

**Stingray Auxiliary Power Unit: Implementation and
benchmarking of Enterprise resource planning**

by

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1 Executive summary

The more information is integrated in a company the better communication is within the company. Enterprise Resource Planning (ERP) can achieve the goal of information integration within a company if the ERP package is suited for the company.

This project looks at the steps that were followed to ensure the ERP package is suited for SME as well as the specific steps for implementation of the ERP package.



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4 List of abbreviations

APU : Auxiliary Power Unit
 ACU : Air Conditioning Unit
 SME : Specialist Mechanical Engineering
 ERP : Enterprise Resource Planning
 P.O : Purchase Order
 Pr.O : Production Order

5 Introduction and background of the company

5.1 The company

SME is a South African mechanical engineering company specialising in industrial and military HVAC (Heating Ventilation and Air Conditioning) systems. The company was established in 1991.

Their main manufacturing, R&D facility and offices are based in Gauteng, South Africa. They also have a service branch in Richards Bay on the North- East coast of South Africa. A joint venture company was established in 2001 in the Middle East. This will enable SME to expand market and support new products in the GCC countries.



Figure 1 : SME Building

5.2 Previous projects

Previous projects done by SME are:

- BMP3 Tank with 22kW Auxiliary Power Unit & 12kW Air Conditioning Unit
- 20kW Auxiliary power unit (APU) and 12kW Air-conditioning unit for M109 TANK
- 20kW Auxiliary power unit (APU) and 12kW Conditioning unit for G6 Howitzer
- Roofmount Aircons 6-8kW Diesel locomotive air-conditioner
- 6-8kW Electric locomotive air-conditioner 7E & 9E Configurations



Figure 2 : M109 Tank



Figure 3 : M109 Tank with APU & ACU indicated

6 Introduction and background of the project

SME received a contract to design and manufacture the APU of the Stingray rocket system. This is a truck fitted with multiple rocket launching clusters.

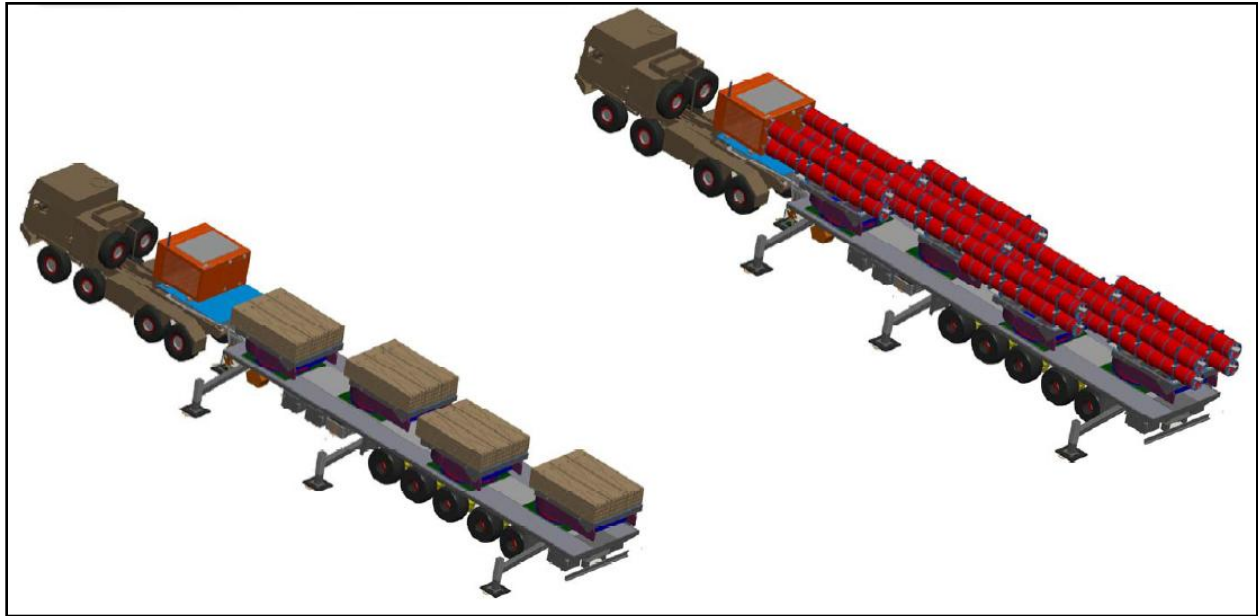


Figure 4 : Animation of Stingray rocket system

The design of the APU was approved by the contractor and manufacturing could commence. During the prototype manufacturing stage an inherent need for better communication arose. It was realized, even more than before, that the communication between departments could be improved. This resulted in a need to find a solution to better the communication between departments. To put it more correctly, SME developed a need for better information integration.

6.1 Problem statement

The problem statement will be discussed around the following diagram.

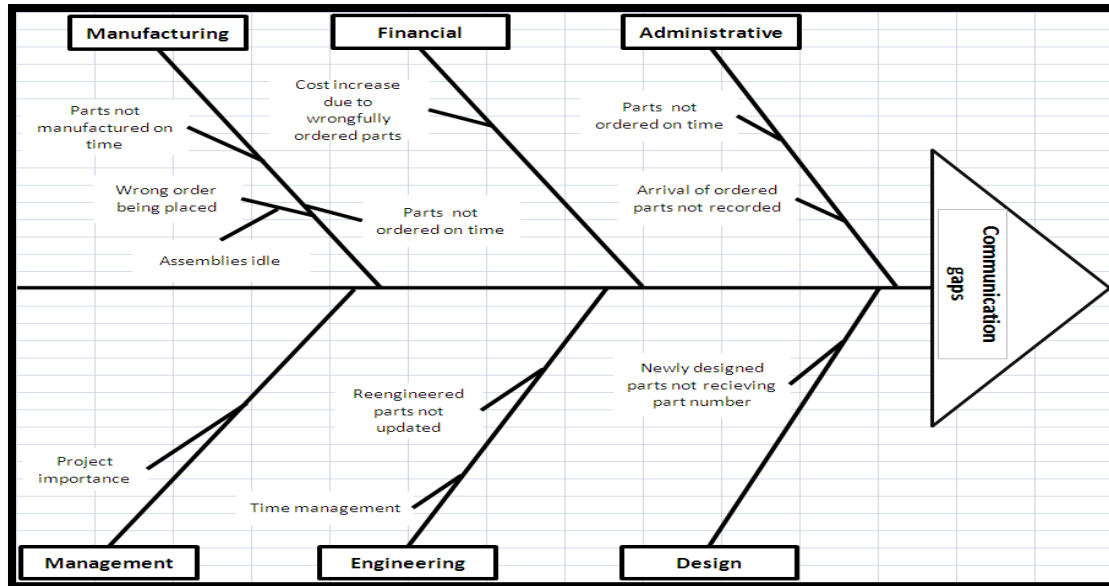


Figure 5 : Fishbone diagram (customized)

Figure 5 show a customized fishbone diagram. Unlike usual fishbone diagrams this fishbone diagram's "fish head" is the cause and the "fish bones" are the effects in each department of SME. The diagram evolved out of several "ordinary" fishbone diagrams which all had one cause in common. The common cause was identified as: Communication gaps. Therefore the customized Fishbone diagram came into existence. All of the effects listed in the diagram are caused by one element. Some of the effects are listed below in greater detail:

- Parts are not ordered on time.
- Parts are not manufactured on time
- Parts are ordered/manufactured when lower level parts have not yet been ordered which causes the first mentioned parts to go to stock. This means that SME pays for parts which are not used immediately.
- Productivity decrease since certain assemblies are idle because of late ordered/manufacturing parts



- Costs increase due to stock increase and penalties paid for behind schedule activities.

As the project progressed and certain milestones were reached it was evident that communication gaps is the root of all problems. Therefore the problem statement is defined as lack of information integration.



7 Project aim

The main objective is to improve productivity in the company as a whole. This can be done in one of the following two steps:

1. Improvement in one department at a time starting with the department with the most effects (as defined Figure 5).
2. Improvement of the whole company by improving information integration in each department simultaneously.

The key point to realise at this stage is not that SME is operating in total chaos but rather that SME can operate with greater integrated information. To put this simply, SME can better its communication between departments.



8 . Project scope

The scope of the project will be divided into two sections namely:

- Milestone blockage.
- Final project scope.

8.1 Milestone blockage

The first option in section 4 was chosen, but reaching a certain milestone it became clear that the second option was the only option. This will be explained in greater detail below.

The original scope was defined as follows:

Every part ordered has a different arrival lead time. It is assumed that each part's supplier is the optimal supplier since it is not required in this project to determine the best supplier.

The goals for this project are:

1. In depth analysis of process
2. Establishing of manufacturing- and order lead times
3. Construction of Bill of Materials
4. Scheduling of ordered and manufactured parts with the use of MRP (Material Requirement Planning)

There are a large number of parts that forms the APU assembly. These parts are either manufactured by SME or ordered from suppliers. The parts then form part of various sub-assemblies which in turn is assembled as the APU. It is of utmost importance that each part is either manufactured or ordered at the correct time to ensure a steady flow of assembly of the final product (the APU).

8.1.1 The blockage

There were two major problems that prevented SME to reach goal 4 which started at goal 2 and -3 mentioned in section 5.1.



The problems are:

1. The lead time for each part varies every time it's ordered and to construct an MRP, fixed lead times is of utmost importance.
2. The construction of the bill of materials showed that there are over 2000 parts to be incorporated into the MRP.

These problems showed that to complete a MRP manually will take exceptionally long; therefore it was decided to do it with the help of software.

8.1.2 The final project scope

Given the above mentioned problems and conclusions it was seen fit to purchase and implement ERP software.

The scope is therefore defined as:

- In depth business analysis to assure an ERP is suited for SME.
- In depth analysis of an ERP system (how it operates).
- Research of what is available in the market.
- Implementation of the ERP software either by phasing it in or by implementing as a whole.

9 Literature review

The literature review is done as part of information gathering or data gathering phase and a total of 15 articles and textbooks will be researched. The gathered data will then be analyzed and is used in the problem solving phase. The literature review is necessary for better understanding of the process/system linked to the ERP. In other words it is needed, to understand how an ERP operate, what is needed for successful operation of an ERP ect. To get this understanding the following analysis technique were used.

The literature review is done on ERP system and -software and is done with the proper operation analysis approach. This is accomplished by asking several questions. (Niebel B, 2004)The questions should be asked with the following key words:

- Why (Most important question and should be started with) (Niebel B, 2004)
- Where
- When
- How
- Who

When these questions are answered the operation can be simplified, combined or can even be eliminated. (Niebel B, 2004)

Using the above mentioned question key words the following aspects where looked at in the literature review:

1. History of the ERP
2. Statistics of ERP
3. Key factors for software selection
4. Key factors for consideration of implementation

9.1 History of the ERP

The history of the ERP reach as far back as the 1960's and carries through till the recent day. Below is a table which gives a brief over sight of the evolving of the ERP.



The 1960's	The largest driving factor for competition was cost. Therefore a lot of effort was put into development of computerized reorder point systems. Material requirements planning (MRP) came into existence. This was the new "state-of-the-art" way of planning and scheduling materials that was required within a manufacturing environment.
The 1970's	The early software of MRP was big and clumsy and because the driving factor for competition became marketing a need for MRP software that is more sophisticated arose. Major software companies were founded that still features in the present day.
The 1980's	The largest driving factor became Quality as new initiatives were presented, by companies and well known "founders" of the quality aspect like: Deming, Ishikawa and many others, the need for new software arose. The MRP II was developed to compensate these new initiatives.
The 1990's	ERP systems were created after a need for better information integration occurred.
The 2000's	Consolidation of software vendors assured better ERP systems that could compliment each vendor's shortfalls.

Table 1 : History of ERP

The table above is a summary of (Jacobs F, 2007)

9.2 Statistics of ERP

The following statistics must be considered before purchase or implementation of an ERP.

1. 90% of companies did not implement successfully on their first attempt. (Sun A.Y.T, 2005)
2. 90% of ERP implementations is finished late or not within the specified budget according to Standish Group research. (Umble E.J, 2003) (Al-Masari M, 2003)
3. Companies can spend three times as much on consultants (implementation) than on the actual ERP software itself. (Al-Masari M, 2003)
4. There is an 80% chance of implementation success if 10-15% of the budget is spent on training. (Umble E.J, 2003)



5. 77% of failures are because of poor planning or poor management. (Umble E.J, 2003)
6. 75% of failures is because the changing of business goals during the project. (Umble E.J, 2003)
7. 73% of failures are because of the lack of support from management. (Umble E.J, 2003)
8. In a study over 80% of ERP users came from the manufacturing sector. (Ehie I.C, 2005)

The following statistics seems to be inconsistent and can have a negative effect if it is interpreted wrong. The explanation, analysis and conclusions of the above mentioned statistics will be discussed at a later stage in this document.

9.3 Key factors for software selection

During the literature study of software selection it was found that there are a lot of different approaches for the selection of software. The different approaches were analyzed, although there were a lot of similarities, there were also differences. Therefore a combination of these approaches was needed.

A combination of these approaches was found and best described by Karzak and Ozogul. (Karzak E.E, 2009)The description follows:

- *Total cost of ownership* – This include cost for implementing, software and hardware purchases, training etc.
- *Functional fit of the ERP system* – This includes the amount of extra development or customization needed to fit the ERP to the business.
- *User friendliness* – Speaks for itself
- *Flexibility* – This not only includes the flexibility to integrate other software packages ass well but also the flexibility to adapt it to the business process.
- *Vendor's Reputation* – Speaks for itself.
- *Service and support quality* – Speaks for itself.



Software selection is a very important part of ERP implementation therefore the decision should not be rushed.

9.4 Key factors for implementation

Establishing of critical success factors gained from articles [(Ehie I.C, 2005), (Umble E.J, 2003), (Al-Masari M, 2003), (Abdinnour-Helm S, 2003) (Chang M, 2008) (Chase R.B) (Chou S, 2009) (Mabert V.A, 2006)] and self developed factors.

The following figure was chosen to represent the implementation process that SME can follow. This figure was chosen because it is the closest to SME needed implementation model.

The figure below is taken directly from: (Ehie I.C, 2005)

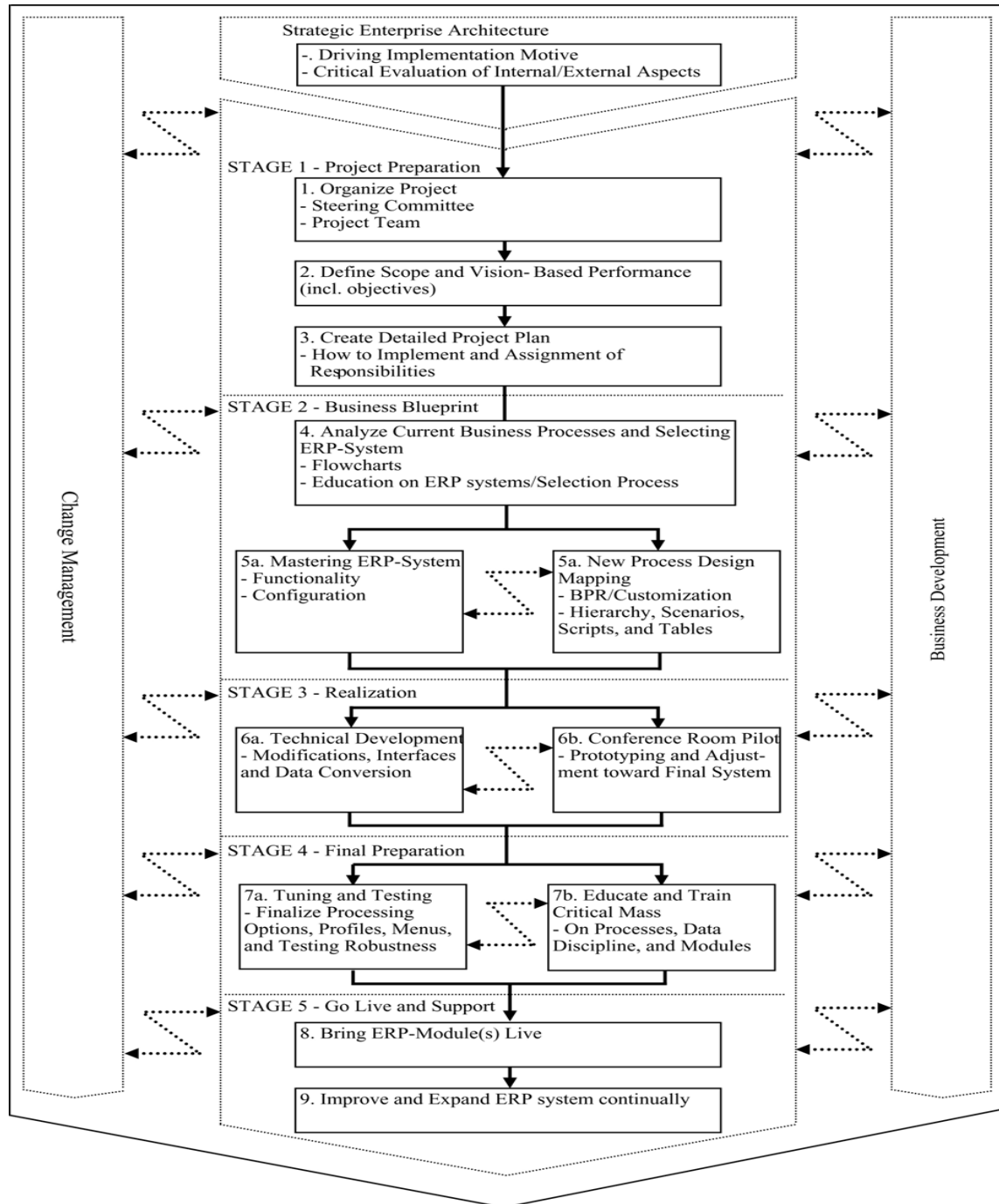


Figure 6 : Implementation process for ERP software



10 Literature review analysis

The data analysis is actually the analysis of the findings in the literature review. Each subsection of section 6 was analysed and the conclusions are given below.

10.1 ERP history

This showed which vendor of ERP had the most success and may be considered when buying ERP software.

10.2 Statistics of ERP

After careful analysis of the statistics it was realized that implementation of ERP cannot be taken lightly. Although the statistics was sometimes contradicting it was of good value to realize the urgency for a well developed action plan. The statistics may be contradicting because of different samples, research setting and even because of different cultures. Nevertheless these statistics created an awareness of what can happen when insufficient planning is done.

10.3 Software selection

This is a very important phase and should be planned thoroughly. The software one purchase may be the reason why implementation can fail.

A drastic change in approach arose when it was discovered that SME already purchased ERP software.

10.4 Key factors for implementation

The process for implementation mentioned in section 6.4 will change drastically after above mentioned change happened. Therefore figure 6 will be totally revised.



11 Problem solving

It was decided to benchmark SME's current business process with the ERP software. This should be done to ensure that SME will actually receive benefits if the ERP software is implemented.

The benchmarking process consisted out of three main steps namely:

1. Analysis of SME's business process
2. Analysis of Cgram's business process
3. Comparing above mentioned analysis

12 The software package

The software package purchased by SME is CGram and the following is taken directly from CGram's website to introduce the software:

CGram's award winning total business management software offers what we think is just the Best Value available on the market today. Soar above it all with our new range of Powerful, Flexible and Affordable solutions that are clever enough to connect everything you do ... and we mean everything !

CGram Enterprise includes Accounts, Full UK Payroll, Sales, Purchasing, Distribution, Stock, Production, Integrated Reporting, Cost Management and CRM to name but a few areas.

- It connects everything and everyone in your company e.g. Sales with Accounts & Stock with Production.
- It's flexible enough to really change & grow with your Process - so it always fits what you do.
- It is affordable. Buy one package, not 3, 4 or more...and add as many users as you like.



13 Data analysis

Each business process was analysed by using the same operation analysis approach stated in section 6. It was decided that Systems engineering's "top-down" approach would be used to analyse certain sections of the business. This means that instead of looking at the business/package as a whole, certain key sectors within the business was studied.

Since most problems occurred when orders were placed, the first key sector that was focused on was Purchase orders. This will also be the only sector that is discussed in detail since it will be too timely to discuss each sector in the same detail.

14 Purchase Orders

The following points will be discussed when looking at the purchase Orders:

1. The current process used by SME for Purchase Orders.
2. The Purchase Order process in CGram.
3. The Advantages and Disadvantages of the Purchase Order process in CGram.

14.1 The current process used by SME for Purchase Orders

Time was spent on asking questions to assure that a good idea was gained of how SME operates. There was also time spend on standing back to observe departments. This was done to assure that the answers gained and the actions of employees coincide. See Appendix A for the flowchart.

The following flowchart describes the present process used for purchase orders by SME.

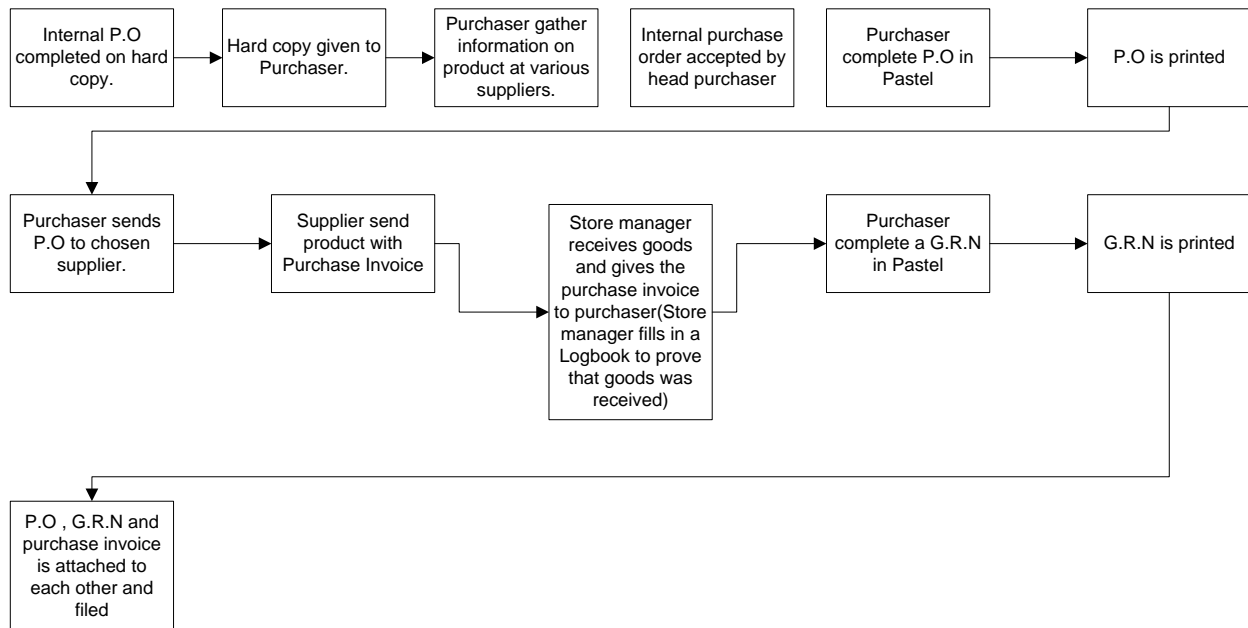


Figure 7 : Flowchart of current P.O process



14.2 The Purchase Order system in CGram

Time was spent on studying the ERP software. Purchase orders were studied and when fields were discovered that should be gained from other sections in Cgram these sections were studied at that given time. After reasonable knowledge was gained of each section, a test run was done with a dummy project. The diagrams that were created for the Cgram sections are shown in Appendix B.

Like any Purchase Order (P.O) the P.O in CGram is used to buy products or stock from suppliers. To explain how the P.O works in Cgram, the following must be looked at:

1. The Mandatory- and Optional fields of the Purchase order
2. What each field mean
3. Why it is needed

14.2.1 Mandatory fields and optional fields of the Purchase order.

Mandatory fields (Cgam) are the fields needed to successfully complete and save a P.O. Mandatory fields (SME) are the fields needed to successfully complete a P.O that will be useful for SME. Optional fields should only be filled if it is needed in a given situation.

Mandatory fields (Cgram)	Mandatory fields (SME)	Optional fields
Purchase order (Auto)	Purchase Order (Auto)	Currency
Supplier	Order Date	Remarks
Price	Supplier	Deliver to supplier
	Buyer	Delivery name
	Buyer reference	Delivery address
	Supplier reference	Delivery postcode
	Delivery point	
	Terms	
	Part number	
	Quantity	
	Price	
	Project and Phase	
	Item description	

Table 2 : Table of mandatory and optional fields for P.O's

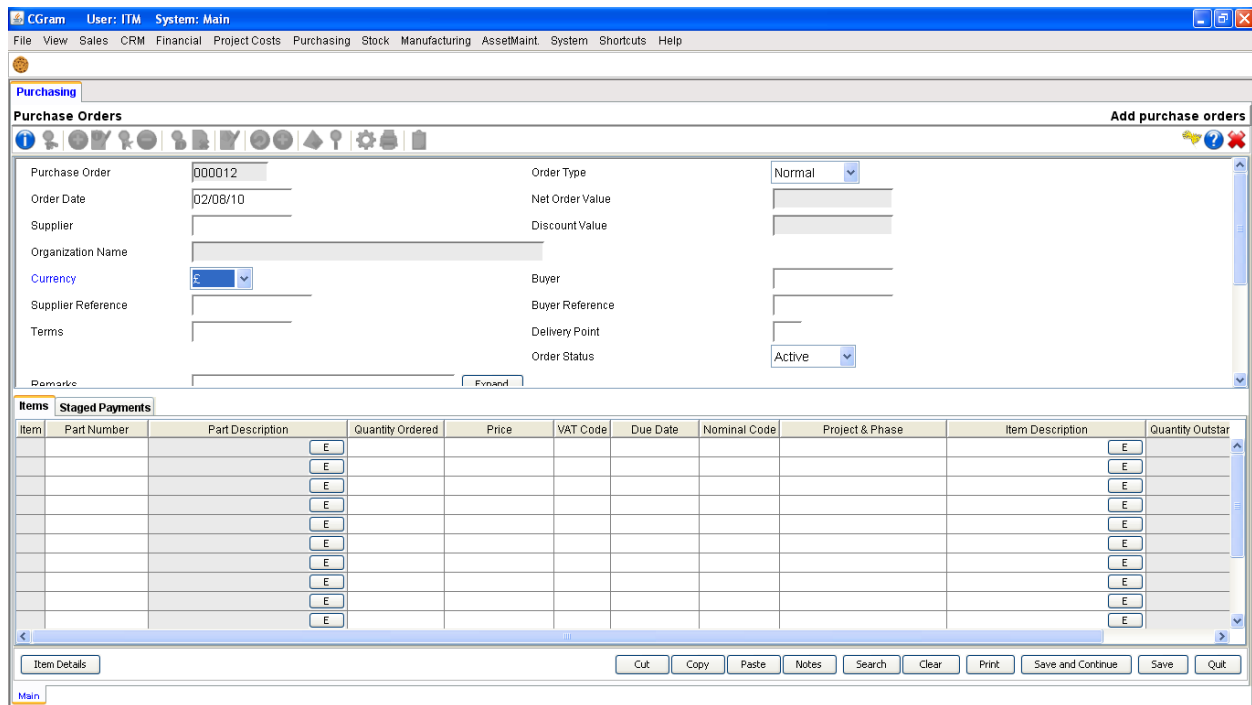


Figure 8 : Screenshot of P.O in CGram



14.2.2 The meaning of each field in Cgram

Field name	Definition
Purchase Order (Auto)	A unique number automatically assigned to each P.O by Cgram.
Order Date	The date the P.O is created.
Supplier	A unique code assigned by the user to a specific supplier when this supplier was added in the Purchasing/CRM section of Cgram.
Organization Name	The name of the supplying company. This field is automatically filled when above mentioned field is entered.
Currency	Currency of company
Supplier reference	This field can be used to enter the person's name who accepted the P.O at the suppliers end.
Buyer	A unique code given to the person using Cgram (The Username)
Buyer reference	The person's name who requested the purchase/ The person's name who created the P.O
Delivery point	Where the goods must be delivered. A code is created by the user.
Terms	The terms of payment
Order status	This field is a drop down box where the user can choose between: Active, Cancelled and Reserved.
Part number	A unique code specified by the user when part was added in the Stock section of Cgram.
Part description	A description of the part. This field is automatically filled with the description given when the part was added in the Stock section of Cgram.
Quantity	The quantity of the part that needs to be ordered.
Price	The price agreed to by the supplier for a single unit of the part.
Project and Phase	The project that the part is ordered against as well as the phase.
Item description	A description of the part ordered. This is a secondary description of the part that can be used when the Part description is to general.
Remarks	An open text field for any remarks or notes.
Deliver to supplier	A unique code assigned by the user to a specific supplier when this supplier was added in the Purchasing/CRM section of Cgram. This field is filled when a part must first be delivered to a secondary supplier for further work.



Delivery name	The name of the above mentioned supplier. This field is automatically filled when the Deliver to supplier field is entered.
Delivery address	Address of secondary supplier. This field is automatically filled.
Delivery postcode	The postal code of the secondary supplier. This field is automatically filled.

Table 3 : Table of field definitions

14.2.3 The necessity of the mandatory (SME) fields.

<u>Mandatory (SME) field</u>	<u>Necessity</u>
Purchase Order (Auto)	Each P.O needs a P.O number
Order Date	It is needed to know when each P.O was created
Supplier	The unique code can be tracked in other areas of CGram. It is also needed to load supplier information automatically.
Buyer	The unique code can be tracked in other areas of Cgram. Also indicates who created the P.O
Buyer reference	Indicates who requested the P.O
Supplier reference	Indicates who was spoken to at the suppliers end or under whose attention the P.O must comes on the suppliers end.
Delivery point	Indicates where order must be delivered in SME
Terms	How payment will commence.
Part number	Each part purchase must have a part number for tracking purposes.
Quantity	Needed to calculate the net price for the P.O. Also needed by the supplier for ordering purposes.
Price	Needed for the calculation of the net price of the P.O. It is also the price that was agreed on by the supplier.
Project and Phase	Needed to allocate purchasing costs against a certain project and phase.
Item description	Needed when the part description is general and it needs to be clearer

Table 4 : Table of field necessities



14.3 The Advantages & Disadvantages of the P.O process in CGram

There are three key advantages of the Cgram Purchase order system namely:

- **Purchase costs:** The purchase costs of is allocated against the specified project and phase which enables SME to keep track of how much is spend on purchasing in every single phase and in the project as a whole.
- **Purchase information:** Each part's supplier and price history can be reported. This will make the task of finding best supplier for each part allot easier for the purchaser.
- **Report hardcopy layout:** The layout of the purchase order and any other report that needs to be printed is fully customizable.

The disadvantages of the CGram Purchase order system:

- Purchase orders can only be created with products that are already uploaded in the stock section. This implies that if the situation occurs were a P.O needs to be created for entirely new product, this product must first be uploaded onto the database.

The above mentioned problem can be solved by creating a product with a general product name, for example consumables, and specify which product is being purchased by describing the item in the item description box.



15 Evaluation

Listed below is the findings gained from the benchmarking process in other sectors of SME.

15.1 Project costs

The project costs can easily be traced with CGram since all costs obtained can be allocated to the project. This means that all P.Os, Pr.Os, employee and asset costs can be linked to the specific project. The current process used by SME also does this but with far more difficulty and time consumption. It is also not easily accessible. Cgram offers the option of ease of accessibility but still keeps it inaccessible for all employees.

This means that with CGram, Directors/Project managers or whoever the user wants to specify, can easily access and analyse the project costs. Therefore the user can see precisely at what phase the project is, how far it is from finished for that phase, how much each department has cost the company to the present and how it correlates with the project budget.

15.2 Parts addition

Adding parts on the database also has numerous advantages. Drawing files or even JPEG pictures can be added to a part which means that everyone can see how a part should look when one is in doubt. If the drawing file is too big or the user doesn't want a picture on the database, for what so ever the reason may be, CGram offers the option of adding a drawing number so that a hardcopy of the drawing can be easily traced.

When parts are added it is also very easy to create a bill of materials. Simply clicking on the required fields will create the BOM to the desired level of the user. This BOM can also be linked to a project for future use.

15.3 Production orders

Production orders can be allocated to a specific project, electronically given or even be scheduled. None of these options is supported by the current process.



15.4 Purchase/Supplier invoices

Purchase/supplier invoices can be captured and validated against Goods Received Notes. This is also not supported by the current process used by SME.

15.5 Timesheets

Timesheets can be completed with ease by each employee daily. This assures that project leaders or project managers can see how much each employee worked on the specific project on a daily bases. The current process used by SME gives employee timesheets to complete by hand on hardcopy on a weekly base. These hardcopies are then collected and captured by a single person once a week. The costs are then allocated manually against specific projects.



16 Conclusion from evaluation

The above mentioned sectors are only a few of the endless list of improvements CGram offers.

The results of the benchmarking step were delivered to SME. SME almost immediately decided to implement CGram. The implementation process will be discussed in the next chapter.

17 Implementation

It was decided to divide the implementation process in to several stages given by the figure below. Currently SME is busy with stage 4; the completed stages will be described in brief.

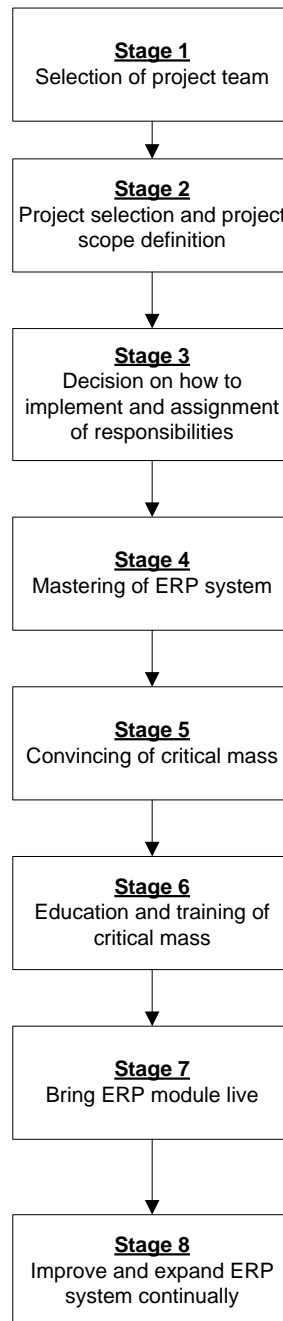


Figure 9 : Implementation stages for the CGram ERP system



17.1 Stage 1

The project team selected consist out of a Director, Head purchaser, Chief designer, Mechanical engineer, Bookkeeper, ERP analyst, workshop manager and specific employees in the workshop.

17.2 Stage 2

The project identified to use for implementation is a sub-project of the greater Stingray project. The scope is defined as certain sectors of Cgram to be used. These sectors are: Purchasing, Production, Timesheets (Payroll) and Parts addition.

17.3 Stage 3

It was decided to implement the system by using the first project as a learning “prototype” and then improving on the use of the system with each following project. The assignment of responsibilities is as follows:

Team member	Responsibilities
Director	Project creation and analysis
Head purchaser	Purchase order, Goods received notes ect.
Chief designer	Parts addition
Mechanical engineer	Parts addition and managing of sectors
Bookkeeper	Timesheets (payroll) and user creation and validation
ERP analyst	“De-bugging” and ERP system mastering
Workshop manager	Production orders and schedules

Table 5 : Team member responsibilities



18 Conclusion

Implementing the ERP software (CGram) will greatly improve information integration within the whole of SME. The flexibility of CGram ensures that not every single sector within CGram have to be used. This is especially advantages for SME since not all sectors are needed but also because it was decided to implement CGram by “phasing it in”.

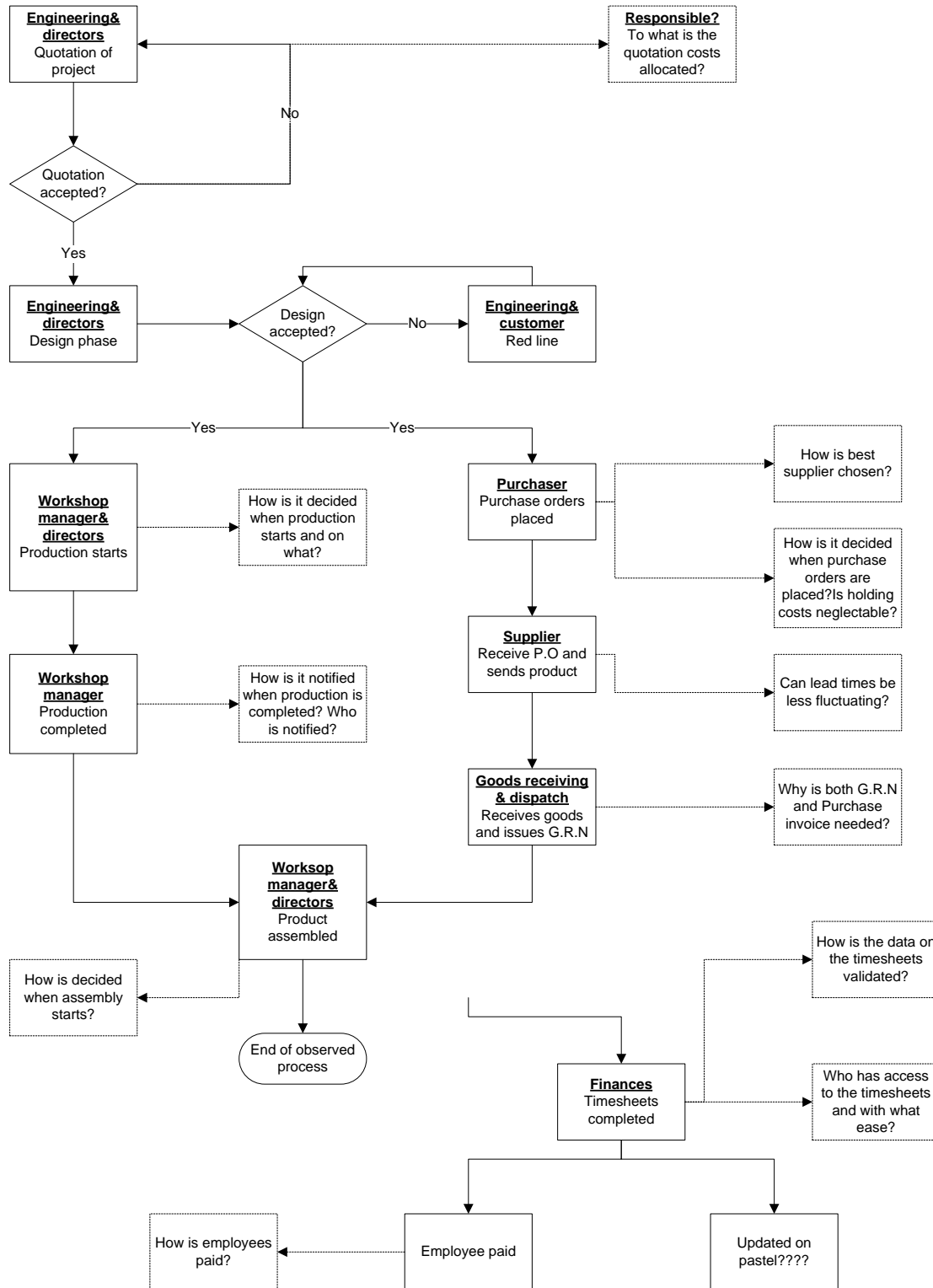
Some of the improvements and/or advantages already noted are listed below:

- Improved communication via internal messenger system and centralized data. Employees can communicate with CGram’s internal messenger system, this reduce time spend on walking between offices and time spend on internal phone calls.
- The hardcopy of the purchase order is fully customizable. This allows that SME is not bound to a certain layout but can adjust the layout to meet SME’s specific document format needs.
- The history of each product can be easily accessed. This allows the purchaser can see how much a specific product cost at all the suppliers; the purchaser can then decide which supplier will supply the product. This reduces time spend on researching at which supplier the product is the cheapest.
- History of each supplier easily accessible.
- Purchase order can be faxed and/or emailed directly without printing a hardcopy.
- Project costs can be tracked to the finest detail. With this function it is easy to see how much is spend on a certain phase; how much was spend on production, purchasing and even general employee costs.
- Better time management. A certain amount of time can be allocated to each individual/department before a project is started. This prevents employees from allocating hours to projects they didn’t really work on.
- Actual project costs can be evaluated against budgeted costs on a daily bases.
- All emails regarding a specific project can be automatically captured.
- Time sheets can be completed electronically. This reduces time spend on capturing time sheets completed by employees on hardcopy.

The improvements and/or advantages listed above are only a few that CGram offers. If implementation is done correctly and each employee is dedicated to the use and understanding of the software the improvements can greatly exceed SME’s expectations.



19 Appendix A





20 Appendix B

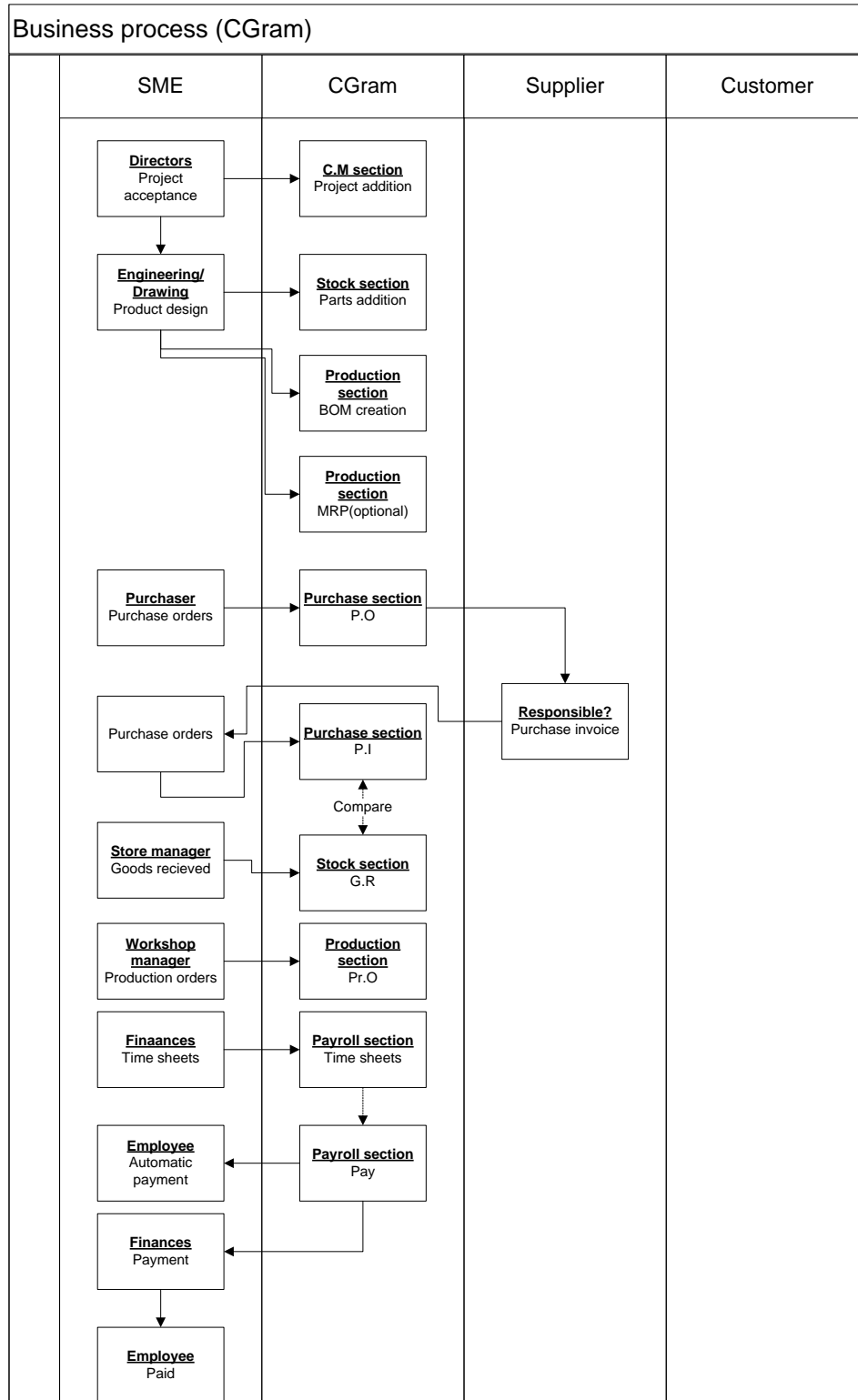


Figure 10 : Business process with Cgam

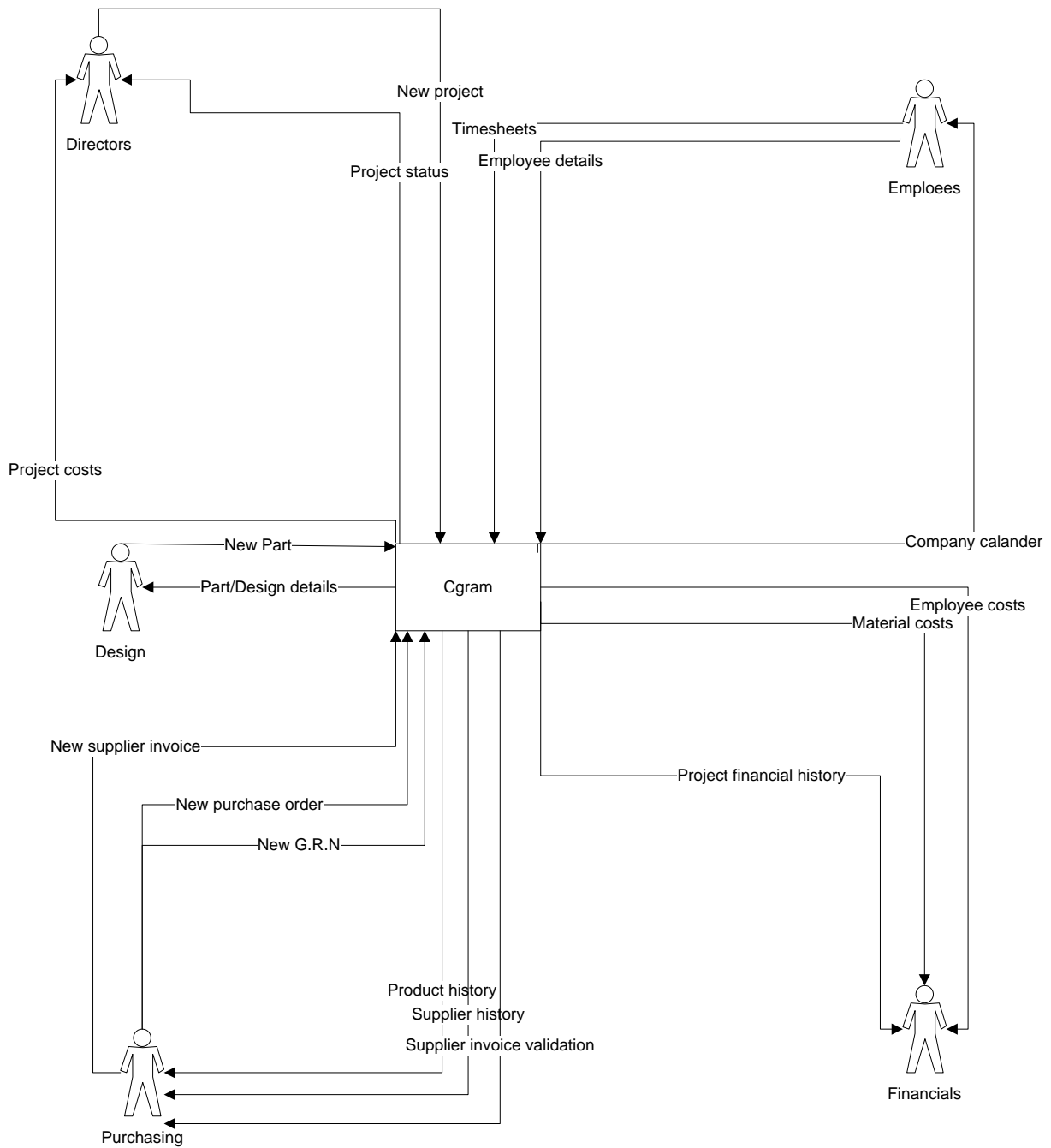


Figure 11 : Context diagram of Cgram

Cost Management section

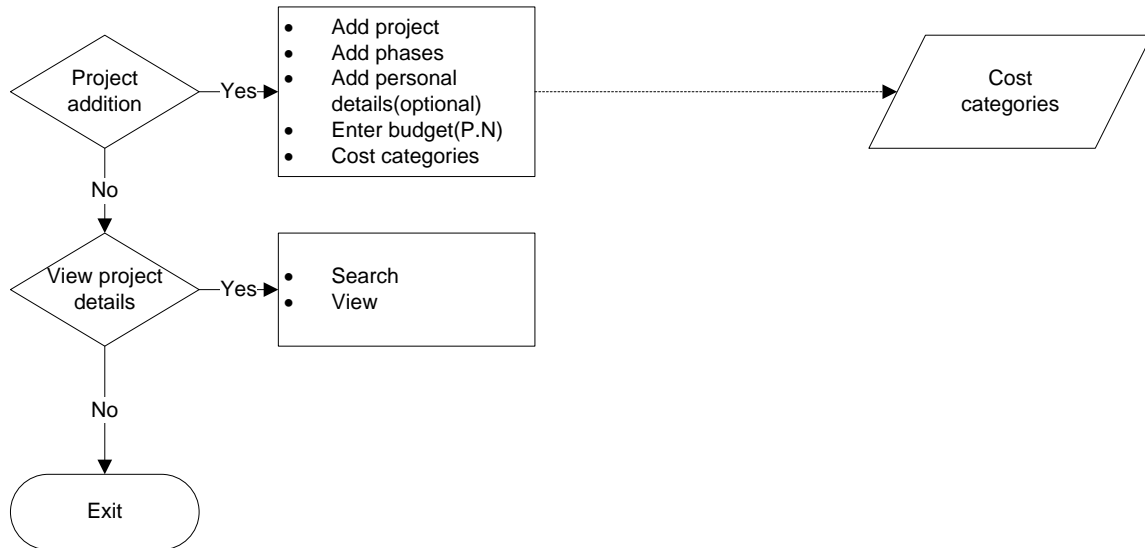


Figure 12 : Flowchart of Cost management section

Purchase section

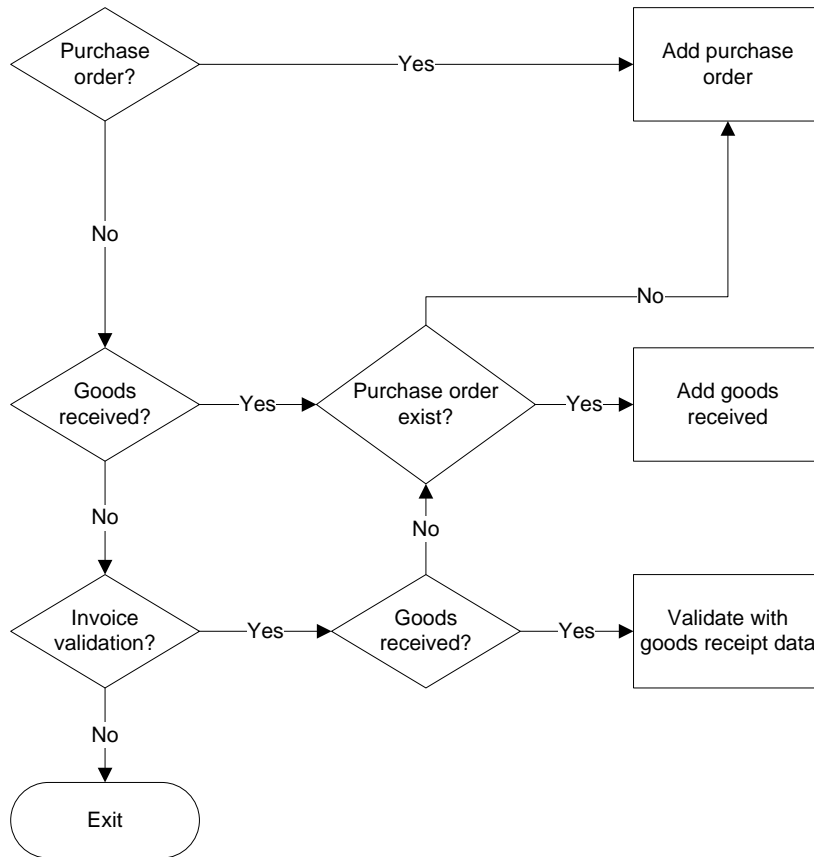


Figure 13 : Flowchart of Purchase section

Production section

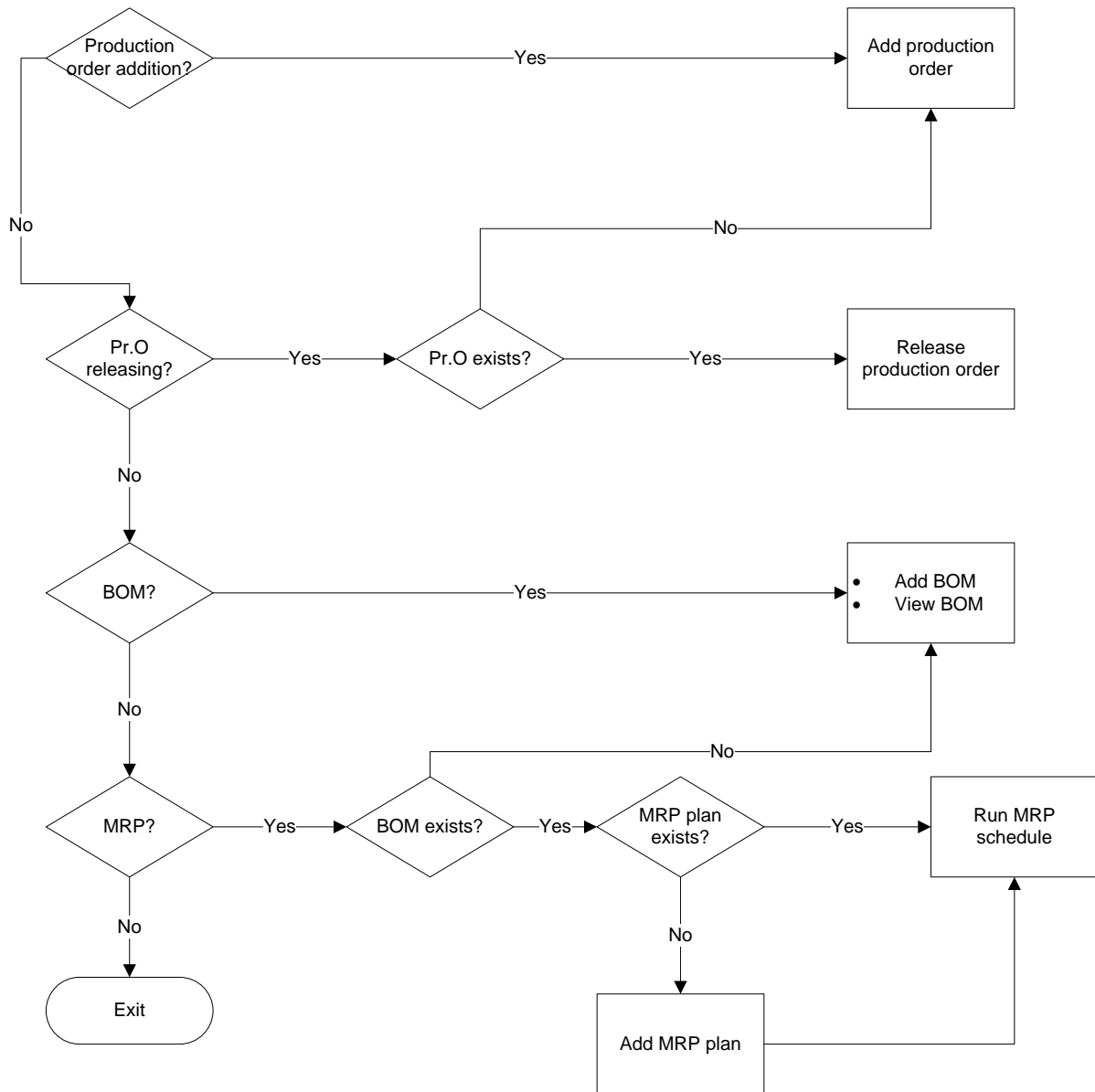


Figure 14 : Flowchart of production section

Stock section

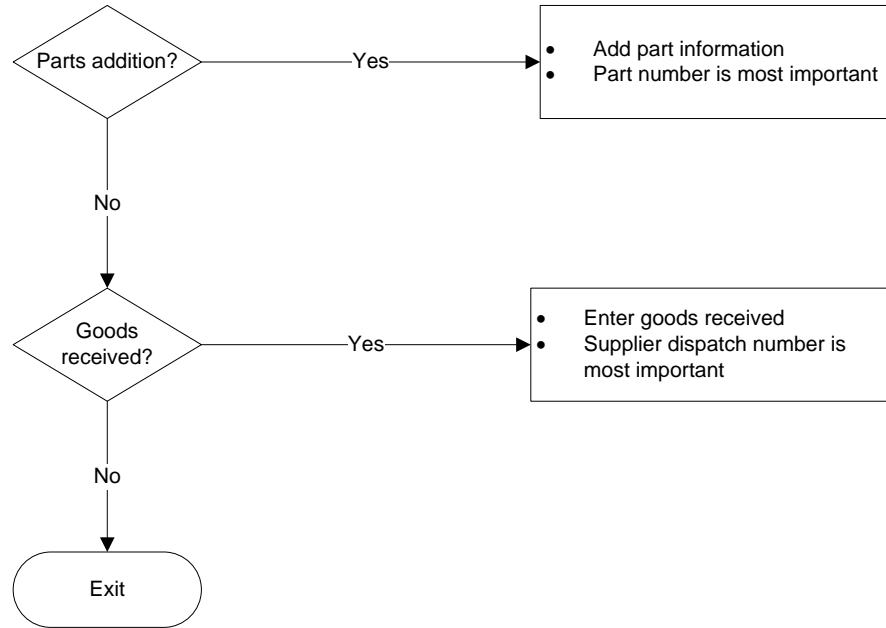


Figure 15 : Flowchart of stock section

21 Bibliography

- Abdinnour-Helm S, L.-H. M.-H. (2003). Pre-implementation attitudes and organizational readiness for implementing an enterprise resource planning system. *European journal of operational research* , 258-273.
- Al-Masari M, A.-M. A. (2003). Enterprise resource planning: A taxonomy of critical factors. *European journal of operational research* , 352-364.
- Chang M, C. W. (2008). Understanding ERP system adoption from the user's perspective. *International journal of production economics* , 928-942.
- Chase R.B, J. F. *Operations management for competitive advantage with global cases*. Mcgraw-Hill Irwin.
- Chou S, C. P. (2009). The influence of individual differences on continuance intentions of enterprise resource planning (ERP). *International journal of human-computer studies* , 484-496.
- Ehie I.C, M. M. (2005). Identifying critical issues in enterprise resource planning (ERP) implementation. *Computers in industry* , 545-557.
- Jacobs F, W. F. (2007). Enterprise resource planning (ERP) - A brief history. *Journal of operations management* , 357-363.
- Karzak E.E, O. O. (2009). An integrated decision making approach for ERP system selection. *Expert systems with applications* , 660-667.
- Mabert V.A, S. A. (2006). Model based interpretation of survey data: A case study of enterprise resource planning implementations. *Mathematical and Computer Modelling* , 16-29.
- Niebel B, F. A. (2004). *Methods, Standards, and Work Design*. McgrawHill.
- Sun A.Y.T, Y. A. (2005). Achievement assesment for enterprise resource planning (ERP) system implementation based on critical success factors (CSF). *International journal of production economics* , 189-203.
- Umble E.J, H. R. (2003). Enterprise resource planning: Implementation procedures and critical success factors. *European journal of operational research* , 241-257.