Effort estimation methods for ERP projects based on function points: a case study

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ABSTRACT

Enterprise Resource Planning (ERP) Systems evolve at a rapid pace based on customer and industry expectations. As a result, historic project data for these kinds of projects lose their value especially for analogy based estimation methods. In this rapidly evolving domain, function point based methods might provide a sound alternative for ERP effort estimation. This paper presents the results obtained by applying three methods published in the literature in which function points are used as an input for ERP effort estimation. The evaluation of these methods with respect to their measurement processes and estimation errors are presented; their advantages and disadvantages are discussed.

CCS CONCEPTS

• **General and reference → Estimation** • **Software and its engineering → Software development methods**

KEYWORDS

Enterprise Resource Planning; Effort Estimation; Function Points

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1 INTRODUCTION

ERP systems are one of the most complicated systems covering almost all processes of an enterprise. Mainly due to this complexity and size, ERP projects frequently suffer from estimation variances [8]. Although, a number of research studies was conducted for developing cost and effort estimation methods for ERP projects, there is still no consensus on how to estimate cost and effort of an ERP project properly [10]. In addition to size and complexity concerns, ERP systems are also evolving based on customer and industry expectations rapidly.

As a result, experience related with the older systems might not always be very useful with new ERP projects. An alternative could be the use of sound and objective methods. Function point based approaches based on customer requirements could be an appropriate candidate for ERP effort estimation.

The main objective of this research study is to analyse studies published in the literature in which ERP effort estimation methods using function points as input are developed. To achieve this objective, we performed a case study applying three main function point based ERP effort estimation methods. Our case study project was an SAP Implementation Project conducted in a large mining company in Turkey. We applied these function point based ERP effort estimation methods for specific four modules of the project and evaluated the results to figure out improvement opportunities of the methods.

The rest of the paper is organized as follows: In Section 2, ERP function point (FP) based estimation studies published in the literature are summarized. The description of the case study project, the applications of FP based effort estimation methods to this project and the results obtained are presented in Section 3. In Section 4, the results of the case study are discussed and methods are evaluated. Finally, Section 5 presents conclusions for our case study and suggested directions for future work.

2 BACKGROUND

Since the first study of Stensrud and Myrtveit [9] discussing that traditional effort estimation methods are not appropriate for industrial projects such as ERP projects, a number of research studies were performed to solve ERP effort estimation problem. Some studies as [18] used reports, interfaces, conversions and extensions (RICEs) for measuring ERP size, whereas some studies rely on function points or expert judgments. We performed a systematic literature review [10] to analyze estimation methods developed/applied to ERP projects by stating their validations and limitations. Our findings in that study showed that effort estimation methods have mostly used function points as an input.

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ERP requirement specification document "Business Blueprint" [16] is the main source to figure out business processes for Function Point Analysis (FPA). There are a number of research studies in the ERP literature depending on FPA; some of them explicitly define an ERP size/effort estimation method, where some of them deal with processes and metrics in estimation methods.

There are two studies directly defining a function point based size estimation method for ERP projects. Martín Téllez, Francisco [5] explained the proposed method called "the eEPC-COSMIC approach" in his thesis report. In this study, the size estimation method using extended EPC diagrams to figure out COSMIC data movements was developed and validated. Kuijpers [4] also studied using function points for size estimation of ERP projects. He suggested a method called "Automated FPA method" that uses ERP system components to calculate IFPUG function points automatically. Daneva investigated reuse measurement process for function point calculation in her studies [6] and [7] which were based on IFPUG function point calculation.

There are three studies [1], [2] and [3] that explicitly suggest an ERP effort estimation method using function points as input. Erasmus [1] performed a comprehensive study that proposes a new ERP effort estimation method called "COSMIC EPC". This method uses business process models for defining COSMIC function points. In this study, also add-on functionality for this calculation was also developed for SAP project management tools.

Vogelezang made an experiment on COSMIC-FFP for ERP projects size and effort estimation [2]. He used "refined approximate COSMIC-FFP" method to make size estimation in early stages of ERP project. In this method, processes are categorized based on their complexity and total COSMIC function points are calculated by using pre-defined function points of categories. This size value is then used for effort estimation by using historical productivity rates.

In 2015, Erasmus, Pierre, and Maya Daneva performed a study [3] suggesting that instead of using certain effort estimation methods for every situation, integrating different estimation strategies based on Function Points and Expert Judgments would be more appropriate for ERP projects. They emphasized that this will leverage strengths of both methods.

3 CASE STUDY

In this section, a retrospective case study including application of three function point based effort estimation methods [1,2,3] to a case is presented. The goal of this case study is to evaluate these three FPA based estimation methods for the purpose of understanding usability of these methods for ERP projects from the perspective of ERP adopter companies.

3.1 Description of the Case

This case project is an SAP Implementation Project. The project was started in April 2015 and completed in March 2016. Go-Live of the project occurred on 01.01.2016; last 3 months of the project was for operational support and maintenance.

This project consisted implementation of mainly following SAP modules:

- MM (Material Management)
- SD (Sales & Distribution)
- PM (Plant Maintenance)
- FICO (Finance & Controlling)
- HR (Human Resource)
- PP-PI (Production Planning – Process Industries)

The case study company implementing SAP is a Turkish mining company with 3 mine sites located in different cities of Turkey. Total number of employee for the company is almost 1200; at the beginning of the project total number of SAP users was predicted as 110. SAP Adopter (Consultancy) Company performing this project, with over 1500 employees, is one of the leading IT companies in Germany. It is also a partner of SAP AG since 2000. This project was conducted by Turkey office of this SAP Adopter Company. The project staff consisted of 1 Project Manager, 7 Senior SAP Consultant and 5 Junior SAP Consultant from SAP Consultancy Company; 1 Project Manager, 3 Process Analyst and 7 SAP Key-User from SAP Adopter Company.

The SAP Adopter Company mostly relies on Accelerated SAP (ASAP) methodology as a roadmap for project implementation. As defined in ASAP, they prepare Business Blueprint Documents in the requirement elicitation phase of the project. Business Blueprint Documents have 3 main sections as "Organizational Units", "Master Data" and "Business Processes". Business process structure in these documents are mainly in three levels; business process scenarios, their related business processes and process steps. Business process structure can be defined as in Appendix A by only analyzing Business Blueprint Documents of the project.

SAP Adopter Company collects effort data on a daily basis at SAP CATS Time Sheet Module. A project document, including realized effort values based on project phases, modules and consultant experience levels, was also obtained from the company. The efforts utilized for this project are presented based on project phase and modules in Table 1.

3.2 Application of the Methods

3.2.1 The COSMIC EPC Method - An ERP functional size measurement method delivering time and cost estimates.

The COSMIC EPC method converts business processes to COSMIC function points, then to effort by using conversion factors. Erasmus [1] defines the method in detail by also illustrating with a sample SAP business scenario.

Business Blueprints for MM, SD and PM Modules were read to figure out which business scenarios & processes were applied in this project. Business processes were searched in Business Process Repository of SAP Solution Manager [16]. Related business processes (level 3- business process steps) exported to Microsoft Excel to make effort calculations. A list of all business processes for the case study is presented in Appendix A.

The data movements (Entry, Exit, Read and Write) were counted on the lowest level of detail, on the process step level (Level3). Basically, the total functional size for a business process

is calculated by summing up all related data movements. This size value is then influenced by parameters as "Reuse" and "Modify". All parameters used in the effort calculation are described in Table 2.

Table 1: Efforts Utilized

Project Phase	Effort (Person-Hours)
Business Blueprint & Infrastructure	*616*
SAP Basis	108.5
Controlling & Budgeting	226
Finance	78
Human Resources	59
Logistics	59.5
Sales & Distribution	32
Service & Energy App.	53
Customization & Development	*1230.5*
SAP Basis	85.5
Mobility	85
Controlling & Budgeting	263
Finance	130
Human Resources	373.5
Logistics	90.5
Sales & Distribution	62
Service & Energy App.	141
Integration & Go Live	470.75
SAP Basis	16.25
Mobility	5.5
Controlling & Budgeting	131.5
Finance	77
Human Resources	144
Logistics	74.5
Sales & Distribution	8
Service & Energy App.	14
Operation & Support	683.75
SAP Basis	37
Mobility	7.5
Controlling & Budgeting	272
Finance	46.75
Human Resources	196
Logistics	29.5
Sales & Distribution	8
Service & Energy App.	87
Total	*3001*

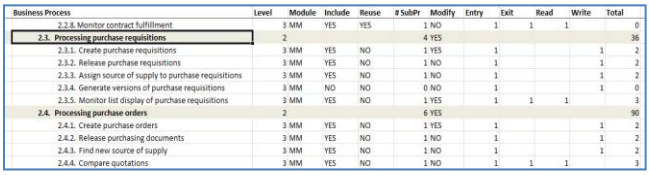
"Reuse" is calculated here for only reuse of the same process step within the project. Other kind of reuse types as reuse of existing repository are not considered in this estimation method. All these parameters were stated for process steps in the calculation sheet. A sample view from the calculation sheet is as in Figure 1.

Based on this calculation, total size of the project for MM, SD and PM modules was calculated as 886 Cfs (COSMIC functional size) points.

Effort calculation formula provided in [1] is as given in Figure 2.

Table 2: Calculation Parameters

Parameter	Description
Level	It shows the process detail level: Level 1 = Business Scenario Level 2 = Business Process Level 3 = Process Step
Module	It shows the ERP module that the process belongs to.
Include	It is used to indicate whether to include the process step or not, "#SubPr" tab is filled accordingly: "YES" => # SubPr = 1 "NO" => # SubPr = 0
Modify	It is used to indicate that either business process requires customization or not. If "YES" is selected for any one of the process steps of a business process: Modify (business process) = "YES" Data movements value for business process is multiplied by #included process steps
Reuse	It shows if the process step is already implemented in another business process. If "YES" is selected, all the related data movement fields for that process step will be reset to value "0".



Business Process	Level	Module	Include	Reuse	# SubPr	Modify	Entry	Exit	Read	Write	Total
2.2.8. Monitor contract fulfillment	3	MM	YES	YES	1	NO	1	1	1		0
2.3. Processing purchase requisitions	2				4	YES					36
2.3.1. Create purchase requisitions	3	MM	YES	NO	1	YES	1			1	2
2.3.2. Release purchase requisitions	3	MM	YES	NO	1	NO	1			1	2
2.3.3. Assign source of supply to purchase requisitions	3	MM	YES	NO	1	NO	1			1	2
2.3.4. Generate versions of purchase requisitions	3	MM	NO	NO	0	NO	1			1	0
2.3.5. Monitor list display of purchase requisitions	3	MM	YES	NO	1	YES	1	1	1		3
2.4. Processing purchase orders	2				6	YES					90
2.4.1. Create purchase orders	3	MM	YES	NO	1	YES	1			1	2
2.4.2. Release purchasing documents	3	MM	YES	NO	1	NO	1			1	2
2.4.3. Find new source of supply	3	MM	YES	NO	1	NO	1			1	2
2.4.4. Compare quotations	3	MM	YES	NO	1	NO	1	1	1		3

Figure 1: Calculation Sample

$$SI\_Time = ST\_Time \times SUC\_CF \times (Cfs / ST\_fs)$$

SI_Time = Scenario Implementation Time

ST_Time = Scenario Template Time

SUC_CF = Standard Unit Cost Conversion Factor

Cfs = COSMIC Functional Size

ST_fs = Scenario Template Functional Size

Figure 2: The COSMIC EPC Effort Formula

Template values for "time to implement" and "total functional size" were calculated without taking into account include, reuse and modify values effect.

ST_fs = 247 Cfs

ST_time = 165 hours

"Standard unit cost conversion factor" in the formula is defined in the study [1] as the implementation engineer level of the project. As a rule of thumb, it is suggested to use higher level of consultant as project complexity increases. The conversion factors used for time calculations are listed in Table 3.

Table 3: Conversion Factors for Implementation Engineer

Level1	Level2	Level3	Level4	Level5
1.6	1.1	0.9	0.75	0.6

Considering consultant level and complexity of the project, we decided to use "Level3" conversion factor. Based on these values, implementation time (effort) calculation is as follows:

SI _Time = 165 × 0.9 × (886/247) = 532 hours

Thus, total effort for MM, SD and PM modules implementation for this project is calculated based on COSMIC EPC is 532 Hours. Realized value for these modules was 378,5 hours, considering these values Mean Relative Error (MRE) is calculated as 0,40.

3.2.2 *Using COSMIC-FFP for sizing, estimating and planning in an ERP environment.*

This method emphasizes that usage of process-chains during implementation of the project will influence effort value. A process-chain is defined as a set of business functions handling specific events of business processes. In our case project, all project is handled in one process chain, thus we made calculations accordingly.

For making effort estimation in early stages of the project, an approximation method "approximate COSMIC-FFP" is developed in this study. Effort is calculated based on both "COSMIC-FFP" and "approximate COSMIC-FFP". Based on "approximate COSMIC-FFP", processes should be classified in one of the categories listed in Table 4.

Table 4: Categories for "Approximate COSMIC-FFP"

Category	Cfsu	Description
Small	4	retrieval of information about a single object of interest
Medium	7	7 storage of a single object of interest with some checks
Large	11	

This method then called as "refined approximate COSMIC-FFP". It is stated in the study that COSMIC function units in this table are taken from Measurement Manual and thought to be 20-30% precise although they are environment dependent.

Based on these definitions, total size of the project for MM, SD and PM modules is calculated as follows:

COSMIC-FFP:

Size = 247 Cfsu

Refined Approximate COSMIC-FFP:

Size = 384 Cfsu

In this study, time to delivery of a project is correlated exponentially with the size of the project. Effort formula is defined as shown in Fig. 3.

$$\text{Time}_{\text{Delivery}} = \frac{Size^{\text{Power}}}{\text{PL}}$$

$\text{Time}_{\text{Delivery}}$= Time to delivery of the process-chain in months

Size = Functional size in Cfsu

Power = 0,20 for a single production line and 0,37 for two production lines

PL= Number of deployed production lines (1 or 2)

Figure 3: Effort Formula

Realized effort for these modules was 2,15 man-months (considering 8 hours' working day) for our case study project. Effort and MRE based on this realized effort is calculated as follows:

Based on COSMIC-FFP:

Time Delivery = 〖247〗 ^0,2/1 = 3 months

MRE = 0,39

Based on Refined Approximate COSMIC-FFP:

Time Delivery = 〖384〗 ^0,2/1 = 3,3 months

MRE = 0,53

3.2.3 *ERP Services Effort Estimation Strategies Based on Early Requirements.*

This study emphasizes that there is not one estimation strategy appropriate to every situation. Instead of selecting one strategy for the estimation, it is suggested to integrate different strategies considering the topic, resources, and situation of the project.

SAP projects are mainly divided to two different types as "Innovation & Ramp-up Projects" and "RDS (Rapid Deployment Solutions)". Innovation & Ramp-up projects are projects where the solution is modified based on customer requirements. However, in RDS projects solutions are pre-engineered and implemented with a small customization. According to this definition, our project in this case study is encountered as an "Innovation & Ramp-up Project".

In this study, three main ERP estimation strategies are defined as "Baseline", "Configurable" and "Tailored". Those requirements and activities representing implementation of core functionalities of ERP are counted as "Baseline" and estimation could be based on FSM data. In "Configurable" estimation strategy, estimator could rely on configurable estimates or rules of thumb since these kinds of customization scenarios are repeatable customizations requiring fine tuning to a certain degree. "Tailored" estimation strategy should be used mainly for activities related to customizations unique to customer specific processes. It is emphasized that these strategies could also be used both for first estimations and validating estimations.

An ERP Services Estimation Strategy Matrix, as shown in Table 5, is developed to assist the estimator to figure out which estimation strategy, methods and material to use according to components and project. We filled in grey this matrix for our case study for MM, SD and PS modules implementation as illustrated in Table 5.

Table 5: The ERP Services Estimation Strategy Matrix

1 - Estimation Strategy	2 - Project Type		3 - Implementation	4 - Configuration Component	5- Estimation Component	6 - Knowledge Base	7 - Effort Estimation	8 - Estimation Reference
Baseline	Time & Material (Innovation & Ramp-Up Projects)	Rapid Deployment Solutions (Engineered Projects)	Baseline	Core	Activities and Sub-activities	Explicit	Function Point & FSM Estimation	Work Breakdown Structure Template
Configurable			Customization	Optional	Pre-configured Scenarios		Expert Judgment	Rules of thumb
Tailored				Specific	Expert Judgment	Tacit		Experience & Expertise

After defining estimation strategy, a validation process is recommended to be applied for the estimations. According to filled Estimation Strategy Matrix for our case study, effort estimation could be done based on both FSM Estimation and Expert Judgment.

A sample validation method is explained in the study for three scenarios having historical project estimates. In this validation method, effort based on COSMIC FP is calculated based on COSMIC EPC method defined by Erasmus [1]. It is recommended to use historical rule of thumb if we could not relay on FSM since it has a frequency count less than 3.

For implementation of MM, SD and PM modules we could rely on FSM since these are modules reused and repeated frequently. In our case study project, there is only one scenario implemented seldom, which is related to a mining industry specific module called PP-PI module specific to. We applied this validation method for this scenario as illustrated in Table 6.

Table 6: Validation

	FSM (COSMIC FP – CFP)			Rule of thumb (Expert Judgment)		
Scenario	*CFP& Effort*	*Frequency Count*	*Effort Variance*	*Rule of thumb (hours)*	*Frequency Count*	*Effort Variance*
Batch Management with Batch Characteristics	null	null	null	Range (70 – 120 Hours)	2 (seldom used)	null

SAP Adopter Company implemented this scenario 2 times, thus we filled frequency field as 2. Expert of this module estimates implementation of this scenario has an effort range as 70-100 hours. Realized effort for this scenario was 87 man-hours which is a value in the range of rule of thumb estimation.

4 DISCUSSIONS

The COSMIC EPC method requires business processes that could be easily obtained from SAP Solution Manager Business Process Repository. However deciding on the parameters require high level of module knowledge, thus could not be performed by novel consultants.

In COSMIC EPC, reuse is not related to previous projects developments, it count reuse only within the same project. This may result in overestimation of effort in case of high level of reuse. Another problematic point in this method is the complexity parameter. The complexity of the project is only evaluated by deciding conversion factor with a range of 0,6 to 1,6. A faulty decision on this parameter will completely change the effort value.

Modification of one process step and multiple process steps have same effect on calculation, sum of data movements will be multiplied by total active process steps in that business processes. Logic behind this is explained as modification of any process step will affect whole business process. However, modifying one business step and whole business steps of a business process will not result in same effort. Thus, modification level does not seem to be reflected to effort value properly in COSMIC EPC.

Based on case study calculations, approximate COSMIC-FFP size estimations seems to be a good alternative method especially if there is no detailed business process data available. This method could be applied for very early estimates of ERP projects especially during signing contracts phase. In COSMIC-FFP method only

parameter affecting effort value is number of production lines. Two projects using same number of production lines, seems to have same productivity based on this method. Effort estimation is not influenced by reuse, modification or complexity rates of the project.

ERP Service Estimation Strategy seems to be critical for especially projects where solutions are tailored based on customer requirements. These kinds of projects do not have historical productivity rates, so Expert Judgment is suggested to be used for effort estimation. By using estimation strategies, it is claimed that expert bias could be reduced.

In our case study, 3 modules were all reused and repeated SAP modules and scenarios. Thus, we could apply the estimation strategy concept defined in [3] for only one scenario specific to mining industry. Rule of thumb effort value for this scenario was in a wide range. So, relying on rule of thumb would result in high estimation errors as in our case study. FPA based effort estimation methods should be enhanced to estimate these kind of not reused, not repeated scenarios objectively.

4 CONCLUSIONS

This paper presents results of a case study performed to analyze existing ERP effort estimation methods in the literature in which function points are used as an input. We have analyzed three research papers all validate developed effort estimation method for a specific ERP vendor called SAP. Our case study is also performed for an SAP project. SAP Business Blueprint document is a good source for figuring out business processes. Therefore we have used SAP Business Blueprint for calculation.

All studies suggest using COSMIC FPA for size estimation. Requirements based on business processes are analyzed to define COSMIC data movements. COSMIC EPC [1] takes into account also reuse and modification parameters to calculate final size value. This size value then converted to effort by using conversion factors based on complexity. Approximate COSMIC-FFP [2] uses also COSMIC function points for size estimation and converts this size value by conversion factors based on number of production lines. ERP Service Estimation Strategy [3] has a different approach; it is also suggested to use COSMIC EPC for function point based estimation, but if business scenarios are not reused and repeated frequently Expert Judgment based on Rule of Thumb is also suggested. This study does not directly offer one effort estimation method for all types of business scenarios; instead it provides an estimation matrix which presents estimation strategies based on situation, historic data availability and knowledge base.

These studies show us that business processes are valuable resources for effort estimation. COSMIC FPA could be a good candidate for size estimation of ERP projects. ERP project tools as SAP Solution Manager are currently used also for Business Blueprint document generation. These tools could be used for automatically calculate size and effort of an ERP project based on Business Blueprint documents. New approaches as study [11] and [12] required to be developed for ERP domain. Since ERP solutions evolve rapidly, effort estimation method in this domain should be applicable objectively even by a novel user.

Based on our case study, it can be concluded that the size estimation by COSMIC-FFP method is very rough. The number of production lines, the only parameter affecting effort value, was 1 for our case study. Thus, productivity rate for any project with same number of production lines would be same with our case study. COSMIC-EPC has a detailed effort estimation method with modification, reuse, and complexity parameters. Main difficulty we faced during applying this method was selecting complexity conversion factor. This conversion factor has a range between 0,6 to 1,6. Decision of this factor affects effort value completely.

ERP Service Estimation Strategy matrix is valuable to integrate different strategies considering the topic, resources, and situation of the project. However, it is not easy to obtain proper out rule of thumb estimations especially for new customer specific requirements. In our case study, rule of thumb value for the scenario was in a wide range which could result in high estimation errors.

These conclusions cannot be generalized to all kind of estimation scenarios for ERP systems due to limitations of our case study. Main limitation of our study is that we applied function point based estimation methods to only one kind of ERP system, namely SAP. Another limitation is the sample size; we only applied estimation methods to one project. Further studies are required covering also other ERP systems and different kind of ERP projects.

In our study, we observed that FPA based effort estimation methods are good candidates for ERP projects. Critical parameters for function point based ERP effort estimation methods are modification and reuse levels. Modification and reuse levels should be defined and calculated precisely. Instead of using conversion factors with wide ranges, exact productivity rates should be determined. Further FPA based studies should be performed especially considering these parameters.

A APPENDICES

A.1 Business Processes

A.1.1 Sales Scenario

- Master Data Governance for Customer
  - Initial load for customer
  - Search for customer
  - Display customer
  - Process customer via change request
  - Approve changes
  - Change customer
- Contract Processing in ERP
  - Create contract
  - Create contract items
  - Display contract
  - Maintain target and estimated values
  - Determine and maintain texts
  - Perform credit check

- Determine and process message output
- Monitor contract fulfillment

- Assemble-to-Order Processing in ERP
  - Create assemble-to-order
  - Select inquiry or quotation
  - Determine business partner
  - Create order items
  - Perform material configuration
  - Create returnable packaging items (optional)
  - Check availability
  - Schedule order
  - Maintain prices, conditions, and costs
  - Determine and maintain texts
  - Check foreign trade data
  - Perform credit check
  - Determine and process message output
  - Monitor sales order processing
- Billing in ERP
  - Create billing document
  - Determine business partner
  - Determine prices and conditions
  - Determine and maintain texts
  - Determine foreign trade data
  - Post rebate accruals
  - Determine and process message output
  - Perform retroactive billing
  - Generate intercompany billing
- Order Fulfilment in ERP
  - Create delivery
  - Generate Picking List/Request
  - Send Print Delivery Documents
  - Post goods issue

A.1.2 Procurement Scenario

- Supplier Master Data
  - Create Supplier
  - Extend Supplier master data
  - Display Supplier master Record
- Contract Processing in ERP
  - Create contract
  - Maintain authorized business partner
  - Create contract items
  - Maintain target and estimated values
  - Determine and maintain texts
  - Perform credit check
  - Determine and process message output
  - Monitor contract fulfillment
- Processing purchase requisitions
  - Create or process purchase requisitions
  - Release purchase requisitions
  - Assign source of supply to purchase requisitions
  - Generate or manage versions of purchase requisitions
  - Monitor or view list display of purchase requisitions
- Processing purchase orders
  - Create or process purchase orders
  - Release purchasing documents
  - Find new source of supply
  - Compare quotations
  - Generate or manage versions of purchase orders
  - Monitor the output of messages
  - Monitor or view list display of purchase order
- Store Replenishment
  - Run requirements planning
  - Check order proposals
  - Change order quantity
  - Add additional articles
  - Save order list
- Processing Contracts and Sourcing Rules in ERP
  - Process vendor master data
  - Process message conditions
  - Process contracts in ERP
  - Process purchasing info records
  - Process source list
  - Process quota arrangement
  - Process conditions for procurement
- Inbound Processing and Receipt Confirmation with Warehouse Management
  - Receive advanced shipping notification
  - Create inbound delivery
  - Post goods receipt
  - Create WM transfer order
  - Confirm WM transfer order
  - Send proof of delivery (POD)

A.1.3 Maintenance Scenario

- Phase-In Equipment
  - Create equipment
  - Create / add documents
  - Create measurement point(s) / counters
  - Create task list
  - Create maintenance plan
  - Create BOM
  - Create partners
  - Create classification information
  - Create warranty
  - Create permit
  - Create serial number information
  - Install in functional location or equipment
- Phase-Out Equipment
  - Set equipment inactive'

        - Review and close outstanding orders
        - Set maintenance plans inactive
        - Archive master data
    - Maintenance Planning, Scheduling and Dispatching
        - Create maintenance order
        - Define resources required for each operation
        - Check material and tools availability
        - Check budget
        - Define scheduling parameters
        - Define maintenance opportunities
        - Assign orders to an opportunity
        - Perform capacity leveling
        - Dispatch the order to crew or individual within crew
        - Print the job cards
    - Maintenance Execution
        - Review assigned jobs
        - Execute job
        - Confirm job

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