

Maintenance Strategy Selection Theory & Practices in Natural Gas Industry: A Case Study of an Indian Gas Utility Company

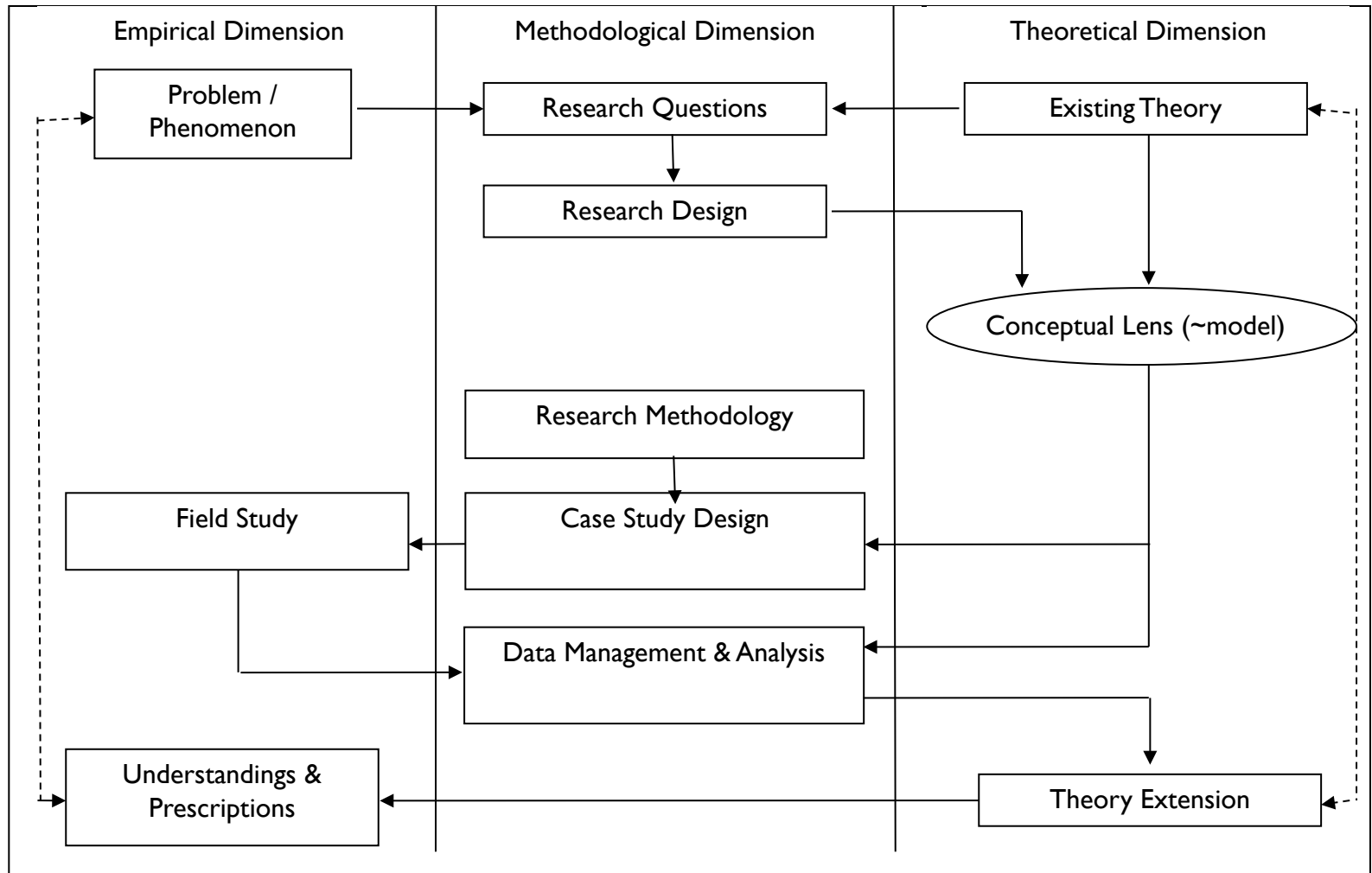
Presented by

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Research Process (Maxwell, 1996)



Problem Statement

- How the maintenance managers in a large gas utility company in India formulate the maintenance strategies for their gas transportation/processing operations and how they practice these formulated maintenance strategies?

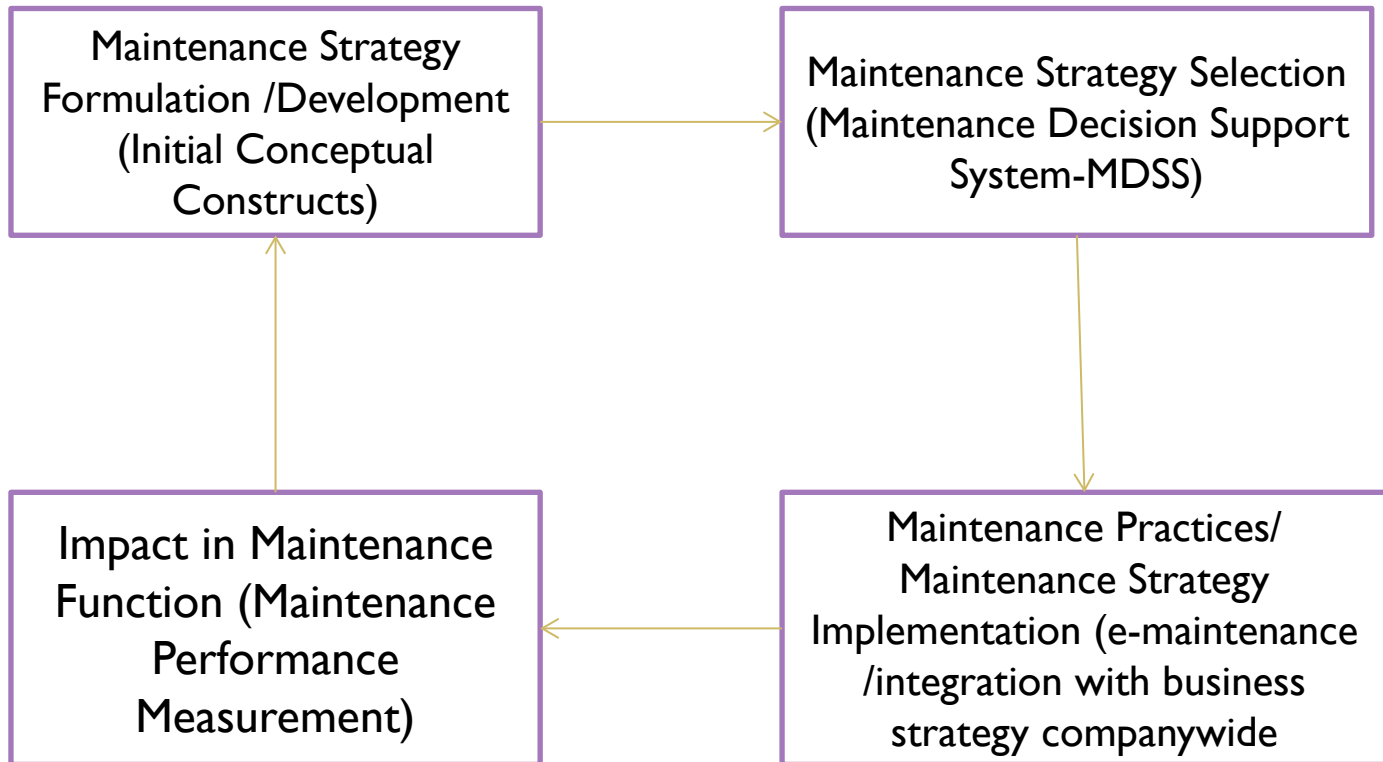
Research Objectives

- To understand and model the existing maintenance strategy formulation & maintenance practices in a large gas utility company in India
 - To describe the extent of practices regarding reliability in maintenance of equipment/assets/processes.
- To find the gaps between maintenance strategies & practices and benchmarks.

Research Question

- How the gas utility company is planning and executing its maintenance strategy & practices to ensure smooth operation process in the company's business verticals such as petrochemicals & pipeline systems (NG transmission) and why the specific maintenance strategy has been selected for a particular operation process/equipment?

Conceptual Lens- Theoretical Framework



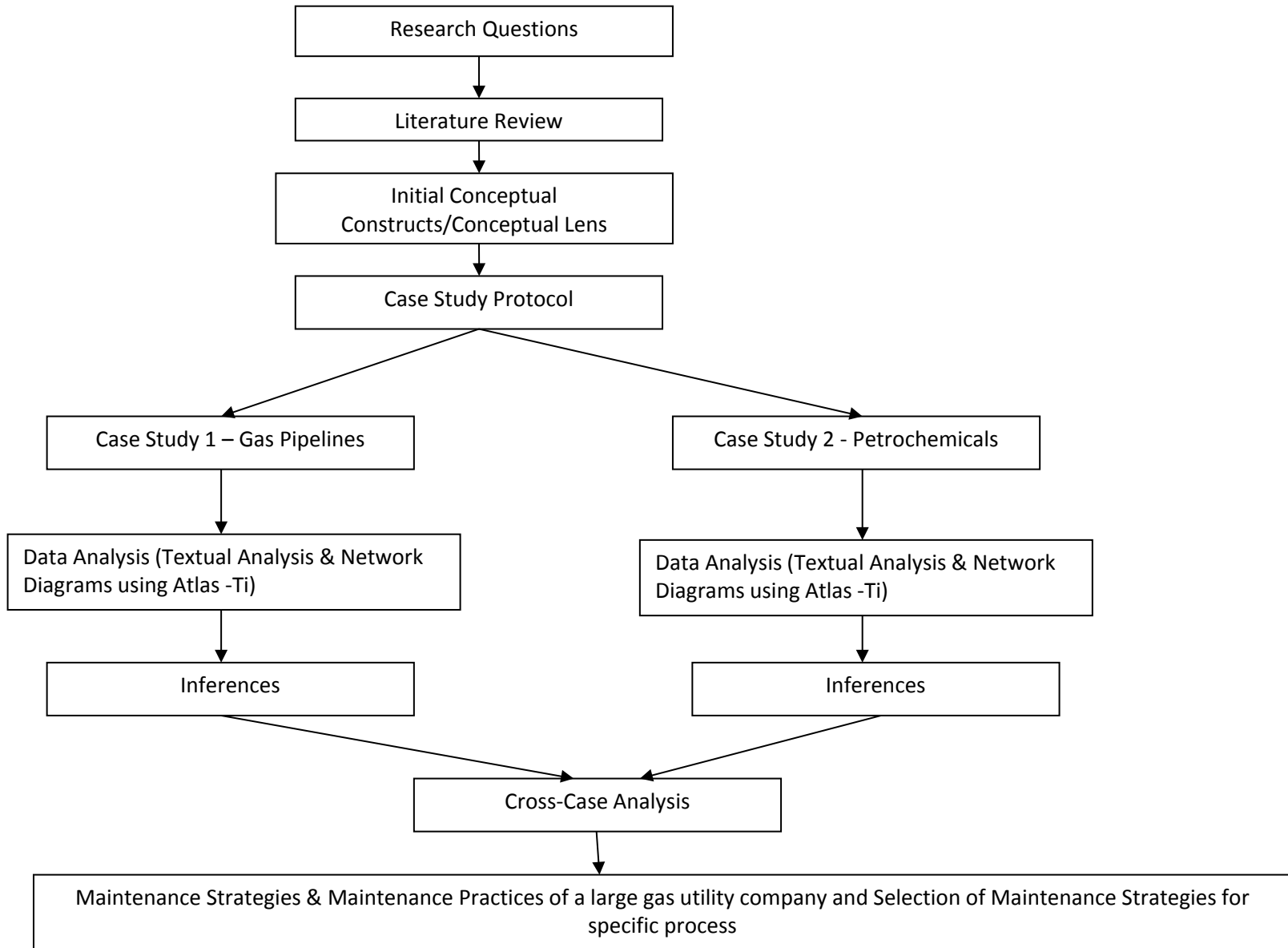
Conceptual Lens- Theoretical Framework

Constructs	Sub-constructs
Maintenance Tactics	Breakdown man hours; CBM; TBM; PM; Compliance of PM; OEM Recommendations; RBM;TPM
Reliability Analysis	Equipment History; RCA; MTBF; Value Risk Study of maintenance program; Equipment Criticality
Performance Measures/ Benchmarking	Labour/Material Cost; Downtime Records; KPI; Training Man hours; Maintenance Performance measures; Internal/Industry Norms; Benchmarking measures & targets
Planning & Scheduling	Plant Equipment Register; Standard work order; PM schedules; priorities of WO; Shutdown maintenance schedule; backlog work measurement; long term plans for shutdown work
Materials Management	Spares availability; Identified spares; Inventory analysis; Emergency purchase; Average Inventory Turnover; Material stores; Inventory control system & integration with maintenance planning
Organization/Human Resources	Maintenance staff level; Maintenance organization; Responsibility of supervisors; adequacy of support staff; Regular Technical training; Apprenticeship program; Deployment of contractors
Employee Empowerment	Multi skilled trade people; OBM; Regular discussions with staff supervisors; Self directed work team; minor modification done ; partnership with key suppliers/contractors
Information Technology	Availability & Integration of computerized maintenance management & materials management system; Shutdown scheduling; CBM supported automated data analysis; Expert systems for diagnosis
Maintenance Policies/ Budget	Maintenance mission & objectives; Long term maintenance plans integrated with business plans; maintenance policy; maintenance budget

Research Framework

S. No.	Case Studies	Description/ Unit of Analysis	Level of Analysis
1	Case Study1 (Petrochemicals)	Study of Maintenance strategy & practices for Petrochemical processing plant ; UOA : Plant	<ol style="list-style-type: none"> 1. Company Level 2. Unit Level/Department Level 3. Individual
2	Case Study2 (NG Pipelines)	Study of Maintenance strategy & practices for NG Pipeline network; UOA : Plant	<ol style="list-style-type: none"> 1. Company Level 2. Unit Level/Department Level 3. Individual
3	Cross-Case Analysis	Cross-Case analysis of above 2 cases Petrochemicals & NG Pipelines	

Case Study Design



Data Collection- Main Steps

Steps in data collection	NG Pipelines (Case Study 1)	Petrochemicals (Case Study 2)
Development of Case Study Protocol (CSP), Review and final CSP development	December, 2012 to Feb, 2013	
Initial Contact and Arrangements	March, 2013	April, 2013
Data Collection Interviews	July, 2013 to October, 2013	July, 2013 to August, 2013
Site visits for field observations	October, 2013 to November, 2013	September, 2013 to November, 2013
Review of case report for internal validity	November, 2013	November, 2013
Additional data collection	December, 2013	December, 2013
Total Number of interviews	6	5

Data Analysis Method

- Analysis was done with the Textual Analysis & Cross-case synthesis
- Modified grounded theory approach (Charmaz, 2006)
- Qualitative data analysis software– Atlas.ti for managing & visually displaying data
- Manual coding (Charmaz, 2006)

Open coding

‘grounded in data’
Line-by-line coding

Focused coding

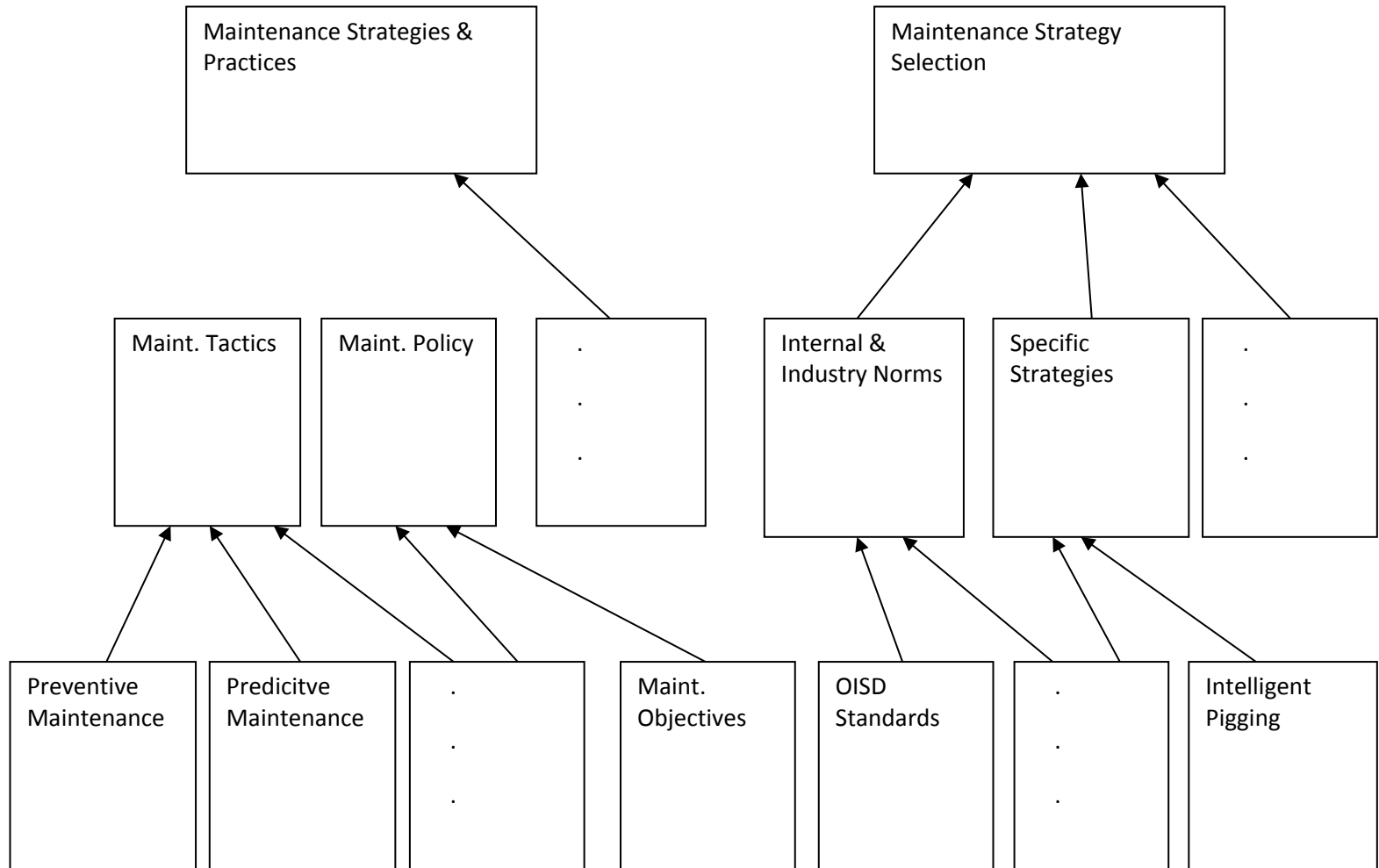
Directed, selective
and conceptual

Axial coding

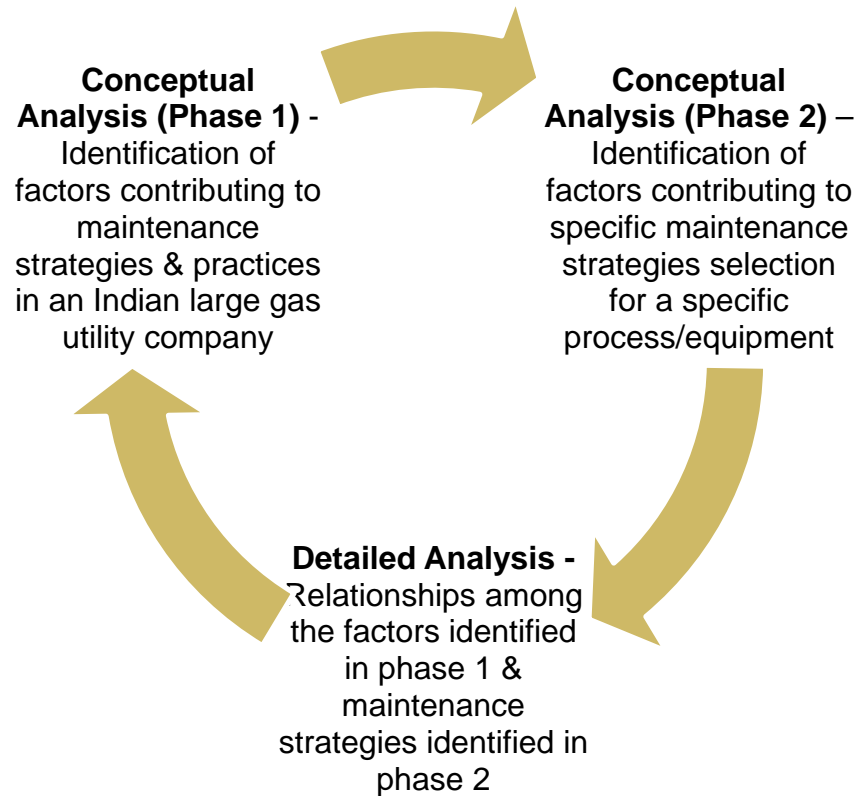
Properties and dimensions
of a category

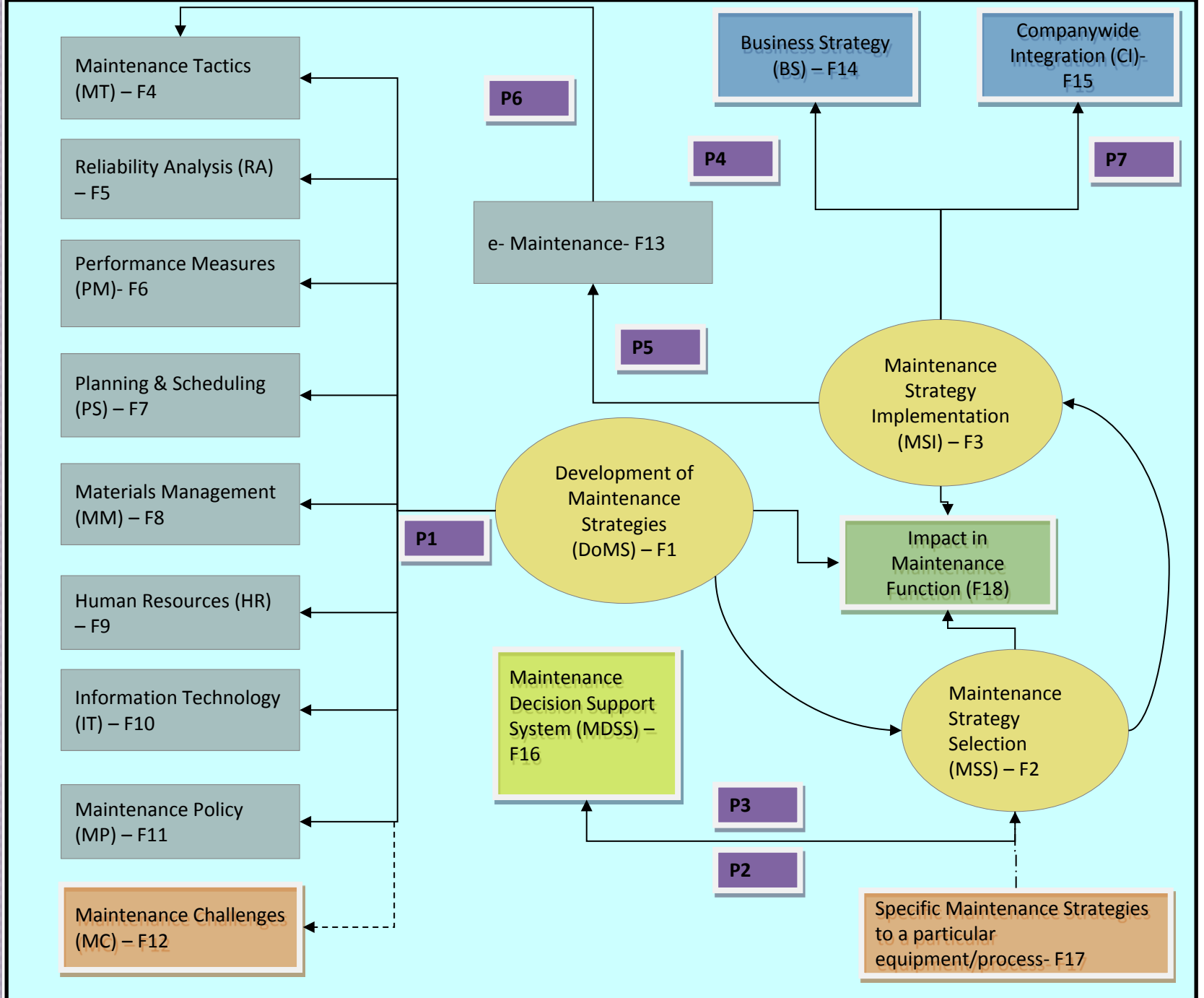
- Patterns of relationships among codes

Data Analysis -Categorization of codes



Data Analysis – With-in case





Findings of Case Study I & II

- Constructs emerged out from this study are Maintenance Tactics, Reliability Analysis, Performance Measures/ Benchmarking, Planning & Execution, Information Technology, Human Resources, Maintenance Policy/Budget, Material Management and Employee Empowerment
- Constructs emerged out from the study are matching with the initial conceptual constructs
- Additionally, two new constructs have been identified such as Maintenance Challenges & Specific Maintenance Strategy for NG Pipelines

Findings Cross-Case Analysis

- Predictive Maintenance is more used in NG Pipelines than petrochemicals
- TPM & RCM techniques are not followed in both NG Pipelines & Petrochemicals
- Emergency maintenance is very rare in NG Pipeline where are the same is minimized by various maintenance tactics in petrochemicals
- Shutdown maintenance is very crucial in petrochemicals
- No evidence of cost minimization concepts in maintenance in both the cases

Findings Cross-Case Analysis

- Operator based maintenance is being followed in small terminals/ SV stations in NG Pipelines. Not in other plants
- Expert Systems used in equipment diagnosis are specific to NG Pipelines & Petrochemicals
- Maintenance Techniques used are also very specific to systems in NG Pipelines & Petrochemicals

Contributions

- Two types of new constructs related to maintenance strategies & practices such as **Maintenance Challenges** and **Specific Maintenance Strategies & selection of maintenance strategy**
- One new type of maintenance tactics i.e., **Proactive Maintenance**
- **Process Framework** for maintenance strategies development & maintenance practices implementation
- **Propositions** for testing the relations among maintenance strategy development, selection of maintenance strategy and maintenance practices

Suggestions

- Gas utility company to assess the existing maintenance strategies based on the 10 factors emerged out from this study to set its base line
- Implementation of Reliability Centred Maintenance (RCM) & Total Productive Maintenance (TPM) to be thought of
- More benchmarking parameters are to be introduced for measurement of maintenance performance compare to world standards
- Maintenance cost optimization concept is to be implemented
- Pro-active maintenance concept to be further explored for effective implementation for minimizing maintenance failures



Thank You