

Interface Management Implementation Guide



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Interface Management Implementation Guide

Research Team 302, Interface Management

Construction Industry Institute

Implementation Resource 302-2

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Executive Summary

As the complexity of capital projects has increased across increasingly globalized industry sectors, the use of interface management (IM) in the delivery of these projects has grown significantly. However, because construction organizations have implemented IM in wide variety of ways, the industry has no common IM definitions and practices. This variability hinders the widespread and systematic adoption of IM, despite its potential to improve project performance on large and complex capital projects around the world.

To address this issue, the Construction Industry Institute (CII) formed Research Team (RT) 302, Interface Management, charging the team with determining the most effective practices, techniques, and processes for improving the critical interfaces among globally dispersed project teams, multiple project partners, and an increasingly diverse labor force. RT 302 members studied and conducted interviews on more than 45 projects to determine the current state of IM in the construction industry and to identify any correlations it has with general project characteristics and performance. This effort revealed that the industry has no common and well-developed IM implementation process, and that the understanding of IM elements varies by organization. RT 302 thus decided that, by developing common IM terms, practices, and processes, it could lay a foundation for standardized IM processes for use on projects and within organizations. This research product, the Interface Management Implementation Guide (IMIGe), presents these terms, practices, and processes.

The IMIGe explains how organizations can use standard definitions and terms to implement IM effectively and systematically; it shows organizations how to determine the appropriate degree of IM implementation, at both corporate and project levels; it presents the requirements for each level of IM implementation; and it shows how to implement these requirements. The guide also presents several case studies, along with example workflows and forms, to help the user understand IM implementation.

With the IMIGe, users can assess the current state of IM on their projects and within their organizations, establish a goal of implementing the appropriate level of IM, and identify any gaps. To bridge any gaps, users can then develop and execute phased IM strategy and implementation plans, for both the short and long terms. Implementers may also selectively use specific IMIGe recommendations, depending on the status and conditions of their respective organizations and projects. To supplement the IMIGe,

RT 302 also produced Implementation Resource 302-3, *The Interface Complexity Assessment Tool* (ICAT), a tool that assesses the complexity of project interfaces. This Excel®-based resource is included on the disc accompanying the IMIGe and is available for download.

Chapter 1. Introduction

Background and Need for Interface Management Implementation Guide

To address the increasing scale and complexity of capital projects, as well as the need to manage multiple stakeholders effectively throughout the project life cycle, the construction industry has increasingly used the IM methodology. CII chartered RT 302, Interface Management, to investigate the potential answers to the following research question:

Which practices, techniques, and processes are most effective for improving the critical interfaces among globally dispersed project teams, multiple project partners, and an increasingly diverse labor force?

Composed of 18 industry team members and four academic team members, the team first investigated the origin and history of modern interface management.

The concept of IM has been around since the 1960s, primarily as a subset of systems engineering and its applications in the aerospace industry. Until recently, the construction industry has lacked a consistent approach to IM. In today's project environment, the importance of effective IM has increased as a result of the following factors:

- complex and geographically scattered projects
- globalized design and manufacturing processes
- compressed schedules, with parallel design and construction processes
- need for collaboration and timely exchange of information
- increased use of modular construction methods through multiple contracts
- increased demands from external stakeholders.

These challenges demand a structured approach to managing interfaces—both internal and external to the capital project environment—and the alignment of stakeholder interests to achieve successful project outcomes.

Currently, the practice of IM varies significantly between industries and corporations, especially within the oil and gas sector—and particularly in the offshore projects arena. The lack of a consistent understanding and common approach to IM can create false expectations of improvement in project performance or communication between parties. As part of the RT 302 effort to establish IM definitions, identify best practices, and gauge the current state of IM in the industry, team members used a survey to structure interviews with owner and contractor personnel on more than 45 projects in different industry sectors. The RT chose these 45 projects according to their general characteristics (e.g., cost and project type, among others), the contributing interface risk and complexity factors, and their correlation with IM adoption. A product of these research efforts, the IMIGe provides common IM definitions, principles, and best practices to support the development of standardized IM processes on projects and within organizations. As the first CII research team to investigate IM, RT 302 necessarily took this general approach to the subject, leaving future research teams to provide more detailed standardized IM processes for specific construction industry sectors.

Objectives

In order to understand the applicability of IM, establish the benefits of IM, and identify IM best practices, the research team identified the following objectives:

- Establish common language, definitions, and elements of IM.
- Ascertain representative project characteristics that can determine the need for IM.
- Identify important principles and proper timing, to guide the implementation of IM throughout the project life cycle.
- Identify effective IM practices that can be applied broadly to diverse projects.
- Propose multiple indicators that measure the potential effectiveness of IM.

Scope

To accomplish its objectives, RT 302 developed a scope of work that was divided into five main activities:

1. Develop a common set of terms and definitions.
 - Perform a thorough literature review of research on IM to develop a common set of terms and definitions for use by the RT members and survey participants, as well as by the broader capital projects industry.
 - Identify effective IM practices and IM tool capabilities.
2. Address survey stakeholders.
 - Identify project characteristics required to implement IM on a project.
 - Examine the current state of IM.
 - Identify mechanisms to quantify IM effectiveness.
 - Investigate effectiveness of IM for certain types of projects.
3. Develop tools and processes.
 - Establish an IM maturity model.
 - Develop a means to assess the current state of IM on a project or within an organization, and determine an appropriate level of IM implementation.
 - Identify IM requirements as they relate to the project life cycle.
4. Document practical examples of effective IM programs.
 - Select practical examples based on results of the interviews and case studies.
 - Conduct an analysis of the specific IM programs studied, and show any correlations with the maturity model.
5. Compile findings as a guide (i.e., IMIGe).

These five activities were all accomplished through the intellectual contribution of industry and academic team members, as well as that of the IM managers or project managers from the projects studied. The initial data-gathering target was 30 to 50 projects, all nominated by the RT members' respective companies. At the end of

data collection, the team had successfully gathered data from more than 45 projects. These projects were in different industry sectors, with various sizes and geographic distributions. For data collection purposes, the team developed a standard questionnaire with the following goals: isolating the project characteristics that motivate the formal IM implementation; examining the current state of IM; and identifying mechanisms to quantify its effectiveness. The three-part questionnaire asked for general project information, current IM practices, and past IM performance. To ensure the clarity and effectiveness of the questionnaire, team members also used this questionnaire to conduct four pilot interviews. Drawing on feedback from these pilot interviews, the team reviewed and improved the questionnaire and then used the final version for the actual interviews.

Intended Use of IMIGe

The IMIGe provides a common understanding of IM, allows users to assess the current state of IM on their projects, and helps them determine the appropriate level of IM implementation for their respective organizations. To bridge the gaps they find, they can use the IM requirements they identify to develop short- and long-term IM strategies and implementation plans.

Structure of the IMIGe

Chapter 3 presents the common set of definitions and elements the research team developed from its literature review and interviews. It also discusses the benefits and costs associated with proper IM implementation. Chapter 4 provides assessment criteria for determining an organization's needs and the gaps to be bridged. After introducing the research team's recommended practices and implementation tools, Chapter 5 offers a guide to developing a master interface plan for a project. Chapter 6 summarizes a case study of an organization's implementation of formal IM practices based on the project life cycle model.

IMIGe Benefits to Owner and Contractor

RT 308 developed the IMIGe to help owners specify the appropriate level of IM implementation across the project life cycle. For instance, the guide explains that when projects involve multiple contracts, owners should deploy IM systems that allow for the alignment of interests among the interface stakeholders. Such IM systems provide common goals, effective communication, improved oversight, and the timely resolution of conflicts. Contractors can also benefit from the IMIGe by using it to establish effective IM processes that are consistent with industry practice. This greater alignment within the larger market context will in turn give them access to higher-value projects and improve project performance.

Determining the direct effect of IM implementation on reducing project total cost was not feasible during this research, since it is a function of many other factors. However, three of the interviews the team conducted produced anecdotal evidence of a relationship between project cost performance and appropriate IM implementation:

- On a project with a total cost of \$1-5 billion, identifying and managing interface points (IPs) between interface stakeholders resulted in less rework and early completion of the design by approximately five months; this improved performance represented \$25 million in savings.
- On a project with total cost of \$5-10 billion, the design was subcontracted to several engineering contractors. In a design package of \$45 million, the early identification of major IPs between the engineering contractor and the procurement contractor resolved a procurement issue, which resulted in \$10 million of savings.
- On a project with total cost of \$5-10 billion, the lack of appropriate IM and the failure to recognize a supply and quality issue between the engineering/procurement stakeholder and the construction stakeholder resulted in a penalty of \$10 million per week incurred over several weeks.

From its analysis of the data collected, RT 302 also gained a non-anecdotal perspective on the benefits of IM. In general, the team's analysis of project performance shows that the projects with high-level IM implementation, on average, had lower cost growth compared to the ones with low-level IM implementation. For the research data set analyzed, the average cost growth for the high-level and low-level IM implementation groups of projects was four percent and 20 percent, respectively. Chapter 3 discusses the cost of implementing IM.

Chapter 2: What Is Interface Management?

Overview

IM was first conceptualized in 1967 on an aerospace and electric power pool project, to identify the contact points between relatively autonomous interacting organizations and analyze the inter-organizational problems that arose from missed contact (Wren, 1967). Although IM has a long history, it has not been fully utilized in construction practice, mainly due to a lack of the necessary technological infrastructure required to organize, communicate, and control effective amounts of interface information and data. However, due to significant advances in information and communication technologies in the last two decades, the construction industry has gradually adopted IM in dispersed and varying forms. (Examples of IM procedure implementation can be found at Wood Group Mustang Engineering (Shirley and James 2006) and Foster Wheeler (Collins et al. 2010).)

Interface Management Definitions and Elements

Despite the growing need for IM practices in mega-construction projects, the industry has no commonly agreed-upon definitions for IM and its elements. Therefore, RT 302 first sought to develop the fundamental definitions for elements of IM, which are listed as follows:

- **Interface Management (IM):** IM is the management of communications, relationships, and deliverables among two or more interface stakeholders.
- **Interface Stakeholder:** An interface stakeholder is an organization involved in a formal interface management agreement within an interface management plan for a project.
- **Interface Point (IP):** An IP is a soft and/or hard contact point between two interdependent interface stakeholders. An IP is also a part of the project's scope split as defined by project documents, in which the responsibility passes from one interface stakeholder to another. (See Figure 1 for an example of an IP at a flanged joint.)

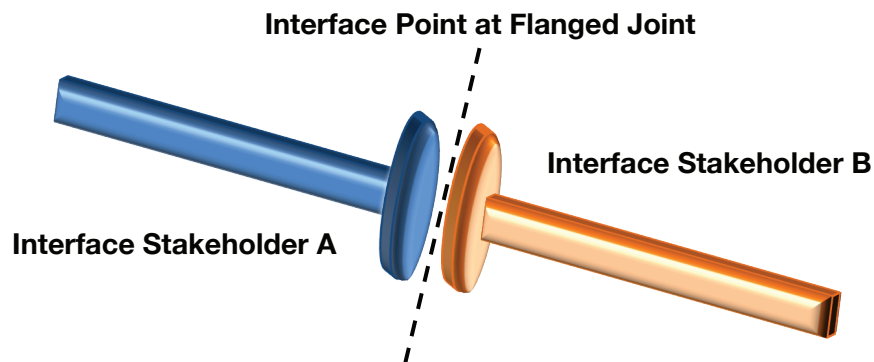


Figure 1. IP Example: IP at Flanged Joint

Typical examples of IPs are as follows:

- pipes crossing a contract boundary (piping IP)
 - cables terminating at a substation (electrical IP)
 - gravity drains crossing a contract boundary (civil IP)
 - pipe rack crossing a contract boundary (structural IP)
 - government regulatory permits to operate or work (regulatory IP)
 - third-party/agency certifications of equipment
 - operating procedures between dependent, but separately owned, facilities
 - reconciliation of local and industry standard specifications
 - product specification between feedstock provider and end user.
- **Interface Agreement (IA):** IA is a formal and documented communication between two interface stakeholders regarding an IP, addressing deliverables descriptions, need dates, and required actions.
 - **Interface Action Items (IAIs):** IAIs include the tasks/activities that are performed to provide the agreement deliverables defined in each IA.
 - **Interface Control Document/Drawing (ICD):** An ICD is the documentation that identifies and captures interface information and any approved interface change requests. ICDs are useful when separate organizations are developing design solutions to be adhered to at a particular interface.

Figure 2 illustrates the hierarchy and relationship between the elements of IM (Shokri et al. 2012).

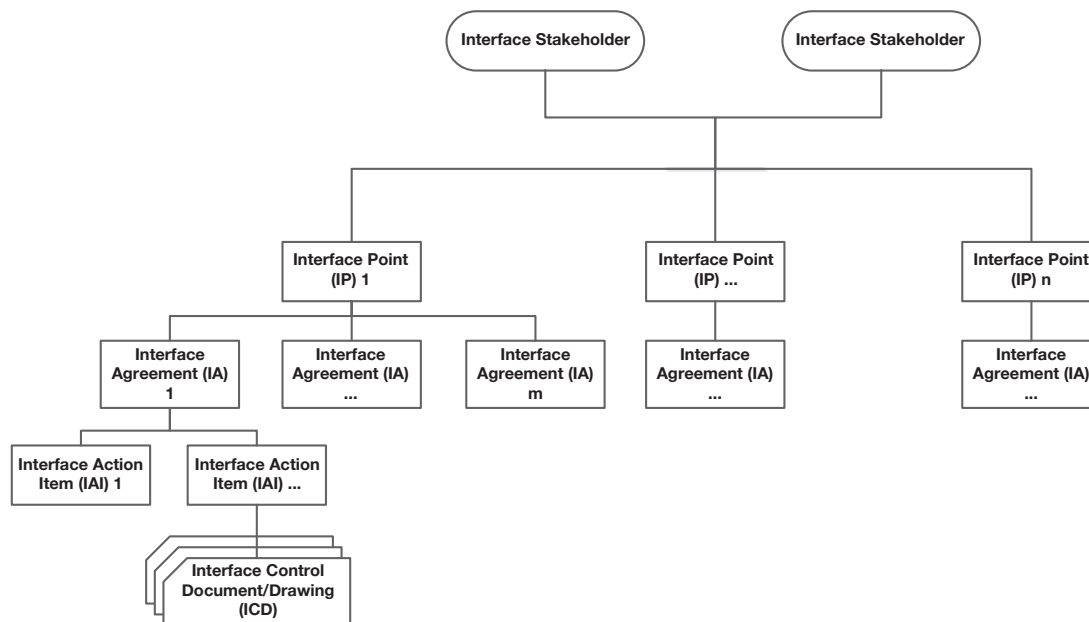


Figure 2. Hierarchy of Interface Management Elements

In general, interfaces are classified as soft or hard. They can also be considered either internal or external. The definitions of each category are as follows:

- **Soft Interface:** Soft interfaces typically involve the exchange of information such as design criteria, clearance requirements, or utility needs between delivery teams or between a delivery team and an external party. Soft interfaces are present in regulatory and permit issues, as well as in situations involving differing languages and cultures (Adapted from Khadimally 2011).
- **Hard Interface:** Hard interfaces represent physical connections between two or more components or systems. Examples of hard interfaces are structural steel connections, pipe terminations, or cable connections (e.g., tie-in points) (Adapted from Khadimally 2011).
- **Internal Interface:** Internal interfaces are those identified within a single scope of work (Chen et al. 2007; Lin 2009).
- **External Interface:** External interfaces are those identified between two or more scopes of work (Chen et al. 2007; Lin 2009).

Interfaces can be further classified into different categories to serve specific purposes. These categories include but are not limited to the following: physical, contractual, organizational, functional, resource-related, and social (Pavitt and Gibb 2003; Chen et al. 2007; Crumrine et al 2005). (Appendix A provides more IM-related definitions.)

IM Benefits

Industry leaders believe that IM improves alignment between stakeholders on mega-projects and that it reduces project issues and conflicts by increasing the visibility and clarity of roles, responsibilities, and project deliverables (Archibald, 1992). It follows logically that almost any project that is highly complex—such as an urban light rail project or an offshore oil platform—could merit the application of IM. The explicit outcomes of successful IM implementation are discussed in the sub-sections below.

Alignment of Stakeholders

A significant outcome of a successful IM program is the increased alignment of interface stakeholders; such successful IM implementation involves regular face-to-face meetings and an interface management plan (IMP). The IMP describes the methods and strategies for managing interfaces. Well-planned IM helps ensure that all stakeholders are working toward common goals, with clear methods, first, to avoid potential conflicts and, then, to resolve any conflicts that arise.

Facilitation of Communication Channels

Communication is the key success factor on today's globally dispersed construction projects; on these typically complex projects, each stakeholder deals with multiple parties, at different geographical locations, in the midst of significant cultural and language differences. IM facilitates communication between stakeholders by creating a formalized framework for the effective sharing and distribution of information. Not only do stakeholders know how to communicate, but they also know what information should be communicated, and when. In other words, they agree on the content and specifications of the deliverables in a written format by issuing interface agreements; and they commit to a deadline that is mutually feasible for both interface stakeholders by recording the dates in the IAs.

Real-time Visibility and Oversight

By implementing formalized IM on a project, interface stakeholders can gain real-time visibility of the deliverables by defining clear roles and responsibilities, agreeing upon deadlines to provide interface-related deliverables, and accessing real-time project information.

Mitigation of Interface-related Aspects of Project Risk

In addition to creating increased alignment and coordination between stakeholders, formalized IM helps project parties achieve a common understanding of interfaces, deliverables, and associated deadlines. A formal IM system thus allows for the early identification of interfaces—specifically, during front end planning (FEP)—and the effective management of interfaces throughout the project life cycle. Moreover, interface stakeholders can effectively share and distribute the risk related to detailed information, through formalized IM. This leads to reducing project redundancies, uncertainties, and surprises for all parties engaged in the IM process.

Improvement of Project Performance

Improving project performance could be considered the ultimate outcome of all other benefits of successful IM implementation. Analysis of the data acquired through the RT 302 research indicates that IM increases alignment, facilitates communication channels, improves real-time visibility and oversight, and formalizes the distribution of potential “risk-creating” information between stakeholders. These outcomes result in the effective project delivery and in improved project performance (e.g., reduction in cost and schedule growth).

Cost of IM Implementation

IM implementation involves significant cultural and structural shifts within an organization. This paradigm shift to formal acknowledgement, management, and tracking of project interfaces (previously identified primarily through schedule logic ties or project action item lists) may vary from one organization to another, depending on the formality and automation of IM system adopted. However, in general, IM implementation requires the assignment of new IM-related roles, each

with acknowledged accountability for interface management functions (e.g., interface manager and interface coordinator). An interface manager's duties are to develop work processes and employ IM software—ranging from in-house spreadsheets to commercial workflow-based specialized software packages. The interface coordinator is also responsible for training employees to adapt to any cultural and organizational change occasioned by the new IM system. All of these new IM-related activities, as well as contract administration, add to the organization/project cost, and this increased cost should be considered and justified. Some of the implementation costs could be allocated across multiple projects and amortized over a period exceeding that of the project duration. Anecdotal evidence from one of the interviewees indicates that for a project valued at slightly over \$10 billion, approximately 0.2 percent of total project value is assigned for IM implementation.

Due to the status of IM as an emerging project management practice and its interdependency on other practices, IM research to date has not determined the direct cost savings of its implementation. However, on average, the research team's data analysis showed that projects with a high level of IM implementation have almost five times better performance in terms of cost growth (3.7 percent versus 18.4 percent), compared to projects with a low level of IM implementation. (Note that the analysis shows a wide range of possible outcomes, and it does not directly link to cost savings in a cause-and-effect relationship.) Thus, for a hypothetical project valued at \$10 billion, the cost of implementing IM might be \$20 million, and the benefit might be over \$1 billion. At the very least, it would be expected to be many times greater than the cost.

Chapter 3: How Do We Determine the Appropriate Level of IM Implementation for Our Project and/or Organization?

IM Implementation Maturity Model

The maturity model for IM implementation recommends a stepwise process to move an organization to a desired state of IM implementation. Management and project teams can determine this desired state by identifying and simultaneously considering project interface risk and its potential consequences. The pathway toward a complete IM implementation plan should be a maturation process that promotes learning and adaptation appropriate to the organization. The process and pace of maturation can be customized to the anticipated IM requirements across the organization's portfolio of projects. This will also allow for a high-quality, measured implementation of each of the components of an IM implementation plan.

The basic elements to consider when implementing IM are business processes, enabling tools/systems, qualified people/practitioners, and sustaining culture. The stages of the maturity process for each of the basic elements start with Stage 0 (the starting point for an organization that is just venturing into IM implementation) through Stage 4 (the point at which IM is fully implemented across the organization on appropriate projects). The stages can also be viewed as a progression from informal to formal interface management (i.e., IM formality).

Business Processes: The way in which IM is implemented on projects is normally documented in company- or project-level processes and procedures.

- Stage 0: Implement *ad hoc* project-derived processes to meet specific coordination requirements on that project.
- Stage 1: Adopt industry best practice, based on the IMIGe guide and other sources.
- Stage 2: Develop a best practice on several pilot projects.
- Stage 3: Measure the impact of processes on key project performance indicators (e.g., cost and schedule) that can be aggregated across projects.
- Stage 4: Integrate IM processes with other dependent project processes, such as project schedule and cost, change management, risk management, and document review.