ELEMENT 9

INFORMATION TECHNOLOGY

OPERATIONS AND MAINTENANCE INFORMATION NEEDS SURVEY RESULTS

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Lifecycle Data Management Project

Operations and Maintenance Information Needs Survey Results

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1. Executive Summary

This report documents results of a survey conducted by the FIATECH Lifecycle Data Management (LCDM) project's task force on Operations and Maintenance Information Needs. The task force goal was to understand and document Operations and Maintenance information needs and current issues with the information exchange between projects and O&M, so they can be addressed in further efforts by FIATECH and/or technology suppliers. The survey is intended as a first step in understanding and documenting, from the Owner-Operator perspective, the Operations and Maintenance information requirements that capital projects should meet when turning over new or upgraded facilities.

The survey, conducted in late 2002, intended to solicit input from experienced hands-on Operations and Maintenance leaders with respect to their company O&M information systems. Topic areas included in the survey were:

- how those information systems supported O & M work processes,
- what information is valuable to O&M users,
- how information is delivered to O&M users from projects, and
- the identification of specific issues and opportunities for improvement related to that information delivery.

The survey topic areas and questions reflect input and discussion from representatives of the various companies that participated in the FIATECH Lifecycle Data Management Project and its predecessor, the Owner-Operator Forum.

The survey respondents included 12 experienced site team leaders from 10 process industry companies. These respondents all had significant on-site experience as operations and/or maintenance team leaders in their companies.

Key findings from the survey include the following:

1) For almost all of the companies in the survey, there is a clear organizational divide between projects and O&M, and for most multi-facility/multi-product process industry companies, there are significant organizational hurdles that need to be addressed to integrate information systems between O/M and projects effectively.

2) Maintenance information systems and tools are: a) significantly more standardized within multi facility companies than operations systems and tools, and b) are more likely to be integrated with company wide Enterprise Resourcing Planning (ERP) systems than are operations systems.

3) Current typical project engineering deliverables have value to operations and/or maintenance, but many of them need to be manually manipulated before operations or maintenance functions can use them. Eight of the ten respondents rated their company's state of automated data transfer between the two work process areas as "Low."

4) While all survey respondents felt that legacy data was a barrier in bringing in new information tools, the legacy data issue is much more significant for larger companies.

5) In identifying opportunities to improve information delivery to O&M, larger company respondents focused on integrating systems and integration methodologies, while mid-sized companies tended to focus on specific issues related to the content of the information and/or implementation.

6) A significant opportunity area is one where data is captured during the project process but then data presentation context shifts from a project "view" to an O&M "view" on demand.

2. Introduction

This survey is a product of the FIATECH Lifecycle Data Management (LCDM) project's task force on Operations and Maintenance Information Needs. Its purpose was to refine further the preliminary work completed by the Owner-Operator Forum sub-team members.

The LCDM project and its task forces were originally formed as the Owner-Operator Forum in early 1999 when a group of process industry owner-operators recognized that their businesses could gain a great deal of the value by better managing information generated in initial project design throughout the lifecycle of a manufacturing facility. This group, led by representatives from Air Products and Chemicals, BASF Corporation, The Dow Chemical Company, DuPont, and Merck & Co., sought to define technologies that could be used to better manage technical facility information through the life of the facility. In late 2000, the Owner-Operator Forum became the Lifecycle Data Management Project of FIATECH.

Between 1999 and 2001, the Owner-Operator forum conducted a series of 18 steering meetings and workshops to define collectively a vision for Lifecycle Data Management, and to identify the specific challenges and opportunities associated with that vision. The results of those meetings were documented in January 2001 in a FIATECH report entitled "Guidelines and Drivers for Achieving Plant Lifecycle Data Management." Following are some of the important discussion points from that report that guided the work of the Operations and Maintenance Information Needs task force:

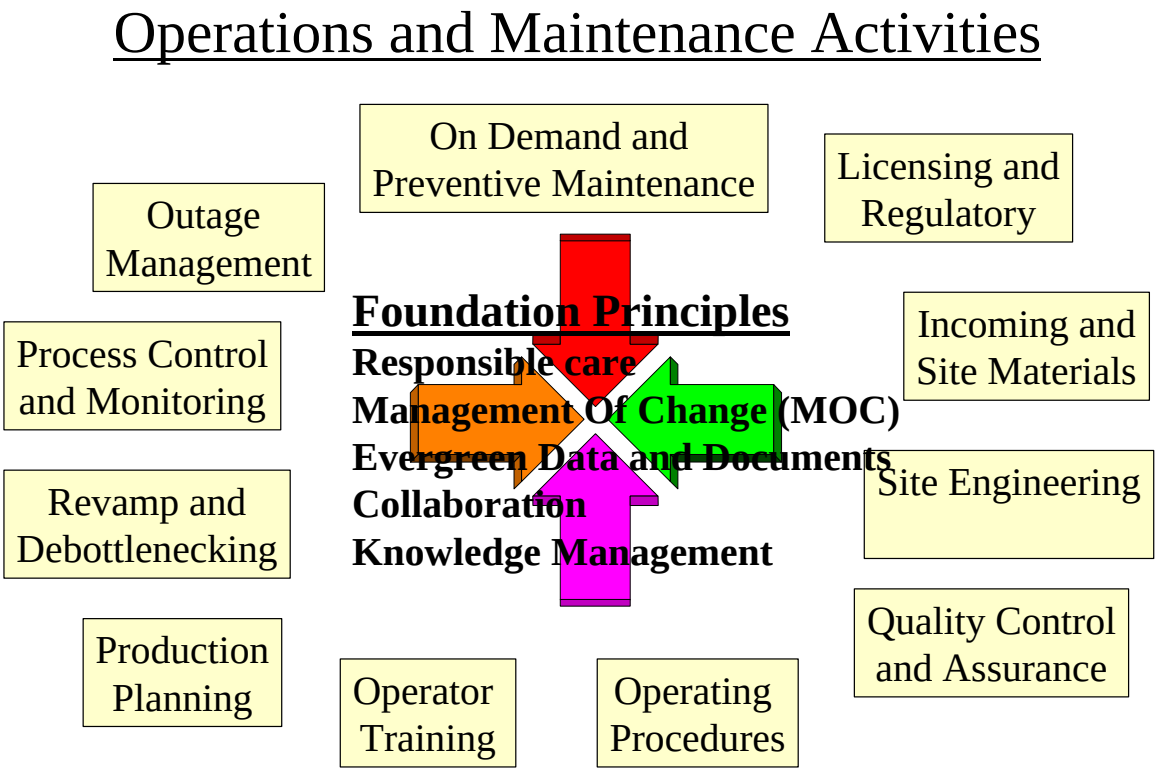
1) Information transfer during each phase of the lifecycle is currently costly, takes a long time, and is prone to error.
2) Owners would like to migrate data instead of transferring it. The information is the fundamental asset of the owner. When the barriers to migration are eliminated regardless of the data model, the advantage to all of stakeholders will be significant.
3) Owners believe that there is great potential for profitable use of facility information after asset creation.
4) We encounter high cost and cycle times when we translate information for downstream use and regenerate information that is frequently on paper today.
5) We see that there are tools for using this data downstream, but we do not see that data delivered in a way that is usable.
6) We understand that manual steps in a process limit its ability to only one or two sigma capable. We want to use automation to get to Six-Sigma.
7) A significant breakthrough of this FIATECH Project is the focus on understanding what information the engineering/project work processes could be delivered to operations and maintenance.
8) Owners and operators are on a quest to leverage the automation investments made during design and engineering into the day-to-day maintenance and operations activities.

9) Facilities today frequently must expend large amounts of effort and time converting the project information for relevant maintenance and operations systems and work processes.

10) One of the fundamental values of the Forum is the documentation of the information needs for downstream activities and this has partially been done to define better the required project information turnover.

In response to these points, the FIATECH Lifecycle Data Management (LCDM) Project's task force on O&M Information Needs sought to define, from the Owner-Operator perspective, the Operations and Maintenance information requirements that capital projects should meet when turning over new or upgraded facilities. The task force goal was to understand and document Operations and Maintenance information needs and current issues with the information exchange between projects and O&M, so they can be addressed in further efforts by FIATECH and/or technology suppliers.

The O&M work processes focused upon are shown in the figure below.



This survey was conducted as a first step in an effort to understand better those issues with information exchange that may be common to the process industry.

3. Survey Goals and Methodology

3.1 Survey Goals

The survey intended to solicit input from experienced hands-on Operations and Maintenance leaders with respect to their company O&M systems, how those systems supported O & M work processes, what information is valuable to O&M users, and how information is delivered to O&M users. Specifically, the survey sought input to the following major topics areas:

1) **Company Organization and O&M Work Process Definition** - In this topic area, the survey sought to understand the issues around the respondent company's organization and work processes that might bear on the integration and information systems between Operations and Maintenance and Projects.
2) **O&M Information System Standardization** - In this topic area, the survey sought to understand the degree of intra-company standardization of both Operations and Maintenance information management systems.
3) **Value of Project Information to O&M** - In this topic area, the survey wanted to understand the relative value to O & M users of the different types of information typically contained in project engineering deliverables.
4) **Automation of Information Delivery to O&M** - In this topic area, the survey sought to understand how efficiently information generated by project engineering was delivered to O & M.
5) **Legacy Data as a Barrier to Automated Information Delivery** - In this topic area, the survey sought to understand the impact of legacy data as an issue in adopting new data management automation tools.
6) **Opportunities for Improvement** - In this topic area, the survey sought open ended input from the respondents as to what the most important issues with O&M information in their companies.

3.2 Survey Methodology

The survey was developed by Debbie McNeil of The Dow Chemical Company as leader of the Life Cycle Data Management Project's task force on Operations and Maintenance Needs. Much of the basis for the survey topic areas and questions came out of workshops led by Ms. McNeil in 2000–2001 as a part of the Owner-Operator Forum. The survey topic areas and questions reflect input and discussion from representatives of the various companies participating in the Owner-Operator forum and the FIATECH Lifecycle Data Management Project.

The survey was administered by Charles Wood, Project Manager of the FIATECH Life Cycle Data Management Project between July and October of 2002. In administering the survey, Mr. Wood first contacted potential respondents to discuss his/her background and experience with respect to the survey topic areas as well as the survey objectives, methods and time commitment. Those respondents that were both qualified and willing to participate in the survey were sent an electronic copy of the survey form to review. In most cases, Mr. Wood interviewed the respondents in person or over the phone and captured their responses to the

survey questions. In some cases, the respondents completed the survey on their own and returned the survey to Mr. Wood.

3.3 Survey Respondents

The survey respondents included 12 experienced site team leaders from 10 process companies. The survey respondents all had on-site experience as operations and/or maintenance team leaders in their companies. Two of the large companies had representatives from both operations and maintenance functions respond to the survey together. Two of the respondents were currently working in information systems, but had previous experience as on-site O&M leaders.

In order to encourage open participation in the survey, all respondents were guaranteed personal and company anonymity. Throughout this report, the discussion and tables refer to responses from individual companies. In order to preserve anonymity and still analyze and discuss potentially interdependent responses (e.g., Does the degree of work process definition in a company correlate with the degree of information system integration within the respondent companies?), this report identifies the respondent companies by codes (L1, L2, etc. and M1, M2, etc), where L indicates a large company (over $20 B annual revenues) and M indicates a mid-sized company ($500 MM-$2 B annual revenues). Table 3.3.a below summarizes the respondent companies.

Table 3.3.a: Respondent Companies

Identifier	Industry	Comments
L1	**Chemicals**	
L2	**Chemicals**	
L3	**Metals**	
L4	**Upstream Oil & Gas**	
M1	**Industrial Gases**	**Single plant location**
M2	**Chemicals**	
M3	**Minerals**	**Single plant location**
M4	**Chemicals**	
M5	**Refining and Chemicals**	
M6	**Chemicals**	

4. Key Findings and Conclusions

Organization and work process definition - For almost all of the companies in the survey, there is a clear organizational divide between projects and O&M. The multi-location companies all used separate engineering and construction organizations for 'non-routine' projects. Other interview discussion with respondents (not documented in the survey) indicated that most plant facilities in multi-location companies were managed by, or their management was strongly influenced by, the product line organizations that they serve. This organizational separation between project and O&M organizations is reflected in the responses to the survey questions about work process definition and integration. It seems reasonable to conclude that, for most multi-facility/multi-product process industry companies, there are significant organizational hurdles that would need to be addressed in order effectively to integrate information systems between O&M and projects.

Each of the ten respondents to this question indicated that their company had clearly defined project work processes, and nine of these also indicated clearly defined O&M work processes. However, only three companies indicated that project and O&M work process definitions were integrated with each other. Further, the major O&M work processes proposed for consideration in the survey seemed to be consistent across companies, and there were relatively few additional processes that were important to individual respondents. However, few respondents claim to have integrated these relatively standard work processes between O&M and projects. It appears that factors other than variability of work process between locations or companies are responsible for the lack of integration between information systems.

System standardization and integration with ERP systems - The survey responses indicate that maintenance information systems are significantly more standardized than operations information systems, especially for the larger companies. Most companies (6 out of 10) surveyed either already have or have plans to integrate maintenance information systems with an ERP system. Three companies (all mid-sized) had done so already. Only one company had fully integrated its operations information systems with ERP

The only large company that did not use a standardized tool set for maintenance information had plans to standardize tools around its ERP implementation. This suggests that it is easier or more practical for both large and midsize companies to standardize maintenance information systems than operations information systems.

Value of project information to O&M - Respondents identified most of the typical engineering deliverables listed in the survey as being of value to either Operations or Maintenance or both. As might be expected, there did not appear to be any significant variance in the value of a given deliverable between large and medium sized companies.

The following project engineering deliverables were identified by **60% or more** of the respondents as having high value to Maintenance as delivered from project engineering, without further data manipulation:

High Value to Maintenance as Delivered:

OEM Manuals	Relief Valve Settings and Specs	Electrical Schematics
Electrical Connections Drawings	Instrument Loop Drawings	Instrument Calibration Settings
Vendor Data-Drawings	Process and Instrument Diagrams	Electrical Single Line Diagrams
Electrical Loop Diagrams		

The following deliverables were identified by 50% or more of the respondents as having high value to Maintenance but needing to be manipulated after delivery from project engineering:

High Value Information but Manipulation Required For Value Achievement

Spare Parts Lists	Instrument Datasheets	Predictive Maintenance Schedules
Equipment Detailed Specifications	Vendor Data-Catalogues	Piping Isometrics
Underground Piping Drawings		

The following deliverables were identified by 60% or more of the respondents as having high value to Operations as delivered from project engineering, without further data manipulation:

High Value to Operations as Delivered:

Process and Instrument Diagrams	Instrument Shutdown Logic	Relief Valve Settings and Specs
Production Recipes	System Isolation Plans	

The following deliverables were identified by 50% or more of the respondents as having high value to Operations but needing to be manipulated after delivery from project engineering:

High Value Information but Manipulation Required For Value Achievement

Instrument Shutdown Logic	Instrument Loop Diagrams.	

Automation of information delivery to O&M - Six out of nine of the companies that responded claimed to deliver 50% or less of the information needed by O&M from projects in a form that did not have to be manually transferred or generated by O&M. None of the respondents believed that their company delivered all of the information needed by O&M in a form that was immediately usable.

Eight of the ten respondents rated their company's state of automated data transfer as "Low" meaning that data was either pulled manually from engineering or vendor documents, or it was transferred using local office tools (e.g., spreadsheets). The other two respondents indicated that they transferred data between independent databases. Most respondents (6 of 9) indicated that optimal point of automated information delivery is at the next level forward from their own current state.

Legacy data as a barrier to information delivery systems- All of the respondents felt that legacy data was an issue in bringing in new tools. All of the midsize companies indicated that legacy data was a barrier to new tool implementation, but that those barriers could be overcome if the value was high enough. In contrast, all but one of the large companies indicated that legacy data was such a significant barrier that they only introduced new tools in new facilities- they generally left older facility data in the older information systems. The primary drivers for O&M "evergreen" data maintenance for most companies are safety or regulatory requirements.

Opportunities for improvement - In responses to an open ended question about improving delivery of information to O&M from projects, the larger companies focused most on integrating systems and integration methodologies, while the mid-sized companies tended to focus on specific issues related to the content of the information and/or implementation.

5. Survey Results by Topic

(Note: the tables in this section often refer to responses from individual companies. In order to maintain anonymity, and still analyze and discuss potentially interdependent responses the companies are identified by code (L1, L2, etc. and M1, M2, etc). See section 3.3 above for further explanation of these codes.

5.1 O&M Work Processes

In this topic area, the survey sought to understand the issues around the respondent organization's work processes that might bear on the integration of information and information systems between Operations and Maintenance and Projects. The surveyors expected that both the organizational structure for project execution (i.e., the degree to which project were managed by organizations separate from the plant operations organization), and the degree of definition and integration of work processes between projects and operations would influence the ability of the companies to integrate information between O&M and projects. That is, companies with well-defined and integrated work processes and integrated project organizations would be more likely to have better integrated and automated information systems to support them; and conversely, companies with less defined and integrated work processes would have more difficulty integrating information systems.

Specifically, the survey asked about the level of definition of both Operations and Maintenance work processes, as well as the degree of integration between those two sets of work processes within the respondent companies. In addition, the survey questioned respondents about the organizational context for managing non-routine projects in the operating facility (i.e., Did the respondent company use a separate organization for non-routine projects or were these managed within the operating facility's organization?). Finally, the survey asked that the respondents identify significant O & M work processes not already anticipated in the survey.

In answering questions about this topic, the survey suggested respondents consider the following typical O&M work processes:

1) On Demand and Preventative Maintenance,
2) Quality Control and Assurance,
3) Site Materials Management,
4) Outage Management,
5) Licensing and Regulatory,
6) Process Control and Monitoring
7) Operating Procedures,
8) Operator Training, and
9) Production Planning.

Respondents were asked if there were any additional major O&M work processes that they would consider in responding to the survey. Additional work processes considered by the respondents are listed below in "Findings."

Findings

(Actual Questions asked can be found in survey form.)

Project Organization –

Eight of the ten companies used separate EPC organizations for non-routine project execution within the plant facility (see table 5.1.a below). Of the two companies that did not use a separate EPC organization, one was a single facility company that uses the same plant operating engineers and managers to fulfill the owner role in project execution. One of the large companies relied on an alliance with an EPC contractor to fulfill the owner role in project execution. Most respondents identified the size of the project as the principal criteria in determining when a project needed a separate EPC group for execution (see exhibit 5.1.b). Other considerations included the extent of new design required, resource availability, and urgency.

Table 5.1.a

Companies with separate EPC organization		Companies without separate EPC organization	
L1	M2		M1
L2	M3		M5
L3	M4		
L4	M6		

Table 5.1.b: A facility becomes EPC group's responsibility when:

Company	Comment
L1	Generally whenever it is budgeted as capital project, 80/20 rule, extensive design or high $value goes to EPC approach
L2	Maintenance does no facility changes or design changes; like to like replacement and repair executed by Maintenance. Maintenance also does technical troubleshooting.
L4	Typically it is a scope and cost determination of it is beyond the local workforce capability
M2	Size and scope of project
M4	Size of project, resource availability, and urgency of getting the project completed
M6	When its time to detail selected option

Work Process Definition (see table 5.2.c) –

Each of the ten respondents to this question indicated that his company had clearly defined project work processes, and nine of these also indicated clearly defined O&M work processes. However, only three companies indicated that project and O&M work process definitions were integrated with each other; a fourth indicated that his company had partially integrated its project and O&M work processes. Note: the only large company indicating tightly integrated O&M and project work processes operates multiple upstream oil and gas production facilities. These operations use very similar production processes and plant equipment across multiple facilities.

Table 5.1.c: Current state of work process

General Guidelines Only	O/M Work Processes Defined	Project Work Processes (PWP) Defined	Tightly integrated O/M and Project WP's Defined
None	L1 <---------	----------->L1	L2 (50%)
None	L2 <----------->L2		L4
None	L3 <---------	----------->L3	M2
None		M1 (1 site)	M1 (1site)
None	M4 <---------	----------->M4	M3 (1site)
None	M5 <---------	----------->M5	
None	M6 <---------	----------->M6	

O&M Work Processes Considered –

In addition to the major O&M work processes proposed for consideration by the survey (exhibit 5.2.d), respondents identified those items shown in exhibit 5.2.e as important O&M processes.

Table 5.1.d

Sl. No.	Items included in survey
1	On Demand and Preventative Maintenance
2	Quality Control and Assurance
3	Incoming and Site Materials Management
4	Outage Management
5	Licensing and Regulatory
6	Process Control and Monitoring
7	Operating Procedures
8	Operator Training
9	Production Planning

Table 5.1.e: Additional O/M work processes brought forward by respondents

L1	1 Reliability (optimization of Asset performance), ½ budget spent on fixed equipment 1.1 Failure analysis, 1.2 Weibull analysis – statistical analyses- indicates which other processes apply 1.3 Risk based inspection, etc.) 2 Condition based Maintenance and Reliability (continual, not on demand or preventative, maintenance based on readings while operating)
L2	1 Maintenance work scope definition (clarity imperative) 2 Communication between Maintenance and Operations on planning work and progress 3 Maintenance craftsmen training/ certification 4 Failure analysis 5 Spare part management
L3	Production planning is ad-hoc (spreadsheets), outage mgmt is not coordinate
L4	Predective Mainteinance
M1	None
M2	None
M3	1 Revamp Engineering 2 Mainteinance Enigineering
M4	None
M5	None
M6	1 Advance Process Control 2 Manufacturing execution systems

Analysis and Conclusions

For almost all of the companies in the survey, there is a clear organizational divide between projects and O&M. The multi location companies all used separate engineering and construction organizations for "non-routine" projects. This divide makes business sense as "non-routine" projects, by definition, require effort beyond normal operations and maintenance scope, staffing levels, and skill sets, and it would be inefficient to retain skilled project staff during routine operations to be available for "non-routine" projects.

Further, other discussion with respondents (not documented in the survey) indicated that most plant facilities in multi-location companies were managed by, or their operations were strongly influenced by, the product line organizations that they serve. This is often the case even within a single facility producing multiple products. Since the needs and priorities of each different product line are variable and dynamic, it would be difficult to establish a single homogenous organization to respond to both plant operations and non-routine project needs.

The organizational separation between project and O&M organizations described above is reflected in the responses to the survey questions about work process definition and integration. Only three companies indicated that they had integrated O&M and project work processes. Two of these three were mid-sized companies, and one of those was a single facility company. As noted above, the only large company with integrated O&M and project work processes

produces a single commodity product and uses very similar production processes and equipment across its facilities.

The major O&M work processes proposed for consideration in the survey seemed to be consistent across companies, and there were relatively few additional processes that were important to individual respondents. While the survey did not suggest a set of project work processes for respondent consideration in this topic area, it is generally recognized that current project work process are relatively standard across the industry. However, few respondents claim to have integrated these relatively standard work processes between O/M and projects. It appears that factors other than variability of work process are responsible for the lack of integration between information systems.

From the discussion above, it is reasonable to conclude that for most multi-facility, non-commodity companies, there are significant organizational hurdles that would need to be addressed in order to integrate information systems between O/M and projects.

5.2 Operations and Maintenance Information Management Systems

In this topic area, the survey sought to understand the degree of company standardization of both Operations and Maintenance information management systems. For each of 1) Operations Information Systems and 2) Maintenance Information Systems, the survey asked respondents whether or not their company had: A) a standard set of information systems across sites (i.e., standardized tool sets), B) a single integrated information system across sites, and/or C) was the information system integrated with the company's ERP system.

Findings

System Standardization (see table 5.2.a)-
Most companies surveyed used standard sets of maintenance information systems or tools across multiple company facilities. Both companies that had a single maintenance information system were single location companies. One (midsized) company had plans to standardize to a single cross company maintenance information system, but has not yet done so. None of the others mentioned plans to standardize on a single maintenance information system.

None of the companies surveyed used a single cross company operations management system. Only 4 of the 10 companies surveyed used standard sets of operations management systems or tool, and of these four companies were midsize; none of the large companies surveyed used a standard set of operations information systems across the company.

Integration with ERP Systems (see table 5.2.b)-
Most companies (6 out of 10) surveyed either already have or have plans to integrate maintenance information systems with an ERP system. Only three companies had done so already; one additional company had "one way' integration with ERP, meaning that maintenance fed information into ERP but did not receive significant information out of the ERP system. Only one company had fully integrated its operations information systems with ERP, one had "one way" integration (as it had with maintenance), and one company had

integrated with ERP for the purpose of managing materials only. The three companies that claimed to have successfully integrated their maintenance system with an ERP were all midsize companies.

Table 5.2.a: O&M Information management system standardization

	Standard Set of Information Systems	Single Information System (company wide)
Maintenance Information system	**L1, L2, L3 M2, M5, M6**	**M1(1site) M3 (1site)**
Operations Information system	**M1(1site), M2, M5, M6**	**None**

Table 5.2.b: Company's MIS and OIS integration with ERP

Company	Maintenance Information system integrated with ERP	Operations Information system integrated with ERP
L1	**No**	**No**
L2	**Yes (one way)**	**Yes (one way)**
L3	**Will**	**Will**
L4	**Will**	**Will**
M1	**No**	**No**
M2	**Yes**	**No**
M3	**No**	**No**
M4	**Yes**	**Yes**
M5	**Yes**	**Yes (materials only)**
M6	**No**	**No**

Analysis and Conclusions

The survey responses indicate that maintenance information systems are significantly more standardized than operations information systems, especially for the larger companies. Most companies, including all but one of the large companies had standard sets of maintenance information tools as a minimum. The only large company that did not use a standardized tool set had plans to standardize maintenance information tools around its ERP implementation.

This suggests that it is easier or more practical to for both large and midsize companies to standardize maintenance information systems than operations information systems; possibly because maintenance work processes vary less from site to site than do operations processes. Still, only one company (a single site company) had found it practical to implement a single maintenance information system company wide.

While none of the larger companies used a standard set of operations information systems across sites, four of the midsize companies (including one single site company) did. Larger companies may find it less practical to standardized operations information across sites because

the larger a company is the more sites it has and the more products it is likely to produce, the more variable its processes are from location to location.

While a slight majority of companies have already or have plans to integrate maintenance information systems with an ERP system, there is little correlation in the survey results between the standardization of maintenance information systems and companies' integration with ERP. Some companies imply in their comments that they will use the ERP implementation to standardized systems, but others with standard system sets have not planed to integrate with an ERP.

5.3 Value of Project Information to O&M (what is the high value information?)

In this topic area, the survey focused on understanding the relative value to O&M users of the different types of information typically contained in project engineering deliverables. The survey presented a list of 41 typical project engineering deliverables and asked the respondents to rank each item as to its value to Operations and to Maintenance as it was delivered from the project. Specifically, the survey asked the respondents to categorize the value to O&M in one of five ways as follows:

1) little value,
2) some value but needed manipulation to be useful,
3) some value as delivered from the project,
4) high value but needs some manipulation to be fully utilized, and
5) high value as delivered by projects.

The survey also asked whether each information item was routinely supplied to O&M from projects in the respondent's organization, and invited respondent comments.

Findings *(see Appendix B- Value of Information- Detailed Responses for more detailed findings)*

Value to Maintenance (see Exhibit 5.3.a) –

Exhibit 5.3.a lists those typical engineering deliverables deemed to have high value to Maintenance by 60% or more of the respondents. 80% of respondents identified 24 of the 41 engineering deliverables listed in the survey as high value to Maintenance either as delivered by project engineering or with some manipulation after delivery from project engineering. 30% or more of the respondents indicated that all of the 24 high value deliverables needed some kind of manipulation after delivery from project engineering.

The following deliverables were identified by 60% or more of the respondents as having high value to Maintenance as delivered from project engineering, without further data manipulation: OEM Manuals, Relief Valve Settings and Specs, Electrical Schematics, Electrical Connections Drawings, Instrument Loop Drawings, Instrument Calibration Settings, Vendor Data-Drawings, Process and Instrument Diagrams, Electrical Single Line Diagrams, Electrical Loop Diagrams.

The following deliverables were identified by 50% or more of the respondents as having high value to Maintenance but needing to be manipulated after delivery from project engineering: Spare Parts Lists, Instrument Datasheets, Predictive Maintenance Schedules, Equipment Detailed Specifications, Vendor Data-Catalogues, Piping Isometrics, and Underground Piping Drawings.

Exhibit 5.3.a

Sl. No.	Value to Maintenance	% who think item is **high value***	% who think item **high value as delivered***	% who think item is **high value** but needs **manipulation***
1	OEM Manuals	100%	70%	30%
2	Relief Valve Settings and Specs	100%	70%	30%
3	Electrical schematics	100%	70%	30%
4	Electrical Connection Drawings	100%	70%	30%
5	Instrument Loop Diagrams	100%	60%	40%
6	Instrument Calibration Settings	100%	60%	40%
7	Spare Parts Lists	100%	50%	50%
8	Instrument Datasheets	100%	50%	50%
9	Preventative / Predictive Maintenance Schedules	100%	50%	50%
10	Instrument Databases	100%	40%	60%
11	Vendor Data- Drawings	90%	60%	30%
12	Process and Instrument Diagrams	90%	60%	30%
13	Electrical Single Line Diagrams	90%	60%	30%
14	Electrical Loop Diagrams	90%	60%	30%
15	Equipment Drawings	90%	50%	40%
16	Instrument Shutdown Logic	90%	50%	40%
17	Grounding Plans	90%	50%	40%
18	Equipment Detailed Specifications	90%	40%	50%
19	Installation Data	80%	50%	30%
20	Installation Inspection/ Test Records	80%	40%	40%
21	Civil/ Structural Drawings	80%	40%	40%
22	Vendor Data - Catalogs	80%	30%	50%
23	Piping Isometrics	80%	20%	60%
24	Underground Piping Drawings	80%	20%	60%
25	Equipment Performance Specifications	70%	40%	30%
26	Hazard / Risk Analyzes	60%	30%	30%

Value to Operations (see Exhibit 5.3.b) –

Exhibit 5.3.b lists those typical engineering deliverables deemed to have high value to Operations by 60% or more of the respondents. 60% of respondents identified 15 of the 41 engineering deliverables listed in the survey as high value to Operations either as delivered by project engineering or with some manipulation after delivery from project engineering. 9 of the 15 engineering deliverables identified as high value to Operations were also identified as high value to Maintenance. These included: Process and Instrument Diagrams, Instrument Shutdown Logic, Relief Valve Settings and Specs, Hazard/Risk Analysis, Instrument Loop Diagrams, Instrument Calibration Settings, Equipment Performance Specifications, Instrument Datasheets, Predictive Maintenance Schedules.

The following deliverables were identified by 60% or more of the respondents as having high value to Operations as delivered from project engineering, without further data manipulation:

Process and Instrument Diagrams, Instrument Shutdown Logic, Relief Valve Settings and Specs, Production Recipes, and System Isolation Plans.

The following deliverables were identified by 50% or more of the respondents as having high value to Operations but needing to be manipulated after delivery from project engineering: Instrument Shutdown Logic, Instrument Loop Diagrams.

Exhibit 5.3.b

Sl. No.	Engineering Deliverable*	% who think item is **high value***	% who think item **high value as delivered***	% who think item is **high value** but needs **manipulation***
1	Operating parameters/ guidelines	100%	60%	40%
2	*Process and Instrument Diagrams*	100%	60%	40%
3	*Instrument Shutdown Logic*	100%	50%	50%
4	*Relief Valve Settings and Specs*	80%	60%	20%
5	*Hazard / Risk Analyzes*	80%	40%	40%
6	*Instrument Loop Diagrams*	80%	30%	50%
7	Production Recipes	70%	60%	10%
8	System Isolation Plans (Drain/Vent Points)	70%	60%	10%
9	System Boundaries for Commissioning	70%	50%	20%
10	*Instrument Calibration Settings*	70%	40%	30%
11	System Boundaries for Start-up	70%	40%	30%
12	*Equipment Performance Specifications*	70%	30%	40%
13	*Instrument Datasheets*	70%	30%	40%
14	Environmental Inspection Plans	60%	40%	20%
15	*Preventative / Predictive Maintenance Schedules*	60%	20%	40%

*Italics indicate items of high value to both Operations and Maintenance.

Analysis and Conclusions

Respondents identified most of the typical engineering deliverables listed in the survey as being of value to either Operations or Maintenance or both. As might be expected, there did not appear to be any significant variance in the value of a given deliverable between large and medium sized companies (i.e. they both tended to identify the same high value deliverables). There was not significant disagreement between respondents as to the general value of a given deliverable (i.e. there were few instances where two of more respondents would place a high value on a deliverable and two or more others would place a low value on the same deliverable).

There was a great deal of variance between respondents as to whether a particular deliverable needed to be manipulated in some way in order to be used effectively by operations or maintenance. In all but a few cases the respondents split by 70/30% or less, indicating that different companies may have different expectations as to preparation of a deliverable for use by O&M.

Examination of the detailed responses by company (Appendix B) did not indicate clear distinction between large or medium sized companies with respect to the need to manipulate

data in a deliverable from project engineering. However, there was a clear reverse correlation between the companies that indicated tightly integrated O&M and project work processes in section 5.1 and the need to manipulate data from the high value deliverables for use by O&M. Three companies (L4, M1, M2) that indicated the least need to manipulate deliverables for use by O&M also indicated that they had more tightly integrated O&M and project work processes (see section 5.1).

5.4 State of Automation in Information Delivery to O&M

In this topic area, the survey sought to understand how efficiently information generated by project engineering was delivered to O&M. The survey approached this topic in two parts.

First, the respondents were asked to rate delivery of information along a continuum as follows: 1) all information transfer is manual or generated by O&M, 2) 25% of project information is delivered in usable form – remainder is transferred manually or generated by O & M, 3) 50% of project information is delivered in usable form - balance is manual, 4) 75% of project information is delivered in usable form- balance is manual, 5) 100% of project information is delivered in usable form.

Secondly, the respondents were asked to rate the state of their companies' data transfer systems in terms of "degree of automation" on a continuum of low to high reflecting fives levels of automation as follows:

1) Low- O/M pulls data manually from project documents,
2) Low/Med- engineering hands data over in a "spreadsheet" format (i.e., semi manual),
3) Medium- transfers between data bases,
4) Med/High- databases are linked, and
5) High- work in common databases.

Findings

Information Delivery (see Table 5.4.a) – Six out of nine of the companies that responded claimed to deliver 50% or less of the information needed by O&M from projects in a form that did not have to be manually transferred or generated by O&M. None of the respondents believed that their company delivered all of the information needed by O&M in a form that was usable. Only one company indicated that its current state of information delivery was optimal at 75% of information delivered in useful form. The other eight respondents indicated that they had room for improvement in delivery of this information.

State of Automation (see Table 5.4.b) - Eight of the ten respondents rated their company's state of automated data transfer as "Low" meaning that data was either pulled manually from engineering or vendor documents, or it was transferred using local office tools (e.g., spreadsheets). The other two respondents indicated that they transferred data between independent databases. None of the respondents indicated that they used any more advanced systems such as linked databases or a common database between project engineering and O&M.

Table 5.4.a: Companies rating their information delivery by category

Input From	1	3	5	7	10
	All information generated by project has to be **manually** transferred to O/M systems or generated by O/M	Project delivers **25%** information in right format- rest has to be manually transferred or generated by O/M	Project delivers **50%** information in right format- rest has to be manually transferred or generated by O/M	Project delivers **75%** information in right format- rest has to be manually transferred or generated by O/M	Project automatically delivers **100%** needed to run O/M work processes
L1			**Current**	**Should be**	
L2	**Current (maint)**		**Current (ops)**	**Should be (both)**	
L3		**Current**		**Should be**	
L4				**Current**	**Should be**
M1				**Current**	
M2	**Did not Respond**				
M3				**Current**	**Should be**
M4		**Current**		**Should be**	
M5			**Current**	**Should be**	
M6			**Current**	**Should be**	

Current: **Current state of information delivery**
Should be: **Best Practical state of information delivery**

Table5.4.b: Current State of Automated Data Transfer

	LOW		MEDIUM	HIGH	
Company	O/M pulls data manually from Engineering / Vendor documents	Engineering hands data over in a "spreadsheet" format (semi-manual)	Database transfers (upload/download) occur between databases	Database are linked	Working in common database
L1		**X**			
L2	**X (80%)**	**X (20%)**			
L3		**X**			
L4	**X(small project)**		**X(large project)**		
M1		**X**			

Analysis and Conclusions

Most respondents (6 of 9) indicated that optimal usable information delivery state is at the next level forward from their own current state. It is interesting that, although the great majority of respondents (7 of 9) indicated that the optimal usable information delivery state would be 75%, two out of the three companies that felt they had actually achieved 75% thought that the optimal state would be 100%. It appears that many of the respondents may think of this issue in terms of incremental goals. That is, they do not believe it makes sense to try for 100% usable information delivery until they begin to approach that level and the step change to 100% is less formidable.

The three companies that delivered the largest percentage of data in a usable form also made the most use of electronic tools (spreadsheets or database transfers), indicating that the non-manual transfers were effective in improving the amount of useful data transferred. It is interesting that, while most respondents (6 of 9) indicated that they currently transferred 50% or more of project information to O&M 'in the right format', only three had automated the transfer process to the level of using databases. Evidently, 'the right format' for a substantial amount of information that the O&M organizations may not require data to be in a database, or (possibly) O&M work processes and systems may not be prepared to receive that data in a database, and systems on both sides (project and O&M) will need to be adapted simultaneously in order to take advantage of more efficient electronic transfer.

Exhibit 5.4.c:

Please describe your current Information hand-off procedure between projects and O/M

Company	Comment
L1	During commissioning, don't accept system turnover unless data is supplied (as defied in FEL). Quality of information depends on the project team being able to articulate proper requirements. Issue is whether it is as designed or as built. Prefer as-built, but that is expensive. In general, safety critical items are delivered as-built.
L2	A lot of manual data transfer with "excel" export- import capability A lot of project knowledge is still document based
L3	O&M involved in concept development then handed off to Project Mgmt then handed back to O&M at 90% to startup
L4	If an operations/maintenance rep is assigned to the project this person handles all the handoff/information and usually gets it in the right format. If this person is not available the process for getting information becomes different for each project and the amount and quality can vary significantly.
M1	No comment
M2	Maintenance performs system/start up check out with project folks
M3	Past experience on major project is poor
M4	Equipment data is supplied from PO. Project books supplied for large projects. Doc Look up provided for most drawings (desired for ALL) Need improvement on hand off of design specs, and equipment sizing, quality inspections/UL/API certifications.
M5	Drawing placed in Document Management system, Equipment files in Central Repository, Equipment information manually entered into ERP system and Mechanical Integrity Database. For Large Projects Operating Manuals are provided.
M6	No comment

Exhibit 5.4.d: Comment on state of automation in data transfer

Company	Comment
L1	Some database transfer, but not for everything we need. Engineering drawings downloaded from with little translation, but everything else needs to be translated. Download won't happen unless enforced at leadership level.
L2	Not currently working on moving along the automation path – Common Plant Database (PDB) Vision doesn't exist across businesses Barrier: no common source or receivers
L3	Most info is kept in hard copy-hard to locate data - want to move to electronic handover.
L4	On large project there are information management systems in place that automate the process, on small projects it tends to be primarily manual
M1	No Comment
M2	No Comment
M3	We use Intool, all changes go into an 'electronic storage system'
M4	Almost all data is entered manually into our maintenance functionality
M5	No Comment
M6	No Comment

5.5 Legacy Data as a Barrier to Information Delivery Systems

In this topic area, the survey sought to understand the impact of legacy data as an issue in adopting new data management automation tools. Since the effect of legacy data would be influenced by the organization's policy on keeping "evergreen" data, the survey approached the topic of legacy data in conjunction with that of "evergreen" data.

First, the survey asked about **company policy and practice** with respect to maintaining O&M data as "evergreen". The respondents were asked to explain their company's policy with respect to what data is required to be kept as "evergreen". They were then asked to estimate the percentage of facility data that fell into each of the following three categories: 1) Must be kept as-built at all times, 2) Must be updated upon request (e.g., change in status or new project initiation, and 3) Correct when issued, but not maintained.

To address legacy data the survey asked for two responses. First, the respondents were asked the percentage of existing data kept in each of the following media: 1) paper/microfilm, 2) electronic documents on a local server, 3) electronic documents in an electronic document management system, 4) as data in the O&M information systems, and 5) 3D or object oriented data models.
The survey then asked respondents to indicate how "big" a barrier they felt legacy data was to implementing new automation tools by selecting one of the following descriptions: 1) 'insurmountable- we never get passed it', 2) 'big but we will bring in new tools if the value is high enough', 3) 'big- we bring in new tools for new facilities, but leave existing data in old systems', 4) medium- we just build a new translation table, 5) 'not a barrier'.

Findings

Data maintenance policy (exhibit 5.5.a) - When asked about company policy on maintaining data as "evergreen", almost all of the companies that responded indicated that company policy

was focused first at safety and regulatory compliance. These requirements tended to emphasize electrical and process instrumentation information. Only one company indicated that they try to keep all documents evergreen.

Exhibit 5.5.a
What is your company's policy on what data needs to be maintained in "as-built" or "evergreen" status?

Company	Comment
L1	Anything around OSHA compliance or EPA compliance.
L2	No Corporate policy for Maintenance Equipment Specification Data unless regulatory driven– Strong policy for engineering drawings and maintenance activity related data in US for OSHA PSM requirements (MOC, Inspection/ Testing, Lube oil analysis) Data Value definition not in place; data integrity requirements not defined
L3	Electrical (HV) and instrument (critical controls) is needs to be evergreen.
L4	No Comment
M1	No Comment
M2	We maintain /update as built and store them electronically
M3	We have this clearly defined
M4	Loop sheets, P&IDs, safety & environmental records/data must be kept up to date. We try to keep almost all documents and O/M Work Processes
M5	We maintain P&IDs, HAZCOM (PDFs), Metallurgy, MSDS, Equipment files, Electrical classifications, Refinery PDFs, and instrument database evergreen through our MOC process. Training documents are also maintained via the MOC process.
M6	No Comment

Data maintained evergreen (see table 5.5.b) - Most companies that responded to this question indicated they kept 50% or more of their data as-built. However, only two companies (both midsize) indicated that they kept as much as 75% of data as-built.

Exhibit 5.5.b: Data Maintained Evergreen:

	Evergreen Degree 1 Must be kept "As-built"	**Evergreen Degree 2** Updated upon request	**Evergreen Degree 3** Correct when issued/not maintained
L1	**Did not report**		
L2	▪ **100%** electrical, vessels, critical equipment, critical pipe ▪ **50%** non-critical equipment ▪ **75%** instruments	▪ **50%** non-critical ▪ **75%** piping ▪ **25%** instruments ▪ **95%** civil	
L3	**10%**	**20%**	**70%**
L4	**50%**	**20%**	**30%**
M1	**Did not report**		
M2	**Did not report**		
M3	**50%**	**-**	**50%**
M4	**75%**	**20%**	**5%**
M5	**50%**	**50%**	**-**
M6	**90%**	**5%**	**5%**

Above data driven by safety and regulatory requirements

Data storage medium (table 5.5.c) - All of the large companies indicated that they had 50% or more of their data stored on paper/microfilm or as documents on local servers. In contrast, only one midsize company stored as much as 50% in these forms; all midsize companies kept at least 50% of data.

Exhibit 5.5.c: Data Storage Medium:

	Paper/Microfilm	**Electronic documents on local file servers**	**Electronic documents on document management systems**	**Data on O/M operating systems**	**3D / Object oriented data models**
L1	**5%**	**50%**	**15%**	**25%**	**5%**
L2	**50%**	**20%**	**5%**	**25%**	**0%**
L3	**30%**	**20%**	**25%**	**25%**	**0%**
L4	**20%**	**40%**	**30%**	**10%**	**0%**
M1	**30%**	**0%**	**50%**	**20%**	**0%**
M2	**0%**	**0%**	**95%**	**5%**	**0%**
M3	**25%**	**25%**	**25%**	**25%**	**0%**
M4	**15%**	**25%**	**25%**	**35%**	**0%**
M5	**40%**	**10%**	**40%**	**10%**	**0%**
M6	**20**	**0%**	**20%**	**60%**	**0%**

Legacy data as a barrier to new tools (table 5.5.d) – All of the respondents felt that legacy data was an issue in bringing in new tools. All of the midsize companies indicated that legacy data

was a barrier to new tool implementation, but that those barriers could be overcome if the value was high enough. In contrast, all but one of the large companies indicated that legacy data was such a significant barrier that they only introduced new tools in new facilities- they generally left older facility data in the older information systems.

Exhibit 5.5.d: Legacy data as barrier to new tool implementation

	Comment: Insurmountable – we never get passed it
L2, M1, M3, M4, M5, M6	Big but we have brought in new tools when value is high enough
L1, L3, L4	Big – we bring in new tools for new facilities and leave existing data in old information system
L2, M2	Medium – we just build a new translation table
	Not a barrier

Analysis and Conclusions

These survey questions were posed in a way that may have caused some confusion or different interpretations among the respondents. It is difficult to assess a percentage of 'data' across the different engineering deliverables (e.g. how do you weigh the quantity of data in a P&ID versus a foundation drawing). However some clear conclusions can be made from these responses.

Clearly the primary driver for O&M "evergreen" data maintenance for most companies (based on respondent comments) is safety or regulatory requirements. It appears as though two of the midsize companies have gone beyond these basic criteria in keeping 90% and 75% of data evergreen. The fact that these same two companies lead the others in terms of data kept in O&M operating systems implies that they are using the data for business purposes other than regulatory compliance and safety.

It is clear from the results in tables 5.5.b and 5.5.c that the larger companies have a greater legacy data issues than smaller companies. Across the board, the larger companies keep a smaller percentage of their data evergreen and a greater percentage of the larger company's data is stored in paper/microfiche or on local servers. This should be expected as the larger companies would tend to have been operating for a longer time and would have older facilities, and thus more legacy data originally produced on paper or local systems. This conclusion is reinforced by the responses shown in table 5.5.d in which 3 of the 4 larger companies indicate that they only bring in new tools for new facilities, but leave the existing data in the old information systems.

5.6 Opportunities for Improvement

At the conclusion of the survey, each respondent was asked; "If you were King or Queen and could 'fix' 5-10 things around the issues discussed in this questionnaire- what would they be (in priority order)?"

Findings

Responses are shown in Table 5.6.a.

Analysis and Conclusions

In general, responses from the larger companies focused most on integrating systems and how integration should be accomplished, while most responses from the smaller companies focused on specific issues related to the content of the information and/or implementation. This tends to confirm earlier conclusions (sections 5.1 and 5.2) that the larger, more diverse companies have a greater challenge integrating systems across facilities or product lines than do smaller companies.

Exhibit 5.6.a: Improvement opportunity area feed back from respondents:

Company	Comments
L1	▪ Implement project systems as part of the ERP implementation, because if you don't think it through in the beginning, it will be more difficult later. ▪ Need to consider the construction issues where you share resources with O&M and manage with the ERP system. ▪ Contractor field labor efficiency. ▪ Integration of construction and O&M scheduling- competition for same ▪ Primavera kinds of tools – would like two way Primavera interface to manage schedule of PS PM.
L2	▪ Define the cross function common data architecture (corporate data architecture) for life cycle ▪ Require it's use ▪ Clearly define mandatory and value added entry based on business and technology value ▪ Data ownership is clarified and single data source is defined ▪ Data maintenance resource requirements are understood and supported (data entry barriers are eliminated- easy field entry) – based on tool value maximized ▪ Compliance audit "built in" and easy - with logic checks.
L3	▪ Sharing of project information electronically ▪ Electronic integration of performance/installation information ▪ Electronic integration of catalogue information into BOM ▪ Ability to collaborate electronic during evolution of project
L4	▪ Seamless integration of projects and O/M information ▪ Have O/M reps assigned to every project ▪ Have a standard information management system throughout the company
M1	▪ No comment
M2	▪ Carrying out the project as originally designed ▪ Better job of pre-startup check out ▪ Better communication of projects shortcomings
M3	▪ Visible management support or recognition of the issue ▪ Ability to terminate those who do not follow specified requirement ▪ System to handle non-drawing technical information
M4	▪ More and quicker handoff of project equipment design/performance specs drawing, etc ▪ More complete construction packages, and exchange of info between project manager and construction ▪ Improved scooping & involvement of involvement of more disciplines ▪ More data input at front end of project vs. manual transfer/entry by maintenance personnel

M5	▪ Preventative Maintenance/ Predictive Maintenance information so we can incorporate in the operators duties ▪ Training Package for operators should always be included in the project deliverable. Needs to be in the appropriate format and integrated with the operator qualification matrix ▪ More involvement when defining project with operators so they can know and understand the impact of this new equipment on their jobs.
M6	▪ Provide integration between maintenance and mgt. Any document management system ▪ Provide integration between process control and ERP systems

Appendix A: The O&M Information Needs Survey Form

Task Force on: EPC Information Delivery To/ From Operations and Maintenance

Operations and Maintenance Information Needs Survey

The FIATECH Lifecycle Data Management Project needs to define, from the Owner/ Operator perspective, the Operations and Maintenance information requirements that "Capital" (Engineering / Procurement/ Construction) projects should meet when turning over new or upgraded facilities. The task force goal is to clearly understand and document Operations and Maintenance information needs and problems, so we can address them. Your input will guide the FIATECH Lifecycle Data Management Project in developing appropriate solutions.

Please contact Charles Wood at (713) 665-0004 (cwood@fiatech.org) if you would like to participate or if you have any questions or comments about this effort.

Your name:		Date:	
Your Company		Your Title/Position	
Your Phone #		Your Email Address:	
Your Fax #			

Your Organization: ☐ Maintenance ☐ Operations ☐ Other: *(please specify)*

Work Processes

This task force is focussing on understanding the information requirements for the following O/M work processes:

On Demand and Preventative Maintenance	Outage Management	Operating Procedures
Quality Control and Assurance	Licensing and Regulatory	Operator Training
Incoming and Site Materials Management	Process Control and Monitoring	Production Planning

Are we missing any major O/M work processes? If so, what are they?

Does your Company have a "separate" (EPC) Organization that executes the Engineering / Procurement and Construction of "capital" projects?

☐ Yes ☐ No

If yes -Explain what determines when facility revision becomes the EPC group's responsibility:

If no – Explain how new facilities are engineered and constructed:

What best describes the status of your company's O/M and Project Work Processes:

☐ General Guidelines only	☐ O/M Work Processes Defined	☐ Project Work Processes Defined	☐ Tightly Integrated O/M and Project Work Processes Defined

Anything unique about the **integration** of your O/M and project work processes that you are willing to share?

Maintenance Information Management Systems:

Does your company have a "standard" set of Maintenance information system(s) across sites?	Does your company have a "single / integrated" Maintenance information system?	Is your Maintenance work management system integrated with your company's business planning/ ERP system?
☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

Maintenance Information System(s) include Maintenance Work Management (Break/Fix, Preventative/ Predictive), Facility Documentation (Drawings, etc), Maintenance Reliability Engineering Tools, etc

Are you willing to share an overview of your Maintenance Information System structure?
If yes- please describe below or attach information to questionnaire

Describe here

Operations Information Management Systems:

Does your company have a "standard" set of Operations information system(s) across sites?	Does your company have a "single / integrated" Operation information system?	Is your Operations work management system integrated with your company's business planning / ERP system?
☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

Operations Information System(s) include Production Planning, Process Control and Monitoring, Quality Control and Assurance, Facility/ Operations Change Control Management, Distribution Planning, Incoming and Site Materials Management, etc

Are you willing to share an overview of your Operations Information System structure?
If yes- please describe below or attach information to questionnaire

Describe here

INFORMATION DELIVERY TO OPERATIONS/ MAINTENANCE FROM PROJECTS:

On a scale of 1 to 10 – how well does your current project process deliver the required facility design and procurement information into your O/M systems?
Please indicate your "**C**"- current state; and what you believe it **"S"** Should be (best practical)

1	3	5	7	10
All Information generated by project has to be manually transferred to O/M systems or generated by O/M	Project delivers 25% of information in right format- rest has to be manually transferred or generated by O/M	Project delivers 50% of information in right format- rest has to be manually transferred or generated by O/M	Project delivers 75% of information in right format- rest has to be manually transferred or generated by O/M	Project automatically delivers 100% of information needed to run O/M work processes

The following questions are attempting to place relative value **to O/M** on the information generated during a typical capital (EPC) project. Please use the following scale:

1	Information is needed for constructing facility but has little value to O/M
3	Information has **some** value to O/M **but** information has to be "manipulated" into new context to be useful in the field
5	Information has **some** value to O/M **as delivered** by project
8	Information has **high** value to O/M **but** information has to be "manipulated" into new context to be useful in the field
10	Information has **high** value to O/M **as delivered** by project

Information Type	Value to Maintenance	Value to Operations	Routinely Supplied By Project (Yes/No)	Comments
Equipment Performance Specifications				
Equipment Detailed Specifications				
Equipment Drawings				
Equipment Sizing/ Simulation Programs				
Equipment purchase costs				
Vendor Data - Catalogs				
Vendor Data- Drawings				
OEM Manuals				
Installation Data				
Spare Parts Lists				
Heat and Material Balances				
Utility Requirements				
Quality Specifications				
Production Recipes				
Operating parameters/ guidelines				
Instrument Datasheets				
Instrument Loop Diagrams				
Instrument Databases				
Instrument Calibration Settings				
Instrument Shutdown Logic				
Hazard / Risk Analyzes				
Relief Valve Settings and Specs				
Process and Instrument Diagrams				
System Boundary Descriptions				
Electrical Single Line Diagrams				
Electrical schematics				
Electrical Connection Drawings				

Information Type	Value to Maintenance	Value to Operations	Routinely Supplied By Project (Yes/No)	Comments
Electrical Loop Diagrams				
Installation Quality Check Sheets				
Installation Inspection/ Test Records				
Installation Check Sheets				
3D Model				
Piping Isometrics				
Civil/ Structural Drawings				
Underground Piping Drawings				
System Isolation Plans (Drain/Vent Points)				
System Boundaries for Commissioning				
System Boundaries for Start-up				
Environmental Inspection Plans				
Preventative / Predictive Maintenance Schedules				
Grounding Plans				
Others (add lines as needed by clicking on row below and going to Table>Insert Row):				

Based on your input above—what would be your rough estimate of the information conversion costs the plant faces to move project data into O/M information systems as a % of installed capital /project cost ?

Please describe your current information hand-off procedures between projects and O/M.

At a high level- where are your systems in regards to Automated Data Transfer from project information systems to O/M information systems

X ⇓	Degree of Automation	Description of Automation State
	Low	• O/M pulls data manually from Engineering/ Vendor Documents
		• Engineering hands data over in a “spreadsheet” format (Semi-manual)
	Medium	• Database transfers (Upload/Download) occur between databases
		• Databases are linked
	High	• Working in Common Database

Anything you want to explain about the state of automation on your data transfers?

Where is your company in defining a common Equipment Object Data Model used in both the Project Work Processes and O/M Work Processes?

What is your company's policy on what data needs to be maintained in "as-built" or "evergreen" status?

If you looked at the facility data being managed by your O/M work processes what percentage falls into each "Evergreen Degree" bucket?

Evergreen Degree 1	Evergreen Degree 2	Evergreen Degree 3
Must be kept "As-built" at all time	Must be updated upon request (usually with major change in status, e.g. new project initiation)	Correct when issued but not maintained
?%	*?%*	*?%*

Legacy Data Barrier

When you look at your existing (legacy) data situation what % of your facility data is currently in:

%	Current Media
	Paper/ Microfilm
	Electronic Documents on Local File Servers
	Electronic Documents in Electronic Document Management System
	Data in O/M Operating Systems
	3D / Object Oriented Data Models
	Other (please specify)

When you look at bringing a new automation tool into your O/M work processes – how "big" a barrier is your legacy data situation?

	Insurmountable – we never get passed it
	Big but we have brought in new tools when value is high enough
	Big – we bring in new tools for new facilities and leave existing data in old information system
	Medium- we just build a new translation table
	Not a barrier
	Other

Comments?

Performance Feedback to Project or Next Project

Please describe what work processes/ expectations your company has about feeding back actual performance in the field to the original project team and/or into the next project.

What % of your new capital projects start with a discovery effort to determine actual field performance of previous design basis?

Improvement Opportunity Areas

If you were King or Queen and could "fix" 5-10 things around the issues discussed in this questionnaire- what would they be (in priority order)?

Other Thoughts/ Comments?

Appendix B: Value of Information – Details

1) **Value to Operations by Ranges (ranked by frequency in 8-10 range)**
2) **Value to Maintenance by Ranges (ranked by frequency in 8-10 range)**
3) **Value to Operations by Respondent (1=least valuable, 10=most valuable)**
4) **Value to Maintenance by Respondent (1=least valuable, 10=most valuable)**

Value to Operations- Ranges (ranked by frequency in 8-10 range)

Value to operations (1=least, 10 =most) Frequency of response by range	frequency in 1-3 range	frequency in 4-7 range	frequency in 8-10 range	frequency 10	frequency 8 or 9
Operating parameters/ guidelines	0	0	**10**	6	4
Instrument Shutdown Logic	0	0	**10**	5	5
Process and Instrument Diagrams	0	0	**10**	6	4
Instrument Loop Diagrams	2	0	**8**	3	5
Hazard / Risk Analyzes	1	0	**8**	4	4
Relief Valve Settings and Specs	2	0	**8**	6	2
Equipment Performance Specifications	2	0	**7**	3	4
Production Recipes	1	1	**7**	6	1
Instrument Datasheets	3	0	**7**	3	4
Instrument Databases	3	0	**7**	3	4
Instrument Calibration Settings	3	0	**7**	4	3
System Isolation Plans (Drain/Vent Points)	3	0	**7**	6	1
System Boundaries for Commissioning	3	0	**7**	5	2
System Boundaries for Start-up	3	0	**7**	4	3
Environmental Inspection Plans	2	1	**6**	4	2
Preventative / Predictive Maintenance Schedules	2	1	**6**	2	4
OEM Manuals	3	1	**5**	2	3
Heat and Material Balances	4	1	**5**	3	2
Installation Quality Check Sheets	3	2	**5**	3	2
Equipment Drawings	2	3	**4**	3	1
Equipment Sizing/ Simulation Programs	3	2	**4**	2	2
Utility Requirements	3	3	**4**	4	0
Quality Specifications	3	2	**4**	1	3
Electrical Single Line Diagrams	4	2	**4**	2	2
Installation Inspection/ Test Records	5	1	**4**	3	1
Installation Check Sheets	5	1	**4**	3	1
Piping Isometrics	3	3	**4**	2	2
Underground Piping Drawings	4	2	**4**	4	0
Grounding Plans	4	1	**4**	2	2
Equipment Detailed Specifications	4	2	**3**	1	2
System Boundary Descriptions	3	2	**3**	1	2
Electrical schematics	4	3	**3**	2	1
Electrical Connection Drawings	5	2	**3**	2	1
3D Model	3	3	**3**	1	2
Vendor Data - Catalogs	3	4	**2**	1	1
Vendor Data- Drawings	3	3	**2**	2	0
Installation Data	5	1	**2**	0	2
Spare Parts Lists	6	1	**2**	0	2
Electrical Loop Diagrams	4	3	**2**	1	1
Equipment purchase costs	6	3	**0**	0	0
Civil/ Structural Drawings	6	3	**0**	0	0

Value to Maintenance- Ranges (ranked by frequency in 8-10 range)

Value to operations (1=least, 10 =most) Frequency of response by range	frequency in 1-3 range	frequency in 4-7 range	frequency in 8-10 range	frequency 8 or 9	frequency 10
OEM Manuals	0	0	**10**	3	7
Spare Parts Lists	0	0	**10**	5	5
Instrument Datasheets	0	0	**10**	5	5
Instrument Loop Diagrams	0	0	**10**	4	6
Instrument Databases	0	0	**10**	6	4
Instrument Calibration Settings	0	0	**10**	4	6
Relief Valve Settings and Specs	0	0	**10**	3	7
Electrical schematics	0	0	**10**	3	7
Electrical Connection Drawings	0	0	**10**	3	7
Preventative / Predictive Maintenance Schedules	0	0	**10**	5	5
Equipment Detailed Specifications	0	0	**9**	5	4
Equipment Drawings	0	0	**9**	4	5
Vendor Data- Drawings	0	0	**9**	3	6
Instrument Shutdown Logic	0	0	**9**	4	5
Process and Instrument Diagrams	0	1	**9**	3	6
Electrical Single Line Diagrams	0	1	**9**	3	6
Electrical Loop Diagrams	0	0	**9**	3	6
Grounding Plans	0	1	**9**	4	5
Vendor Data - Catalogs	0	2	**8**	3	5
Installation Data	0	1	**8**	5	3
Installation Inspection/ Test Records	1	1	**8**	4	4
Piping Isometrics	2	0	**8**	2	6
Civil/ Structural Drawings	1	1	**8**	4	4
Underground Piping Drawings	2	0	**8**	2	6
Equipment Performance Specifications	1	1	**7**	4	3
Hazard / Risk Analyzes	2	1	**6**	3	3
Quality Specifications	1	4	**5**	3	2
Installation Check Sheets	3	3	**4**	1	3
System Isolation Plans (Drain/Vent Points)	3	2	**4**	1	3
Equipment purchase costs	4	3	**3**	0	3
Operating parameters/ guidelines	4	2	**3**	2	1
Installation Quality Check Sheets	3	3	**3**	2	1
3D Model	5	1	**3**	2	1
Environmental Inspection Plans	5	0	**3**	1	2
Equipment Sizing/ Simulation Programs	4	4	**2**	1	1
System Boundary Descriptions	4	1	**2**	1	1
System Boundaries for Commissioning	5	2	**2**	1	1
System Boundaries for Start-up	4	3	**2**	1	1
Heat and Material Balances	7	1	**1**	1	0
Utility Requirements	4	4	**1**	1	0
Production Recipes	7	1	**0**	0	0

Value to Operations by Respondent (1=least valuable, 10=most valuable)

Value to operations	L1	L2	L3	L4	M1	M2	M3	M4	M5	M6	frequency in 1-3 range	frequency in 4-7 range	frequency in 8-10 range
Equipment Performance Specifications	8	8	8	10	10	?	8	10	3	3	2		7
Equipment Detailed Specifications	5	3	3	8	10	?	8	5	1	3	4	2	3
Equipment Drawings	5	10	1	10	10	?	8	5	5	3	2	3	4
Equipment Sizing/ Simulation Programs	5	10	5	3	?	10	8	8	1	3	3	2	4
Equipment purchase costs	1	5	1	3	?	1	2	5	1	5	6	3	
Vendor Data - Catalogs	8	5	5	10	?	5	2	5	1	3	3	4	2
Vendor Data- Drawings	?	10	5	10	?	5	2	5	1	3	3	3	2
OEM Manuals	8	10	5	10	?	3	8	8	1	3	3	1	5
Installation Data	5	10	3	8	?	1	2		1	3	5	1	2
Spare Parts Lists	3	3	3	8	?	1	2	8	1	5	6	1	2
Heat and Material Balances	3	10	8	5	10	8	2	10	1	3	4	1	5
Utility Requirements	3	10	5	10	10	5	2	10	5	3	3	3	4
Quality Specifications	8	8	1	5	?	5	2	10	1	8	3	2	4
Production Recipes	10	10	5	1	10	10	8	10	N/A	10	1	1	7
Operating parameters/ guidelines	10	10	8	10	10	10	8	10	8	8			10
Instrument Datasheets	3	8	8	8	10	10	8	10	1	3	3		7
Instrument Loop Diagrams	8	8	8	10	10	10	8	8	1	3	2		8
Instrument Databases	8	8	3	8	10	10	8	10	1	3	3		7
Instrument Calibration Settings	8	8	3	10	10	10	8	10	1	3	3		7
Instrument Shutdown Logic	8	9	10	10	10	10	8	10	8	8			10
Hazard / Risk Analyzes	8	10	8	10	?	10	2	10	8	8	1		8
Relief Valve Settings and Specs	3	8	10	10	10	10	2	10	10	8	2		8
Process and Instrument Diagrams	8	10	8	10	10	10	8	10	10	8			10
System Boundary Descriptions	3	1	5	5	10	?	2	10	8		3	2	3
Electrical Single Line Diagrams	3	10	5	8	10	5	2	8	1	3	4	2	4
Electrical schematics	3	10	5	8	10	5	2	5	1	3	4	3	3
Electrical Connection Drawings	3	10	5	8	10	5	2	3	1	3	5	2	3
Electrical Loop Diagrams	3	?	5	8	10	5	2	5	1	3	4	3	2
Installation Quality Check Sheets	8	1	5	5	10	10	8	10	1	1	3	2	5
Installation Inspection/ Test Records	8	2	3	5	10	10	2	10	1	1	5	1	4
Installation Check Sheets	8	1	3	5	10	10	2	10	1	1	5	1	4
3D Model	10	5	8	5	?	5	2	3	1	8	3	3	3
Piping Isometrics	8	10	5	5	10	5	8	3	1	3	3	3	4
Civil/ Structural Drawings	3	5	5	3	?	5	2	3	1	3	6	3	
Underground Piping Drawings	3	10	5	10	10	10	2	5	1	3	4	2	4
System Isolation Plans (Drain/Vent Points)	10	10	8	10	10	10	2	10	1	3	3		7
System Boundaries for Commissioning	10	1	8	10	10	10	2	10	8	3	3		7
System Boundaries for Start-up	10	3	8	8	10	10	2	10	8	3	3		7
Environmental Inspection Plans	10	8	1	5	10	10	2	10	?	8	2	1	6
Preventative / Predictive Maintenance Schedu	8	10	5	8	?	1	2	10	8	8	2	1	6
Grounding Plans	3	10	5	10	?	1	2	8	1	8	4	1	4

Value to Maintenance by Respondent (1=least valuable, 10=most valuable)

Value to Maintenance	L1	L2	L3	L4	M1	M2	M3	M4	M5	M6	frequency in 1-3 range	frequency in 4-7 range	frequency in 8-10 range
Equipment Performance Specifications	10	5	8	10	8	?	8	10	8	3	1	1	7
Equipment Detailed Specifications	10	8	8	10	10	?	8	10	8	8			9
Equipment Drawings	10	10	8	10	10	?	8	10	8	8			9
Equipment Sizing/ Simulation Programs	10	5	5	3	1	5	2	8	5	3	4	4	2
Equipment purchase costs	10	5	1	3	10	3	2	10	5	5	4	3	3
Vendor Data - Catalogs	10	5	8	10	10	10	8	10	5	8		2	8
Vendor Data- Drawings	?	10	8	10	10	10	8	10	10	8			9
OEM Manuals	10	10	8	10	10	10	8	10	10	8			10
Installation Data	10	10	8	8	10	10	8		5	8		1	8
Spare Parts Lists	8	8	8	10	10	10	8	10	8	10			10
Heat and Material Balances	3	5	1	3	?	3	2	8	1	1	7	1	1
Utility Requirements	3	5	1	8	?	5	2	5	5	1	4	4	1
Quality Specifications	8	5	5	5	10	5	8	10	8	1	1	4	5
Production Recipes	?	1	1	1	?	1	2	5	1	1	7	1	
Operating parameters/ guidelines	5	3	3	8	?	5	2	10	1	8	4	2	3
Instrument Datasheets	10	8	8	10	10	10	8	10	8	8			10
Instrument Loop Diagrams	10	10	8	10	10	10	8	10	8	8			10
Instrument Databases	10	8	8	8	10	10	8	10	8	8			10
Instrument Calibration Settings	10	8	8	10	10	10	8	10	10	8			10
Instrument Shutdown Logic	10	9	10	10	?	10	8	10	8	8			9
Hazard / Risk Analyzes	10	10	8	8	?	5	2	10	1	8	2	1	6
Relief Valve Settings and Specs	10	8	10	10	10	10	8	10	10	8			10
Process and Instrument Diagrams	10	10	5	10	10	10	8	8	10	8		1	9
System Boundary Descriptions	10	1	5	3	?	?	2	8	1	?	4	1	2
Electrical Single Line Diagrams	10	10	10	5	10	10	8	10	8	8		1	9
Electrical schematics	10	10	10	10	10	10	8	10	8	8			10
Electrical Connection Drawings	10	10	10	10	10	10	8	10	8	8			10
Electrical Loop Diagrams	10	?	10	10	10	10	8	10	8	8			9
Installation Quality Check Sheets	8	1	5	5	?	10	2	8	5	3	3	3	3
Installation Inspection/ Test Records	10	5	8	8	10	10	8	10	8	3	1	1	8
Installation Check Sheets	10	1	8	5	10	10	2	5	5	3	3	3	4
3D Model	10	5	8	1	?	1	2	3	1	8	5	1	3
Piping Isometrics	10	10	8	3	10	10	8	10	10	3	2		8
Civil/ Structural Drawings	10	7	8	3	10	10	8	10	8	3	1	1	8
Underground Piping Drawings	10	10	8	10	10	10	2	10	8	3	2		8
System Isolation Plans (Drain/Vent Points)	10	10	5	8	?	5	2	10	3	3	3	2	4
System Boundaries for Commissioning	10	1	8	5	?	5	2	3	1	3	5	2	2
System Boundaries for Start-up	10	1	8	5	?	5	2	5	1	3	4	3	2
Environmental Inspection Plans	10	1	1	3	?	?	2	10	1	8	5		3
Preventative / Predictive Maintenance Schedules	10	10	8	8	10	10	8	10	8	8			10
Grounding Plans	10	10	5	8	10	10	8	10	8	8		1	9