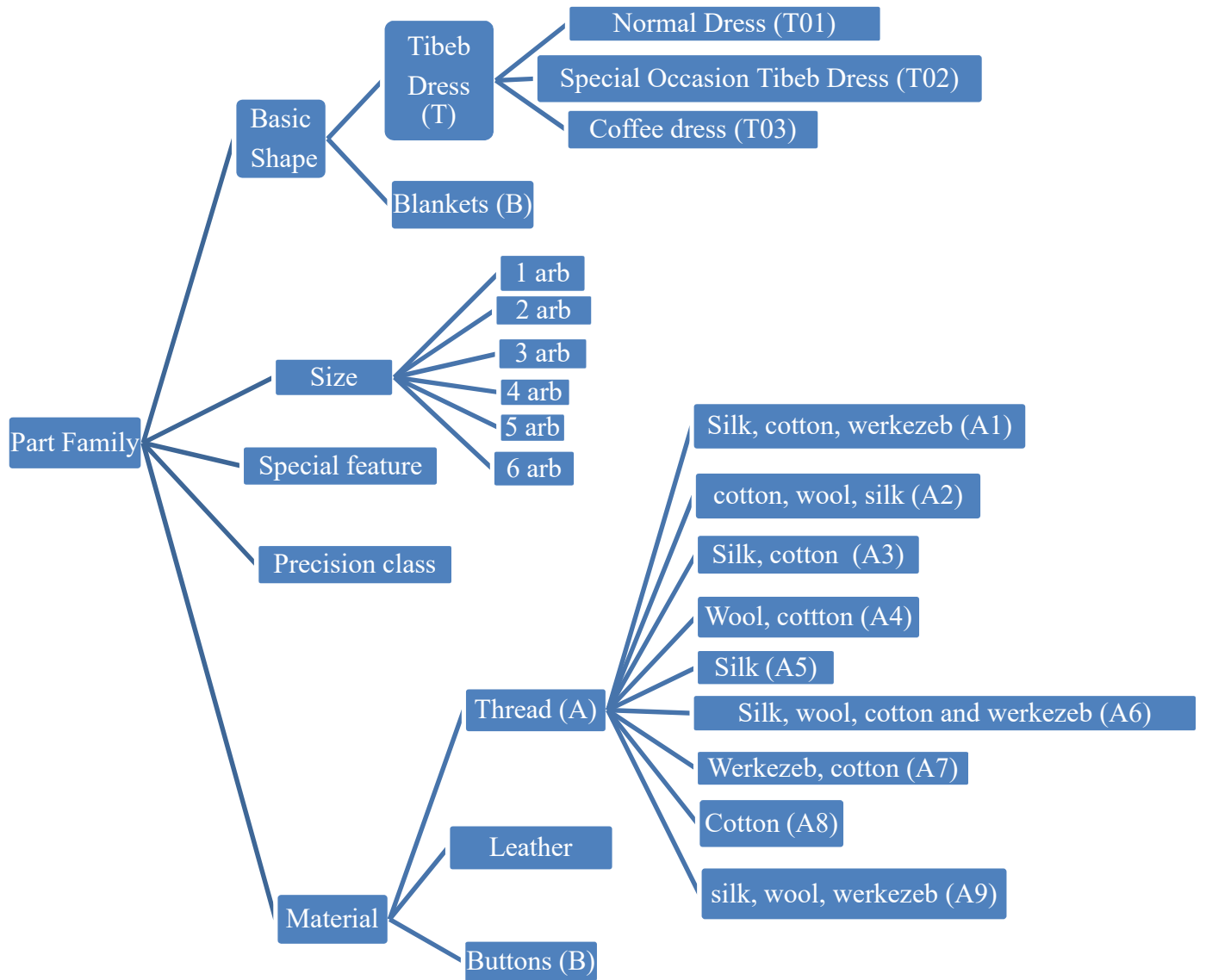


Figure 25 DCLASS logic tree

For the above logic tree the basic shapes of the dresses for the three events (Special occasion, Coffee ceremony and casual) have unique shapes. Even if the tibeb dresses don't have a well

defined shape, the user will definitely distinguish one she wears for the three different events mentioned in the DCLASS logic tree.

For the above DCLASS logic tree T stands for 'Tibeb Dress' and B stands for 'Blankets'. It should not be forgotten that Gabi, Netela and Buluko are included in 'blankets' because these three products share similar basic shape.



Figure 26 Cultural Coffee dress with a Dclass code of T03326A4

The code for the above tibeb dress (kemis) is **T03326A4**. The first three digits indicate the basic shape of the part. The procedure for getting this code is based on the above figure, which illustrates a DCLASS part family classification chart. Note that this chart is structured as a logic tree. It could have been structured in some other manner, but logic trees are much easier to work with. This is the representation of one of many such charts in the DCLASS coding system. By applying this chart to code the 'Tibeb dress', a path through the logic tree that shows the the types of dresses (Simple, occasional and coffee ceremony) is taken. At this point the first logic tree for cultural clothing is used, indicating that the branches of a 'Tibeb dress have three other branches as shown in the above figure. Unlike the existing illustrations that describe DCLASS coding by examples, the attribute for 'Tibeb dress' regarding basic shape is limited to two digits. Therefore, for the last branch of the above logic tree the code value will be terminated as T01 representing the first three digits of the code for 'Tibeb dress'.

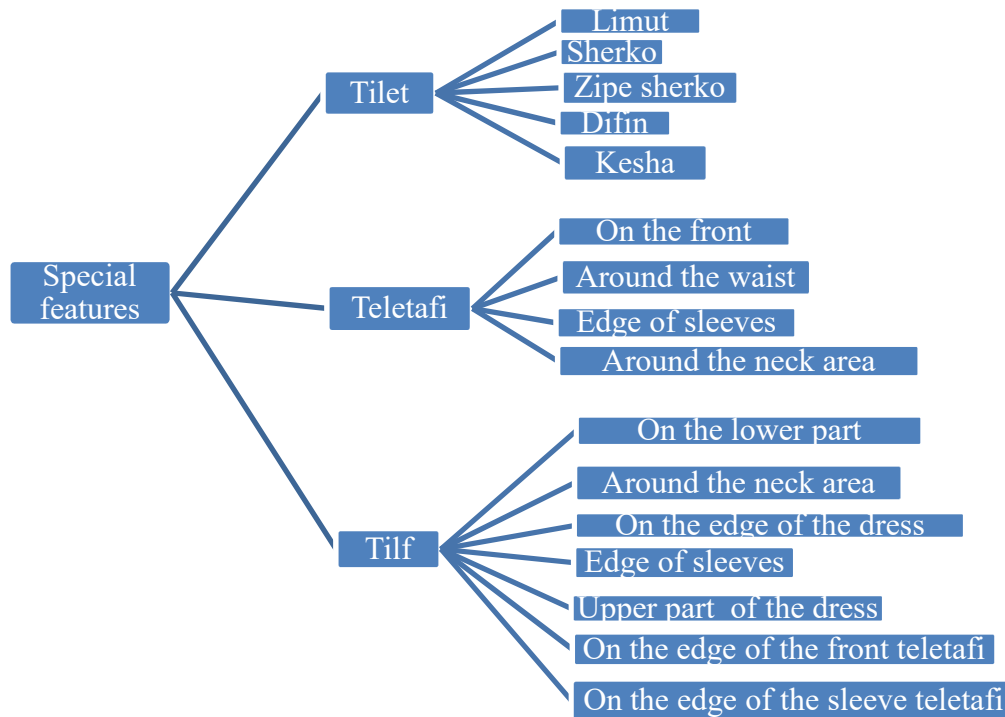


Figure 27DCLASS Logic Tree of special features

Similar to the above description the second section of part family code describes the complexity of special features of the dress being coded, which is the ‘Tibeb dress’. In DCLASS coding system special features of a part include, specifically for this case (Tilet, Teletafi and Tilf). The following table describes the various code values that can be used to code the complexity of the special features. For the above coffee dress, a complexity code of 3 is assigned since there are three special features for this ‘tibeb dress’. This is because the dress has three special features, such as tilf on the front of the dress, edge of the sleeve and around the neck area. The above dress does not have tilet or teletafi.

Table 4 Complexity code for special features

Feature Complexity Code	No. of special features
1	1
2	2
3	3

4	5
5	8
6	13
7	21
8	34
9	>34

The third section of the part family code refers to the size of the part. The current coding system is being applied by adopting DCLASS coding system. But since the parameters set for existing models for this code are not for textile materials. Therefore, the size codes for this research are changed into the ones shown in the figure below.

Table 5 DCLASS size code of cultural clothing

Original Size code of dclass coding			Adopted size code of dclass coding	
Size code	Dimension (mm)	Description	Dimension (mm)	Description
1	0.5	Subminiature	1 arb	0.75m*1.5m
2	2	Miniature	2 arb	0.75m*3m
3	4	Small	3 arb	0.75m*4.5m
4	10	Medium small	4 arb	0.75m*6m
5	20	Medium	5 arb	0.75m*7.5m
6	40	Medium large	6 arb	0.75m*9m
7	100	Large	7 arb	0.75m*10.5m
8	400	Extra large	8 arb	0.75m*12m
9	1,000	Giant	9 arb	0.75*13.5

Using the adopted table of DCLASS size code, '2' would be used in the code for the 'Tibeb dress'. Precision in DCLASS coding system indicates a composite tolerance and surface finish of a part. The table shown below presents the precision value applied by DCLASS coding system.

Table 6 DCLASS precision class code

Original dclass code for precision			Adopted dclass code for precision	
Class code	Tolerance (inches)	Surface finish (rms/ root mean square)	Precision	Description (Complexity of tilet)
1	≤ 0.0005	< 4	Tilf	Hand embroidered
2	0.0005-0.002	4-32	Mixed	Very difficult
3	0.002-0.010	32-125	Difin	Difficult
4	0.010-0.030	125-500	Zipe sherko	Moderate
5	> 0.030	> 500	Sherko	Simple
6	Not specified	Not specified	Limut	Very simple

The above table lists six classes of precision used for cultural clothing. Limut tilet is the simplest of all the other five tilets, whereas tilf is done by hand and much care is needed to find the desired design. Class 5 indicates very low precision and a part with a precision code of and class 1 requires careful processing. Therefore the coffee table shown above requires high cautious for the product to be completed with the desired quality of design, therefore a code value of “6” is assigned.

CHAPTER FIVE

CONCLUSIONS & RECOMMENDATIONS

This chapter describes the major findings and the conclusions of this study. Furthermore, the researcher also indicates recommendations for future study.

5.1. Conclusions

In this research the advantage of part family formation by using group technology classification and coding system are discussed in detail. One of the characteristics of manufacturing system is that, it is possible to take advantage of group technology, even if it is not wholly implemented. As a result, production benefit can be achieved by developing part classification and coding system. This act for the textile industry of Ethiopian cultural clothing indicates that advantage of design retrieval, minimization of duplicated drawings of parts, and minimized operation time can be achieved.

The codes (DCLASS Code) assigned to each part refers to the characteristics of each part implying the advantage of grouping similar parts to overcome the existing problems regarding informal part grouping technique that is being applied in SMEs.

Gabi and Netela can be grouped together, since they share a basic shape; i.e. rectangular shape. And these products can be subdivided by their respective material, special feature and precision. The cultural dresses (Tibeb kemis) are first grouped by the basic shape then a classification with respect to the material the dresses are made of is taken into consideration when developing a dclass code. The dresses are categorized as casual, special occasion and coffee dress according to their fundamental shape. The casual dresses represent the ones that can be worn anytime; the special dresses represent clothing that can be worn for a unique event including wedding ceremony. And the coffee dress has a unique shape which is usually worn for the cultural coffee ceremony.

Besides the basic shape, the clothing is grouped according to the special feature they share. This includes deciding whether the additional features are tilet or tilf. And also counting the number of areas these special features are on specific clothing. As a result, users can be able to understand the characteristics of the cultural cloth they sell or desire to wear.

5.2. Recommendations

First and foremost, applying group technology product classification and coding technique will benefit the SMEs that produce cultural clothing around Gulele subcity. This is because they can benefit from the advantages of the product classification and coding system. Application of the assigned codes to everyday activity assists both customers and users to understand the characteristics of specific clothing. Since the attributes can be identified from the assigned code, users can easily identify which cloth is made of what material, its respective size, the nature of its especial characteristics and for what occasion they would wear the clothing.

Producers will be able to easily explain the nature of the clothing to their customers with a minimum time. This will minimize the large amount of time they spent expelling and negotiating price. In addition producers will be able to estimate fair and accurate amount of selling price to every product. Since all the characters of the cultural clothing can be identified from the code it will minimize the effort and time spent to decide on its selling price.

If producers want to show the different designs of clothing they had, they can group the cloths into a part family that share similarity in size, material, shape and additional features. This act will also minimize the search time they spent every time a customer wants to explore what is inside the shop.

5.3. Further Area of Investigation

For this study only two designers were contacted. Exploring the working system of other manufacturers will provide a better understanding about the nature of tibebe. In addition, the names of the materials indicated in the coding system are the general terms of threads. Each thread has its own number and characters. Because of the knowledge gap, the researcher was forced to use the general terms for threads. For instance in this case we use the term ‘werkezeb’ for all shiney materials. But each shiney material differs from the other by its characters. Some of them will fade when the clothes are being washed and the color of others will not fade at the same time. Accordingly, future researchers can focus on developing classification and coding system that best describes its characteristics for the rest of the Ethiopian cultural clothing and other industries.

References

- Burbidge, J.L. (1996) "Production Flow Analysis For Planning Group Technology", Oxford University Press, USA,
- Burbidge, J.L., (1963) "Production flow Analysis", Production Engineers
- Carrie, A.S. (1973). Numerical taxonomy applied to group technology and plant layout. International Journal of Production Research
- Chandrasekharan, M.P. and R. Rajagopalan. (1986a). An ideal seed non-hierarchical clustering algorithm for cellular manufacturing. International Journal of Production Research,
- Chandrasekharan, M.P. and R. Rajagopalan. (1986b). MODROC: An extension of rank order clustering for group technology. International Journal of Production Research,
- Chandrasekharan, M.P. and Rajagopalan, R., (1986) "An ideal seed non-hierarchical clustering algorithm for cellular manufacturing", International Journal of Production Research
- Comrey, A. L., & Lee, H. B. (1992), A first course in factor analysis, Hillsdale, NJ: Erlbaum
- Dufloy J.R., Vancza J., Aerens R (2005).: Computer aided process planning for sheet metal bending: A state of the art, Computers in industry
- Gallagher, C.C. and Knight, W.A., (1985) "Group Technology Production Methods in Manufacture", Chichester, Ellis Horwood
- Geiger M., Greska W. (1993): Analysis and classification of sheet metal components. Production Engineering
- Geiger M., Greska W., Franke V. (1997): Classification problems in manufacturing of sheet metal parts. Computers in industry
- Groover, M.P. and Zimmers E.W. Jr., (1984) "CAD/CAM: Computer-Aided Design and Manufacturing", PrenticeHall, New Jersey, USA,

- Guerrero, L.C., Lozano, S., Canca, D., Guerrero, F., Larrañeta, J. and Onieva, L., (2000) “Cell formation using sequence information and neural networks”, Proceedings of the 10th International Conference Flexible Automation and Intelligent Manufacturing
- Gupta S.K. et al. (1998): Automated process planning for sheet metal bending operations. Journal of Manufacturing Systems,
- Ham, I., Hitomi, K. and T. Yoshida. (1985), Group Technology: Applications to Production Management, Boston: Kluwer-Nijhoff Press.
- Ham, I., Hitomi, K. and Yoshida, T., (1985) “Group Technology: Applications to Production Management”, Kluwer-Nijhoff Press, Boston, USA
- Han, C. and Ham, I., (1986) “Multi-objective cluster analysis for part family formation”, Journal of Manufacturing Systems
- Han, C., and I. Ham. (1986), Multiobjective cluster analysis for part family formation. Journal of Manufacturing Systems
- Jung, J., Ahluwalia, R.S., (1992) “FORCOD: A coding and classification system for formed parts”, Journal of Manufacturing Systems
- Kang S.S., Park, D.H (2002).: Application of computer-aided process planning system for nonaxisymmetric deep drawing products, Journal of Materials Processing Technology
- Kaparthi, S. and Suresh, N., (1991) “A neural network system for shape-based classification and coding of rotational parts”, International Journal of Production Research
- Katarina Monkova and Peter Monka (2012), Group Technology Utilization inside New Software Application, Applied Mechanics and Materials, Trans Tech Publications, Switzerland
- King, J.R. and Nakornchai, V., “Machine-component group formation in group technology: review and extension”, International Journal of Production Research

- King, J.R., (1980) “Machine-component grouping in production flow analysis: an approach using a rank order clustering algorithm”, International Journal of Production Research
- Kuric I., Kuba J. (2007): New methods of products classification for computer aided process planning, Engineering Revue
- Kline, P. (1994), An Easy Guide to Factor Analysis, New York; Routledge
- McAuley, J. (1972). Machine grouping for efficient production. Production Engineer
- McAuley, J., (1972), Machine grouping for efficient production, Production Engineer
- McCornick, W.T., Schweitzer, J.P.J. and White, T.W., (1972) “Problem decomposition and data reorganization by a clustering technique”, Operations Research
- Messele Kassaw (2013), Competitiveness Model Development for Ethiopian Traditional Fashions in the Global Market, Addis Ababa university, Ethiopia
- Mielnik E. M.(1991): Metalforming Science and Engineering. McGraw-Hill
- Misaki D., Aomura S. (2003): Searching sheet metal parts based on bending process similarity. Proc. of the Mechanical Engineering, Part B – J. Engineering Manufacture
- Mitrofanov, S.P., (1966) “Scientific Principles of Group Technology”, Part I, Boston: National Lending Library of Science and Technology (Originally published in 1959 as Russian text)
- Moon, Y.B., (1992) “Establishment of a neurocomputing model for part family/machine group identification”, Journal of Intelligent Manufacturing
- Murray, J.A. (1984), A concept of entrepreneurial strategy. Strategic Management Journal
- Nancy L. Hyer and Urban Wemmrlöv, (1984), Group Technology and Productivity
- Offodile, O.F. (1992). Application of similarity coefficient method to parts coding and classification analysis in group technology. Journal of Manufacturing Systems

- Offodile, O.F., (1992) “Application of similarity coefficient method to parts coding and classification analysis in group technology”, *Journal of Manufacturing Systems*
- Opitz, H. (1970) “A Classification System to Design Workpieces”, Pergamon Press, UK
- Optiz, H. and Wiendahl, H. P. (1971). *GT and Manufacturing Systems for Small and Medium Quantity Production*, *International Journal of Production Research*
- Peter Šugár, J. Šugárová, M. Kolník (2011), *Technology-Based Sheet Metal Classification and Coding System*, *Journal for Technology of Plasticity*
- Prabhakaran, G., Janakiraman, T.N. and Sachithanandam, M., (2002) “Manufacturing data based combined dissimilarity coefficient for machine cell formation”, *International Journal of Advanced Manufacturing Technology*
- Prabhakaran, G., Janakiraman, T.N. and M.Sachithanandam. (2002). *Manufacturing data based combined dissimilarity coefficient for machine cell formation*. *International Journal of Advanced Manufacturing Technology*
- Prabhakaran, G., Janakiraman, T.N. and Sachithanandam, M., (2002) “Manufacturing data based combined dissimilarity coefficient for machine cell formation”, *International Journal of Advanced Manufacturing Technology*
- Rajagopalan, R. and J.L. Batra. (1975), *Design of Cellular production system –A graph theoretic approach*. *International Journal of Production Research*
- Richard L. Gorsuch (1983), *Factor Analysis*, 2nd Edition
- Seifoddini, H. and P.M. Wolfe. (1986). *Application of the similarity coefficient method in group technology*. *IIE Transactions*
- Seifoddini, H. and Wolfe, P.M., (1986) “Application of the similarity coefficient method in group technology”, *IIE Transactions*

- Selamawit Haile (2016), Assessing the Determining Factors of Competiveness in Ethiopian Traditional Textile Sector, St. Mary's University, Ethiopia
- Singh, N. and D. Rajamani. (1996). Cellular Manufacturing Systems: Design, Planning and Control, London: Chapman and Hall Press
- Singh, N. and Rajamani. D., (1996) "Cellular Manufacturing Systems: Design, Planning and Control", London: Chapman and Hall Press
- Slobodan Morača, Miodrag Hadžistević, Igor Drstvenšek and Nikola Radaković (2009), Application of Group Technology in Complex Cluster Type Organizational Systems, Journal of Mechanical Engineering
- Srinivasan G. (1994). A clustering algorithm for machine cell formation in group technology using minimum spanning trees. International Journal of Production Research
- TNO., (1975) "An Introduction to MICLASS", Organization for Industrial Research, MA, USA
- Yared Mesfin Tefera (2010), Economic Impact and Determinants of Export: The Case of Ethiopian Textile and Apparel Industry, School of Economics, Addis Ababa University, Ethiopia
- Yosef Haileeyesus (2002), Group Technology Based Classification and Coding System: A Case Study on Akaki Spare Parts and Hand Tools Share Company, Addis Ababa Univeresity, Ethiopia
- Yosef Haileeyesus, (2012) Group Technology Based Classification and Coding System: A Case Study on Akaki Spare Parts and Handtools Share Company, Addis Ababa University

Appendices

Appendix I: Questionnaire in English

The questionnaire was asked in Amharic the following content is the translated version of questions that producers of SMEs were asked.

Addis Ababa University

Institute of Technology

Acknowledgement to the respondent

Hereby, I would like to express our gratitude for your dedicated cooperation. Had it not been your genuine cooperation of filling this questionnaire, it would have not been to conduct this term paper.

The main purpose of this research is to investigate the unique characteristics of Ethiopian cultural clothing, specifically Tibebe dress and Netela.

This questionnaire is conducted for the purpose of education. Therefore, I assure you that the information obtained from this questionnaire will be kept confidential and will not be transferred to other for any other purpose.

With regards,

Bethlehem Nessibu

For each statement, mark the column that best describes the reality in your workplace.

1. **G1:** If cultural clothing including Dress, Netela and Gabi having similar geometric shapes are grouped together, it will save time for customers and producers.

Very Poor Poor Fair Good Very Good

2. **G2:** If cultural clothing including Dress, Netela and Gabi having similar geometric size are grouped together can minimize the time customers spent in the shops.

Very Poor Poor Fair Good Very Good

3. **P1:** If cultural clothing including Dress, Netela and Gabi made by the same processing technique are grouped together, it will save the total time spent to produce it.

Very Poor Poor Fair Good Very Good

4. **M1:** If cultural clothing including Dress, Netela and Gabi made from the same material are grouped together it will save time for customers and producers.

Very Poor Poor Fair Good Very Good

5. **S:** If cultural clothing including Dress, Netela and Gabi having similar characteristics are grouped together, it will save time and energy for customers.

Very Poor Poor Fair Good Very Good

6. **C:** If cultural clothing including Dress, Netela and Gabi have codes to distinguish one from the other it will save time for customers and producers

Very Poor Poor Fair Good Very Good

Appendix II: Questionnaire in Amharic

አዲስ አበባ ዩኒቨርሲቲ

ኢንስቲትዩት ኦፍ ቴክኖሎጂ

ምስጋና

በመጀመሪያ በዚህ ጥናታዊ ፅሁፍ ለተሳተፍ ፈቃደኛ በመሆንዎ ምስጋናዬን አቀርባለሁ። መጠይቁን ለመሙላት የእርስዎ ትብብር ባይሆን ኖሮ ይህንን ጥናት ላይሳካ ይችል ነበር።

የዚህ ጥናት ዋና አላማ የባህላዊ ልብብሮች በተለይም ጥበብ ከሌሎች ልብብሮች ያለውን ልዩነት ለማወቅ ነው። ከዚህም በተጨማሪ በተለያዩ ጊዜ ዲዛይን የምታደርጓቸው ልብብሮች ንድፍን እንዴት አድርጋችሁ አንደምትጠቀሙ ለማወቅ ይረዳል።

ይህ መጠይቅ ሙሉ አላማው ለትምህርት ሲሆን ፣ በዚህ መጠይቅ በኩል የሚገኙ ማንኛቸውም መረጃዎች ከዚህ አላማ ውጪ እንዳይውሉ በምስጢር ተጠብቀው ይቆያሉ።

ከምስጋና ጋር

ቤተሰብዎ ነሲቡ

ለእያንዳንዱ ጥያቄ ከታች ከተዘረዘሩት አማራጮች መካከል አንዱን በመመመረጥ ምልክት ያድርጉበት።

1. በቅርፅ ተመሳሳይነት ያላቸው ባህላዊ ልብብሮች ቀሚስ ፣ ነጠላና ጋቢን ጨምሮ በአንድ ቡድን እንዲሆኑ ቢደረግ ደንበኞች እና አምራቾች የሚወስዱትን ረዥም ጊዜ ለመቀነስ ይረዳል።

በጣም ዝቅተኛ ዝቅተኛ መካከለኛ ከፍተኛ በጣም ከፍተኛ

2. በስፋት መጠናቸው ተመሳሳይነት ያላቸው ባህላዊ ልብሶች ቀሚስ ፣ ነጠላና ጋቢን ጩምሮ በአንድ ቡድን እንዲሆኑ ቢደረግ ደንበኞች በመሸጫ በሱቆች ውስጥ የሚወስዱትን ረዥም ጊዜ ለመቀነስና ትክክለኛ ዋጋ ለመተመን ይረዳል።

በጣም ዝቅተኛ ዝቅተኛ መካከለኛ ከፍተኛ በጣም ከፍተኛ

3. በአሰራር ሂደታቸው ተመሳሳይነት ያላቸው ባህላዊ ልብሶች ቀሚስ ፣ ነጠላና ጋቢን ጩምሮ በአንድ ቡድን እንዲሆኑ ቢደረግ በአጠቃላይ ልብሶቹን ሰርቶ ለመጨረስና ዋጋ ለመተመን የሚወስደውን ጊዜ ለመቀነስ ይረዳል።

በጣም ዝቅተኛ ዝቅተኛ መካከለኛ ከፍተኛ በጣም ከፍተኛ

4. በተመሳሳይ ጥሬ እቃ የሚሰሩ ባህላዊ ልብሶች ቀሚስ ፣ ነጠላና ጋቢን ጩምሮ በአንድ ቡድን እንዲሆኑ ቢደረግ አምራቾች ዋጋ ለመተመንና ለደንበኞች ለማስረዳት የሚወስዱትን ረዥም ጊዜ ለመቀነስ ይረዳል።

በጣም ዝቅተኛ ዝቅተኛ መካከለኛ ከፍተኛ በጣም ከፍተኛ

5. በማንኛውም ሁኔታ ተመሳሳይነት ያላቸው ባህላዊ ልብሶች ቀሚስ ፣ ነጠላና ጋቢን ጩምሮ በአንድ ቡድን እንዲሆኑ ቢደረግ ለአምራቾችና ለደንበኞች ጠቀሜታ ይኖረዋል።

በጣም ዝቅተኛ ዝቅተኛ መካከለኛ ከፍተኛ በጣም ከፍተኛ

6. ባህላዊ ልብሶች ቀሚስ ፣ ነጠላና ጋቢን ጨምሮ ለእያንዳንዳቸው ከድ ቢኖራቸው አንዱን ከአንዱ ለመለየት ስለሚደረገው ጥረት ለአምራቾችም ሆነ ለደንበኞች ጠቀሜታ ይኖረዋል።

በጣም ዝቅተኛ ዝቅተኛ መካከለኛ ከፍተኛ በጣም ከፍተኛ

Appendix III: Semi Structured Interview

1. What are the products that are being produced in your enterprise? Eg. Dress

2. What are the materials that are used to make the cultural clothes in your enterprise?
Eg. Cotton

3. What tools and fixtures do you use to make the cultural cloths? Eg. Scissors, needle, etc.

4. Do you have any kind of system in your enterprise that you use to group the different types of cloths?

5. How do you respond to customer's order when they come with a design? Eg. Shape of different designs

6. What additional features that are attached to the cultural cloths? Eg. Tilet and the type of tilets might differ

7. Is there any classification techniques used for grouping cloths according to their dimensions?

Additional questions will be added after gathering information from the basic interview questions that are listed above.

Appendix IV

Sample Pictures from the Software



Casual Tibeb Dress(T01136A8)

✘ This product is currently out of stock and unavailable.

SKU: N/A

Additional Information

Reviews (0)

Additional Information

size	3_arb,
matrial	cotton,
precision	Very simple



Special Tibeb Dress(T02441A2)

✘ This product is currently out of stock and unavailable.

SKU: N/A

Additional Information

Reviews (0)

Additional Information

size	4_arb,
matrial	cotton,wool,silk,
precision	hand_embroidered,



Netela (N01215A1)

✘ This product is currently out of stock and unavailable.

SKU: N/A

Additional Information

Reviews (0)

Additional Information

size	1_arb,
matrial	silk,cotton,werkezeb,
precision	very simple,



casual Tibeb Dress(T01436A9)

✘ This product is currently out of stock and unavailable.

SKU: N/A

Additional Information

Reviews (0)

Additional Information

size	4_arb,
matrial	silk,wool,werkezeb,
precision	hand_embroidered,



Casual Tibeb Dress(T01446A4)

✘ This product is currently out of stock and unavailable.

SKU: N/A

Additional Information

Reviews (0)

Additional Information

size	4_arb,
matrial	cotton_and_wool,
precision	Hand_embroidered



Coffee Dress (T01326)

✘ This product is currently out of stock and unavailable.

SKU: N/A

Description

Additional Information

Reviews (0)

Additional Information

size	1_Arb, 2_Arb, 3_Arb, 4_Arb, 5_Arb, 6_Arb,
matrial	cotton_wool,
precision	lilf,



Casual Tibeb Dress(T01446A2)

✘ This product is currently out of stock and unavailable.

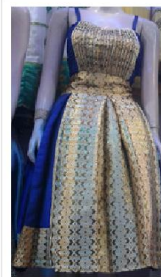
SKU: N/A

Additional Information

Reviews (0)

Additional Information

size	4_arb,
matrial	silk,coton,werkezeb,
precision	very simple,



special occasion (T02336A6)

✘ This product is currently out of stock and unavailable.

SKU: N/A

Additional Information

Reviews (0)

Additional Information

size	3_arb,
matrial	silk,wool,cotton and werkezeb,
precision	hand_embroidered,

Recent Products



Casual Tibeb Dress
(T01136A8)

[Read More](#)



Special Tibeb Dress
(T02441A2)

[Read More](#)



Netela(N01215A1)

[Read More](#)



alhost/ecc/wp-admin/about.php



[Ethiopian Culture here :](#)

Recent Comments

[Bethlehem Nesibu](#) on [Ethiopian Culture here :](#)

Archives

[June 2016](#)

Categories

[Uncategorized](#)

Meta

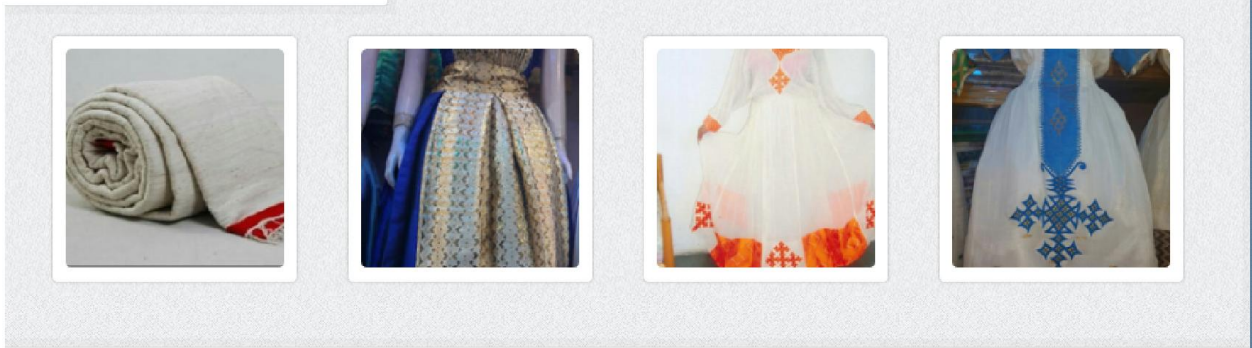
[Site Admin](#)

[Log out](#)

[Entries RSS](#)

[Comments RSS](#)

Featured Products



Recent Products



Casual Tibeb Dress
(T01136A8)

[Read More](#)



Special Tibeb Dress
(T02441A2)

[Read More](#)



Netela(N01215A1)

[Read More](#)



Mulu Gabi

[Read More](#)



special occasion
(T02336A6)

[Read More](#)



Casual Tibeb Dress
(T01446A2)

[Read More](#)



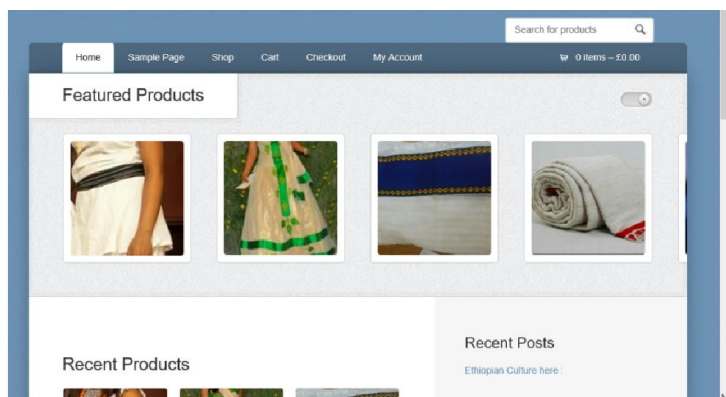
casual Tibeb Dress



Coffee Dress(T01326)

[Read More](#)

[st/ecc/product/casual-tibeb-dress01446a2/](#)
casual Tibeb Dress



Acronyms

SMEs: Small and Micro Enterprises