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## REPORT

The following report was prepared for the Department of Mathematics, Faculty of Science, University of the South Pacific, Suva, Fiji, during the period of the summer holidays, 1982. The work was carried out as part of the research programme in the Department of Mathematics, Faculty of Science, University of the South Pacific, Suva, Fiji, during the period of the summer holidays, 1982. The work was carried out as part of the research programme in the Department of Mathematics, Faculty of Science, University of the South Pacific, Suva, Fiji, during the period of the summer holidays, 1982.

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## **A SURVEY REPORT ON IMPLEMENTATION OF DESIGN FOR ASSEMBLY (DFA) IN MALAYSIAN MANUFACTURING INDUSTRIES**

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### **ABSTRACT**

*DFA is an effective tool to reduce cost, time and improve performance and quality. DFA is widely applied in many industries and in many countries especially in the United States, United Kingdom and Japan. In Malaysia, companies will benefit greatly from this approach, however little is known about the extent of DFA awareness and application in Malaysian industries.*

*This paper reports on the results of a survey carried out as part of an ongoing research at Universiti Teknologi Malaysia (UTM) on the implementation of DFA in Malaysia. The survey was done to determine the level of awareness and implementation of DFA in assembly-related companies.*

### **1.0 INTRODUCTION**

Design For Assembly (DFA) is a set of design guidelines to improve product design for easy and low cost assembly [1, 2]. Hsu and Lin [3] defined it as a method for evaluating product from the viewpoint of assembly and product design.

The main objective of DFA is to ease assembly and reduce costs [2,4,5,6,7,8]. Other objectives are to reduce assembly time [9], and to make it difficult to create errors in the assembly process [8]. An assembly should be easy to assemble without affecting the functionality of the product. Wallace [9] suggested that DFA can also improve product competitiveness in the global market .

## **2.0 BENEFITS OF DFA**

Many researchers have reported on the benefits reaped by companies who implement DFA in their design process. Some of these benefits are listed as below:

- ◆ Ease assembly [7]
- ◆ Eliminate precious time and wasteful errors compared to manual procedures [12],
- ◆ Reduce the number of parts to be assembled [4, 10, 13],
- ◆ Optimize product and process development [4, 10]
- ◆ Shorten lead time [14] and
- ◆ Achieve higher quality [10, 15].

The number of parts to assemble and the ease of assembly can make quite an impact on the total cost of a product. This is because the total cost includes the cost of the parts themselves and the time and cost of purchasing and storing them besides other cost factors and consideration such as, how much the part could upset the assembly and the type of tools and fixtures that need to be used [13].

Thus, DFA is a concept that can contribute to competitiveness in terms of reducing cost and speeding up delivery [16]. However, despite its familiarity in

the rest of the world, for example in Japan, UK and USA [10, 11], little is known or published about its practice in Malaysian industries.

### **3.0 RESEARCH METHODOLOGY**

The aim of this study is to identify the extent of DFA application in Malaysian industries and the nature of problems that companies face in using DFA. For companies who do not use DFA, the survey tries to identify the reasons why this is so. It is also desirable to establish the different types of design practice currently used in industries with a view to relating it with DFA methodology. The questionnaire was mainly targeted at industries that are involved in product assembly.

The questionnaire has been sent to approximately 200 companies in Malaysia. However, about 38 responses were received i.e. a response rate of 19%. Among them, 32 completed the questionnaires and were included in the analysis. 6 responses were either incomplete or found to be not related to the survey and were subsequently rejected.

Questionnaires were sent to and completed by senior personnel in the company such as Managing Directors, R&D Managers, General Managers, Design Engineers and Manufacturing Engineers.

### **4.0 SURVEY FINDING**

The results of the survey will be discussed here. The discussion will be on the different types of practice used and the extent of DFA application.

#### **4.1 Design Practice In Malaysian Companies**

Interviews and discussions during visits to companies and information from questionnaires indicated that there are three types of company alliances. These types are based on who does the design and who does product manufacture or assembly (See Figure 1). Some companies have their own design departments but for those who do not have one, they rely on their clients, external consultants or other companies to provide them with the product design.

It is difficult to ascribe exact percentage figures to each type of companies' alliances because in many situations, companies practice a mixture of design practices. Hence, the results are merely indicative of the trend. Below are the types of company alliances based on the design practices as per the survey:

i) Client – Manufacturer/ Assembly

This alliance usually involves the first party. In this case the client provides the product design and specification while the second party, the manufacturer is required to manufacture and/or assemble the product. Refer Figure 1(i).

ii) Consultant – Manufacturer/ Assembly

In this relationship the manufacturer/assembler provides the consultant with the necessary information and the consultant/s will come up with the product design. This interaction involves a two-way closed-loop communication with the approved product design and specification as the end result. Once this is done, the manufacturer/assembler will produce the product and claim it as its own. Refer Figure 1(ii).

iii) Stand-Alone Company

This actually does not involve any alliance as the companies do their design in-house and assemble the product themselves and do not use an external company to design their product for them. Refer Figure 1(iii).

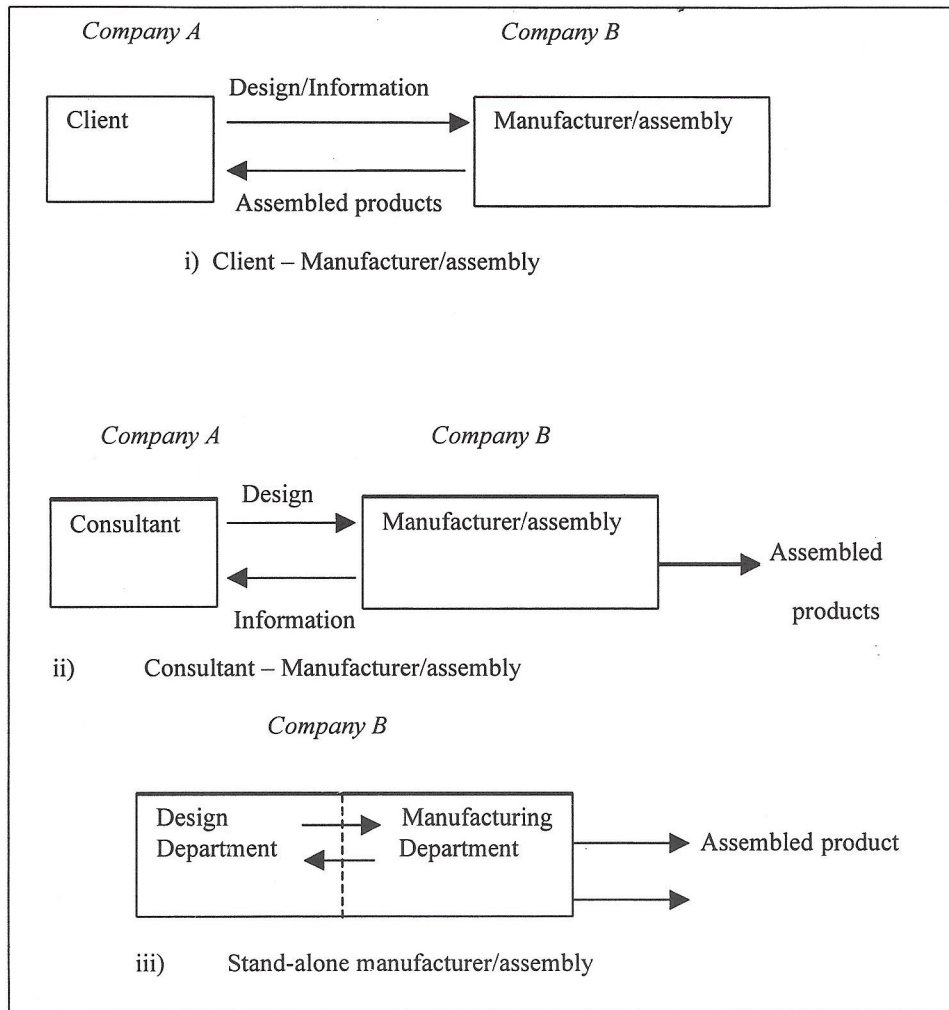


Figure 1 Types of company alliances

A company may also practice a hybrid of these alliances. Figure 2 shows an example of Company R who may do some of its design in-house and manufacture/assembles the main product, but due to some constraints (for example, cost and process capability), the company subcontracts some of its components to another manufacturer (Company S). Company R will provide the product design and specification for that component and Company S will produce it.

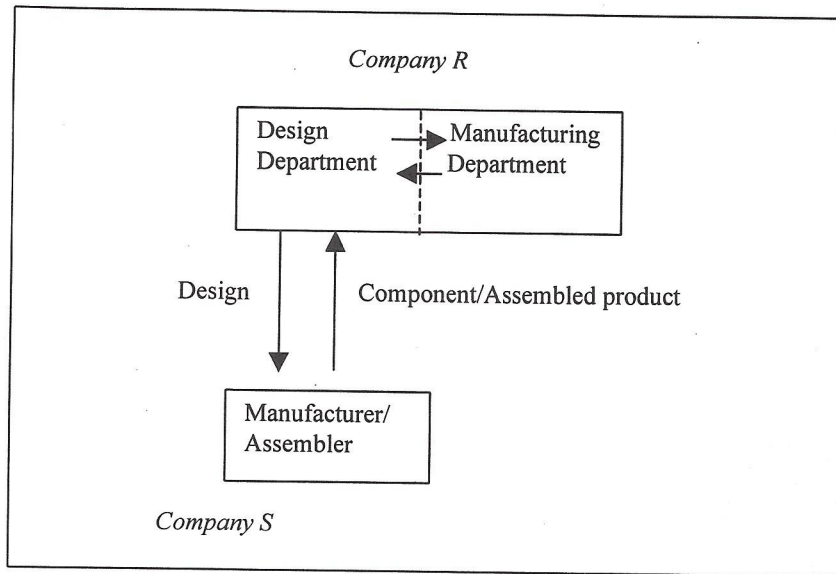


Figure 2 Hybrid alliance (An example)

This is an example of a hybrid between a stand-alone and a client-manufacturer/assembly alliance. The survey found that a majority of companies in Malaysia practice the hybrid type of design practice. There are many possible hybrid combinations that occur in the Malaysian industries.

#### 4.2 Application Of DFA

Companies are grouped into 2 categories; i ) large industries and ii) small & médium size industries (SMIs). This classification is done according to the number of employees, annual sales turnover and shareholders' fund. Out of 32 companies that responded, 4 did not answer the questions relating to company size. We assume that these respondents do not have the information and / or were not sure as to which category they belong to. Figure 1 shows the involvement of respondent companies in design activities and the application of DFA in every category.

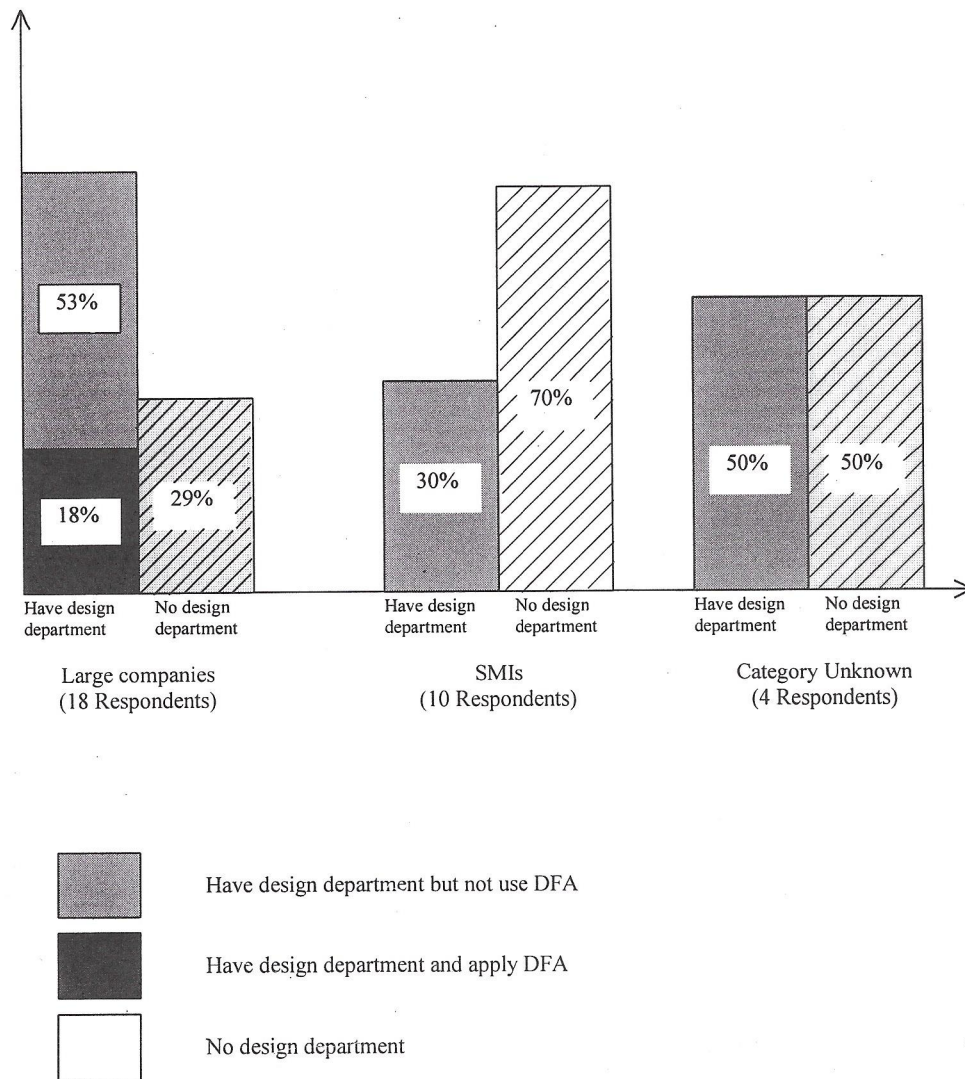


Figure 3 Involvement In Design Activities and Application Of DFA

There are two possible ways to categorize the companies:

- i) by design practice.
- ii) by classification of companies (SMIs or large companies).

The survey shows that a significant number of large companies (71%) have their own design departments compared to only 30% of SMIs . These large



companies have the flexibility of designing and manufacturing their own range of products and that of their clients' and/or acting as design consultants. For example, a client may provide information or partial product design specifications to these companies who will then come up with the completed product design. On approval by the client, the product can then be manufactured or assembled. This is another form of hybrid alliance .

Such flexibility will give an added edge to their competitiveness. These companies will benefit more if they could improve the quality of their product design through the deployment of DFA. Unfortunately only 18% of large companies with design departments actually use DFA whereas none of the SMIs deploy it.

Companies without a design department rely on clients and consultants to provide them with the product design. For example, a client may provide a complete product design and the company needs only to manufacture or assemble the product. Another case may be where a client may give just design information or partial design specification to the company and the company will seek a consultant (which may be another manufacturing company with its own design department) to assist in producing the completed product design.

The quality of the product design used by this company is dependent on the capability of the client and/or consultant. The quality of the product design in terms of ease of assembly and manufacturability may affect the total product cost. Thus, the company has no total control over this factor since the design is done somewhere else. Although some communication and coordination may exist between client-manufacturer-consultant, a high level of effort, time and cost is incurred in such a project.

#### **4.2.1 DFA Awareness**

The degree of DFA awareness can be assessed through the answers given when companies, which did not implement DFA, were asked why they did not do so.

The reasons are as follows:

- ◆ Not sure of its benefit (39%)
- ◆ Have never heard of DFA (26%)
- ◆ Do not understand DFA (26%)
- ◆ Concern about its risks and cost (13%)
- ◆ Felt that there was no need for DFA (8%)

\*(Percentages do not add up to 100%.as companies were allowed to give more than one answer).

More than a quarter of respondents (26%) has never even heard of DFA. This may be because DFA is a relatively new technique amidst other more popular techniques like JIT, TQM and MRP. This however seems to reflect on the need of a mechanism to disseminate knowledge and information important to the improvement of Malaysian industries.

Of those who have heard of DFA but did not implement it, the reasons given again reflect the need to inform industries on DFA and its benefits. Some are concerned about the risk and cost of implementing DFA in their product development process. A small percentage felt that they do not need DFA, perhaps an indication on the degree of ignorance.

However when asked about the benefits of DFA that might interest them, the results are as follows:

- ◆ Reduce lead time (74%)
- ◆ Improve company's competitiveness (70%)
- ◆ Reduce total cost (61%)
- ◆ Increase sales (61%)
- ◆ Improve teamwork (61%)

\*(Percentages do not add up to 100% as companies were allowed to give more than one answer).

Reduction of lead times ranks the highest, followed by improvement in company's competitiveness, reduction of total cost, increase in sales and finally improve teamwork. This indicates that should these companies be given more information on DFA, its benefits and assistance in implementing it, it is highly likely that they would consider implementing it.

#### ***4.2.2 Types Of DFA Practitioners***

The companies that applied DFA in this survey are involved in the assembly of electronic devices and electric goods, electronic medical devices and communication devices.

#### ***4.2.3 DFA Tools Employed***

The DFA method used is either well- known methods or in- house methods:

Method used	Respondents
◆ Hitachi Method.	1
◆ In House method	1
◆ DFMA method	1

#### ***4.2.4 Benefits claimed by using DFA***

These companies that responded claimed that they obtained the following benefits:

- ◆ Reduced lead time
- ◆ Reduced assembly time
- ◆ Reduced number of parts to assemble
- ◆ Help improve competitiveness
- ◆ Increased sales
- ◆ Improved teamwork

The problems that they experienced with DFA are;

- ◆ Lack of DFA specialists to operate the system
- ◆ The high cost of implementing DFA

Thus, companies who did implement DFA in their product development process had confirmed the reported benefits of using DFA such as reduction in lead-time, reduction in total production/assembly time and reduction in the number of assembled parts. These benefits will lead to a reduction in total product cost. Other benefits include improvement in competitiveness, increased in sales and improved teamwork. Companies who do not implement DFA are also interested in these benefits.

#### ***4.2.5 Problems in Implementing DFA***

Nonetheless, companies who do use DFA and reap its benefits report that they still face problems. These are identified as the lack of specialist to refer to and the cost incurred in implementing DFA, for example, training costs, hardware and software costs. Perhaps a user support group could be set-up among companies using DFA, so that experiences may be shared to assist others keen on using this technique. Research institutions can also play a role in solving problems related to the implementation of DFA.

#### ***4.2.6 Need For A Framework***

Based on the findings, a guideline or framework to facilitate companies especially SMIs in implementing DFA would be a very useful in assisting companies dealing with the implementation of DFA and the teething problems that follow. Such a collaboration would not only create DFA awareness among assembly related companies but also encourage the deployment of DFA.

The framework for implementing DFA is already available [15, 16, 17, 18] but all are designed for large companies. A framework developed for SMIs has been reported in the literature designed for the Hong Kong environment [12] which may not be suitable for companies that have hybrid alliances such as in Malaysia. These alliances will involve a complex flow of design information and requirements not addressed by these frameworks. Thus for Malaysian industries, another framework should be made available to take into account these factors.

## **5.0 CONCLUSION**

Although DFA has been successfully applied in Japan, Europe and the USA, this survey has shown that only a small percentage of assembly related companies in Malaysia actually uses DFA. Finding from this survey showed that there is a low implementation of DFA in Malaysian manufacturing companies. The usage is not widespread both in large industries and especially in SMIs. Potential benefits are there but majority of them is not even aware of this method.

Many models of design practice were uncovered by the survey. Generally, almost half of respondents (67%) have design department but a very small percentage actually implements DFA. Therefore, it is a high potential for DFA to be implemented in assembly industries.

The reason why some respondents do not implement DFA is probably due to ignorance and lack of information about DFA. But companies are interested in the benefits that DFA may provide such as lead-time reduction and improvement in company's competitiveness.

All companies who implemented DFA managed to benefit from this implementation. However, problems identified in the implementation of DFA are more due to lack of DFA specialist and the cost involved in implementing it.

A framework for DFA implementation should be built to assist and encourage companies in implementing DFA. This framework should be designed

specifically for Malaysian industries and take into account the different design practices and alliances that exist between manufacturers, designers and clients in Malaysian industry.

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## **APPENDIX**

### **A PART OF RESULTS FROM THE SURVEY (PERCENTAGES)**

#### **A Companies that apply DFA**

##### **1. The benefits when companies implement DFA:**

- ◆ Reduced lead time
- ◆ Reduced assembly time
- ◆ Reduced number of parts to assemble
- ◆ Help improve competitiveness
- ◆ Increased sales
- ◆ Improved teamwork

##### **2. Problems they experienced with DFA are;**

- ◆ Lack of DFA specialist
- ◆ The cost of implementing DFA

#### **B. Companies that do not apply DFA**

##### **The reasons for not using DFA:**

- ◆ Not sure of its benefit (39%)
- ◆ Have never heard of DFA (26%)
- ◆ Do not understand DFA (26%)
- ◆ Concern about its risks and cost (13%)
- ◆ Felt no need for DFA (8%)

(Percentages do not add up to 100% as companies were allowed to give more than one answers.)



2. The benefits interest to companies:

- ◆ Reduce lead time (74%)
- ◆ Improve company's competitiveness (70%)
- ◆ Reduce total cost (61%)
- ◆ Increase sales (61%)
- ◆ Improve teamwork (61%)

(Percentages do not add up to 100% as companies were allowed to give more than one answer).

