



CONSTRUCTION INDUSTRY INSTITUTE

PIPING: IMPROVING P&IDs,
SUPPLIER DATA, AND
PACKAGED UNITS

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Piping: Improving P&IDs, Supplier Data, and Packaged Units

**Prepared by
The Construction Industry Institute
Piping Function Research Team**

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Executive Summary

The piping function in the engineering and construction industry frequently is inefficient and problematic. Improving the piping function could amount to an average savings of \$3.8 million on a \$190 million heavy industrial project.

The major causes for the problem can be found in the engineering development processes for piping and instrumentation diagrams (P&IDs), supplier data, and packaged units. To address these problems, the Construction Industry Institute (CII) established the Piping Function Research Team. The team interviewed more than 100 experts from the industry to identify the drivers of the processes, to collect best practices, and to develop solution tools for improving the efficiency of the piping function.

The research team found three key drivers of P&ID problems: inefficient sequencing and prioritization, inefficient procedures for P&ID development and review, and inefficient communication of P&ID uncertainty. The team identified the major problems in the supplier data process to be communication, coordination, and selection-duration. Packaged units, according to the research team's investigation, have problems that include issues with supplier quality and design.

To improve the efficiency of the piping function, the research team developed several tools, which are categorized into policies, procedures, and checklists. These tools have been designed so that a company, by making minor adjustments, can meet its own particular needs. This research summary provides an overview of the tools and describes the benefits that are possible when the tools are put to use.

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Introduction

The piping function is widely recognized as the most costly and least efficient function within industrial projects. Researchers in engineering and construction have found that solving problems early in a project can often be the most cost-effective approach. The enhancement of piping and instrumentation diagrams (P&IDs), supplier data, and packaged units, however, has largely been ignored. This is especially significant since these issues all occur early in the piping engineering development process.

In 1993, the CII sought to improve the efficiency of the piping process and chartered the Piping Function Research Team. The research team identified 14 problematic areas in the piping function. The team also determined that the two most desirable areas for research were P&ID rework and design rework caused by late submittal of supplier data and packaged units.

The research team reached consensus on two issues: first, too much uncertainty in the piping process is the key factor in the inefficiency of the piping function; and second, the piping function can be greatly enhanced by minimizing uncertainty during the processes of P&ID development, supplier data, and packaged units.

P&IDs

P&IDs are schematic drawings that show the arrangement of all process and utility equipment. P&IDs are extensions of process flow diagrams (PFDs), and are used as the basis for detailed engineering design. P&IDs evolve with the development of a project. A finished P&ID carries information on all equipment, piping, process control, instrumentation, and the inter-relationships of these elements.

P&IDs play a significant role in process piping design, construction, and start-up. Figure 1 is a flowchart depicting the role of P&IDs in industrial plant engineering and construction. The research team determined that “artificially frozen” P&IDs (those containing information elements that have not been finalized) and late P&ID changes are key symptoms of the inefficient P&ID development process.

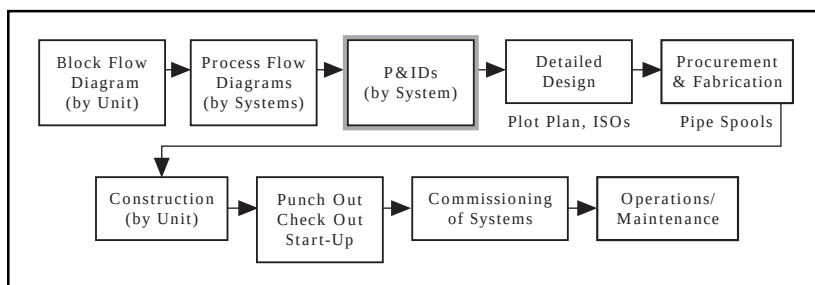


Figure 1. Flowchart for Industrial Plant Construction

Supplier Data

Supplier data is a major information source for the design process. Supplier documents, unfortunately, are often late, missing, or contain inaccurate information at the time they are needed to support accelerated engineering design programs. This causes non-certified (uncertain) data to be incorporated into the design documents, which are then sent downstream into the process. Associated delays and uncertainties affect the piping function in the following ways:

- Re-design of piping interfaces and/or transitions
- Misfabrication of pipe spools
- Rework of pipe spools at the fabrication shop
- On-line piping rework, and on-site piping rerouting.

Packaged Units

A packaged unit is a self-contained system consisting of various pieces of equipment that are piped and/or wired together, supported on a common base (or bases), and designed, fabricated, and furnished by a specialty supplier from a remote site. Packaged units, sometimes referred to as skid-mounted units, are smaller than modules fabricated for an entirely modular approach to plant construction. Similar to supplier data, packaged units also can become a source of delays and uncertainty for the design effort. Also, packaged units frequently cause piping rework and rerouting.

Research Objectives

The primary objective of this research was to identify ways to improve the efficiency of the piping engineering process. To achieve the objective, three sub-objectives were identified:

- Understand the piping engineering process.
- Identify problems in the piping engineering process.
- Develop tools for improvement.

Definition of Terms

Certain terms used in this document need to be defined. These terms are used later to categorize the types of tools developed by the research team. A *policy* reflects an overall organizational purpose and provides a long-range strategy for action. A *procedure* lays out a series of steps or instructions for performing a recurring type of activity. A *checklist* presents desirable items and allows engineers to check documents to ensure accuracy and completeness. A *role* is a functional position created in an organization to perform a particular task.

Table 1 is a summary listing of the tools developed and recommended by the research team. The chapters that follow describe the situations where the tools can improve the efficiency of the piping process.

Table 1. Summary Listing of Solution Tools for Inefficient Piping Function

Drivers for Inefficient Piping Function	Solution Tools			
	Policies	Procedures	Checklists	Role
A) P&ID Development Process				
• Lack of Sequencing and Prioritization	- (Tool #2-A): Owner Project Team Formation for Early Input - (Tool #2-B): Tactics for Overcoming Barriers to Owner Project Team Formation	- (Tool #1-A): Integrated P&ID Development Flowchart - (Tool #1-B): Information and Decisions for P&ID Development Stages - (Tool #1-C): Use of the Integrated P&ID Development Flowchart	****	****
• Inefficient P&ID Development and Review Procedure	- (Tool #3): Pre-P&ID Information List - (Tool #4): P&ID Standardization List - (Tool #7): Strategies for Avoiding Artificially Frozen P&IDs	- (Tool #6): Responsibility Assignment Chart for P&ID Development	- (Tool #5): P&ID Review Checklist and its Use	****