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**ENV-05-190 Information Architecture Planning Template
for Health, Safety, and Environmental
Organizations**

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Information Architecture Planning Template for Health, Safety, and Environmental Organizations

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Section 1: Background

In 2003, Innovene (then as BP) began an initiative to improve the coordination of compliance requirements through development of a new Compliance Management System at their assets in the Houston and South Texas region. An important part of the initiative was to improve the information systems architecture used by Environmental, Health, and Safety (EHS) staff at all of the facilities, resulting in a more effective and efficient organization as a new Compliance Management System was implemented.

At the outset, ENVIRON and RMT prepared an inventory of all of the Tools, Applications, and Data Sets used by EHS staff, or by others at the facilities to maintain compliance. Over 30 such items were identified, with metadata on each presented in a tabular format. A series of Data Flow Diagrams were prepared to graphically illustrate the relationships. An Implementation Plan (with short- and long-term recommendations) was prepared, with key components being the Compliance Management System (task tracking), an Air Emissions Inventory Application, A Waste Tracking System, an Analytical Database, an overall Information Organizer, and a Metrics Dashboard. A series of diagrams was presented to illustrate the implementation of the system as a whole over time.

The second phase of the project involved a detailed, formal evaluation of software programs, which included commercial packages, in-house development projects, and new custom applications. The Waste, Air, Task Tracking, and Information Organizer tools were screened, demonstrated and evaluated against a detailed list of business, technical, and functional requirements. Cost and availability were also considered, as were the relative risks of implementation. Innovene (which includes former BP chemical plants) are presently planning implementation of a combination of custom and commercial applications resulting in an effective overall EHS information system architecture.

Section 2: Inventory

The compliance improvement process was extended to any tools, datasets, and applications that staff use to efficiently maintain compliance. Data were collected from staff at each facility on:

<ul style="list-style-type: none">• Name of tool, dataset or application• Type• Compliance Area• Support Level• Description• Age	<ul style="list-style-type: none">• Maintenance• Owner• Current Users• Data Elements• External Links• Accessibility
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The data was captured in a standard format so that multiple reviewers could collect similar information in a uniform fashion.

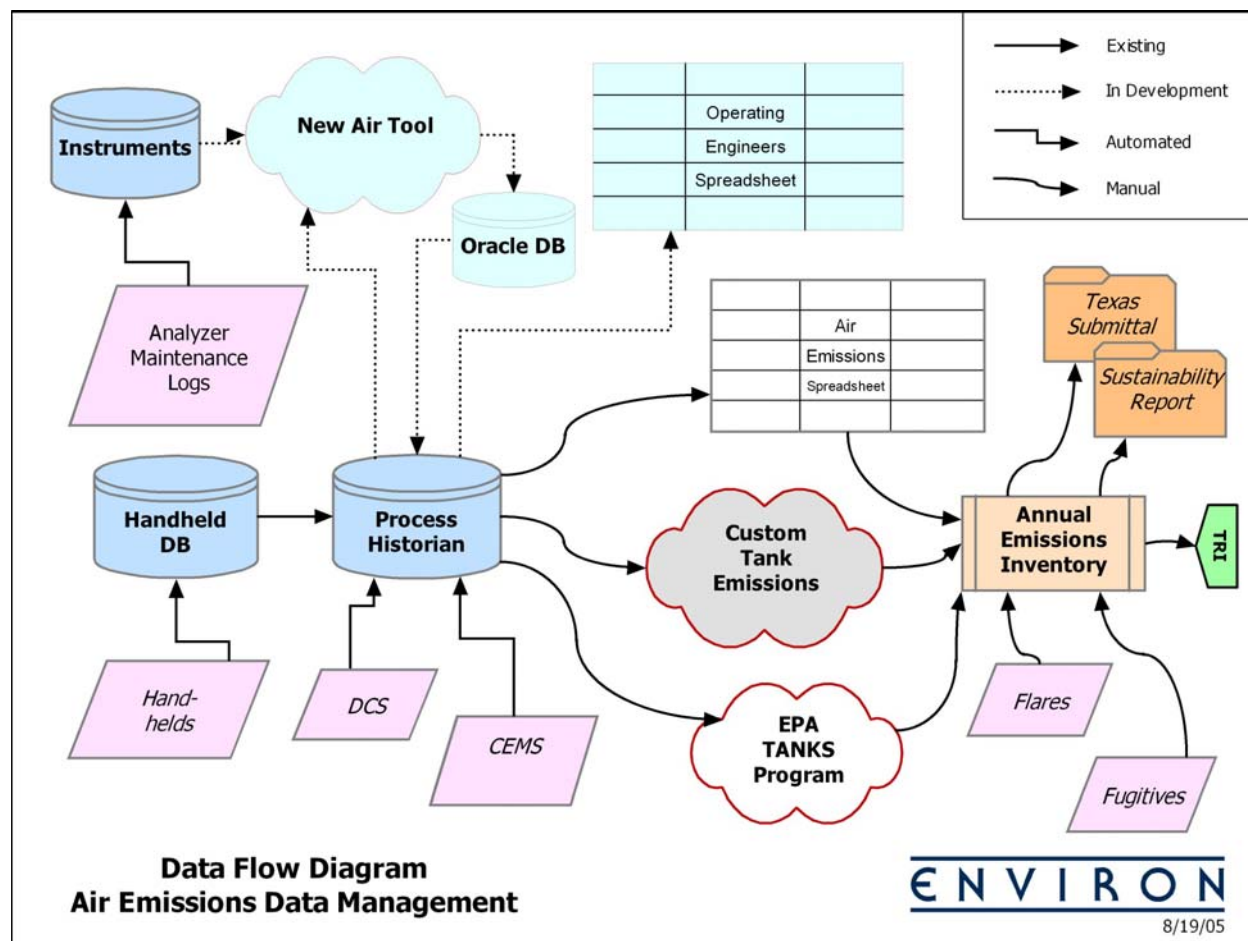
For many situations, combinations of tools were used together, either with manual or automatic data transfer between. Preliminary Data Flow Diagrams were used to illustrate the relationships; an example of a diagram for managing air emissions is shown on Figure 1.

As a result of the inventory, ENVIRON and RMT noted that over 30 separate Applications, Datasets, or Tools were in use.

- The scheme was a mixture of stand-alone desktop applications and integrated systems.
- Data were managed primarily in "silos" (typical for a large installation).
- System use frequency varies from "Continuous" to "Annual."
- There were a variety of "Owners" and "Support" schemes.
- Status was classified as "Current" or "Historic" or "Classic."
- Significant documentation issues were noted (typical for custom applications).

Additional inventories, although somewhat less inclusive, were conducted at the regional chemical plants; emphasis was on common applications, or similar needs at the facilities.

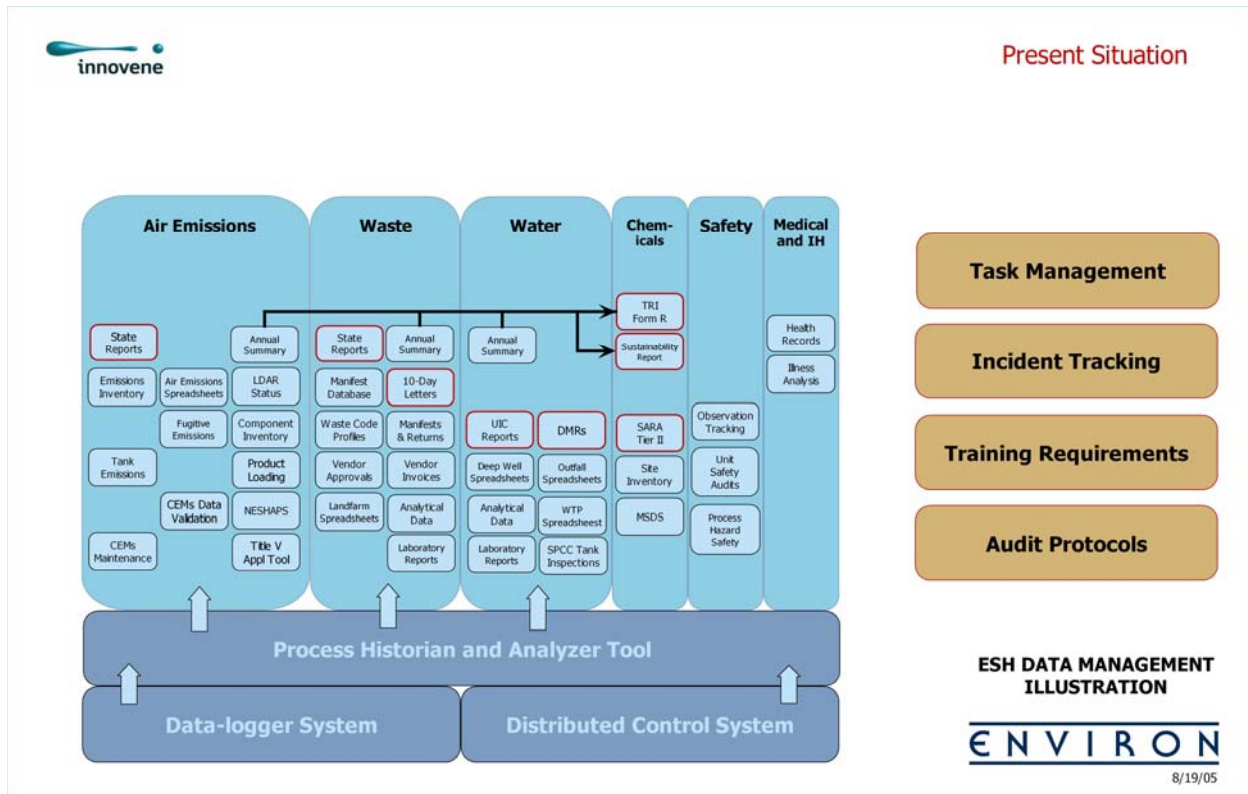
Figure 1
Example Data Flow Diagram – Air Emissions Management



A visual diagram was developed to convey the results of the analyses to a variety of users, without going into excessive technical detail on the functions and linkages. Each individual application was well-known to its particular users, but the overall configuration was important to information system architecture planning. Figure 2 shows the initial graphical depiction of all of the tools, applications, and datasets.

For the most part, data were managed in silos for each of the main functional compliance areas: air emissions, waste, water, chemicals, safety, and medical and industrial hygiene. Note the only significant “trans-silo” transfers were for the EPA TRI report and the internal report for sustainability metrics. Applications that potentially cross silos are shown on the right, and included a task management system (CTMS), an incident tracking application, an internal training matrix, and an audit protocol application.

Figure 2
Initial Graphical Depiction of Tools, Applications, and Datasets



Section 3: Planning

A gap analysis was conducted, based on the results of the inventory, input from facility EHS staff, and ENVIRON's and RMT's experience with current technology and system capabilities. Implementation Plans were developed for each functional area with significant needs. General objectives included:

- Increase linkages (manual and automatic)
- Decrease the number of applications, datasets, tools
- Increase reliability & efficiency
- Reduce the business risk

Short-term and long-term Implementation Plans were developed for all groups of software. The most critical were air emissions management and waste tracking, along with task management and a metrics dashboard.

Figure 3
Example of Short-Term Implementation Planning

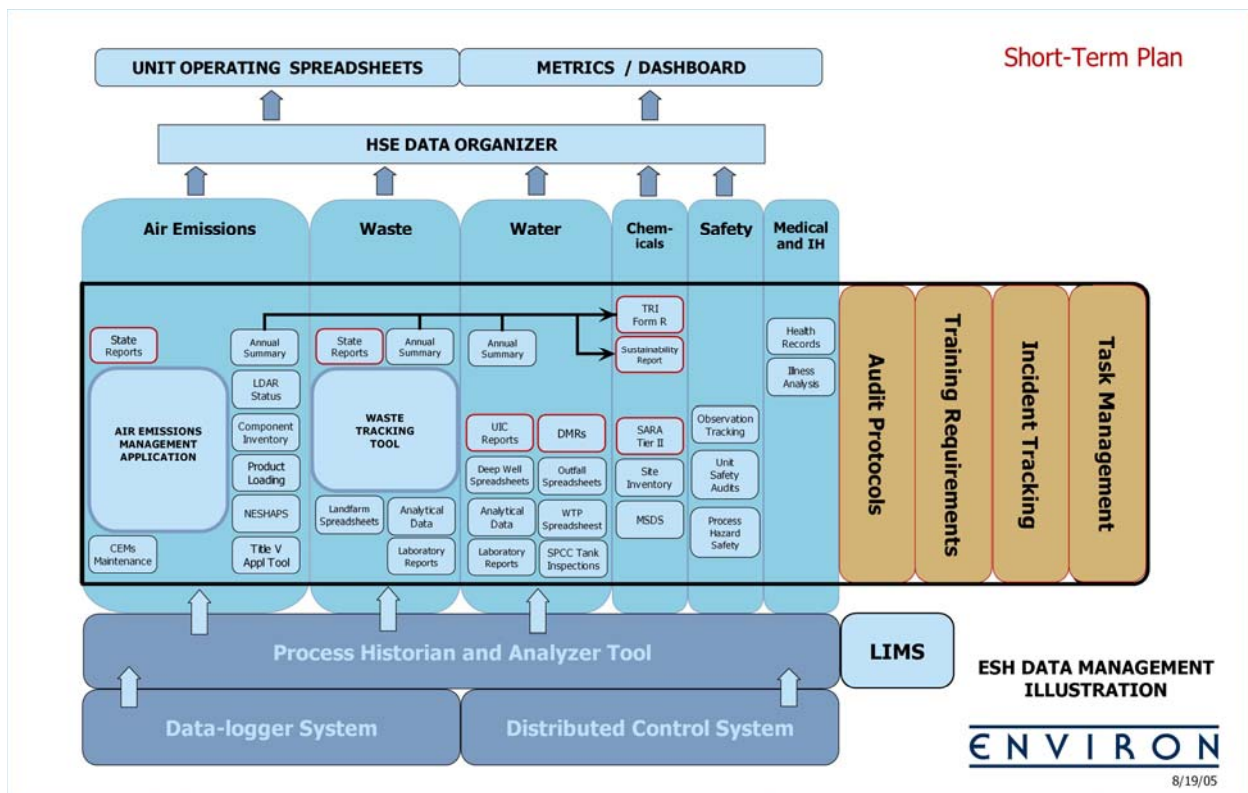
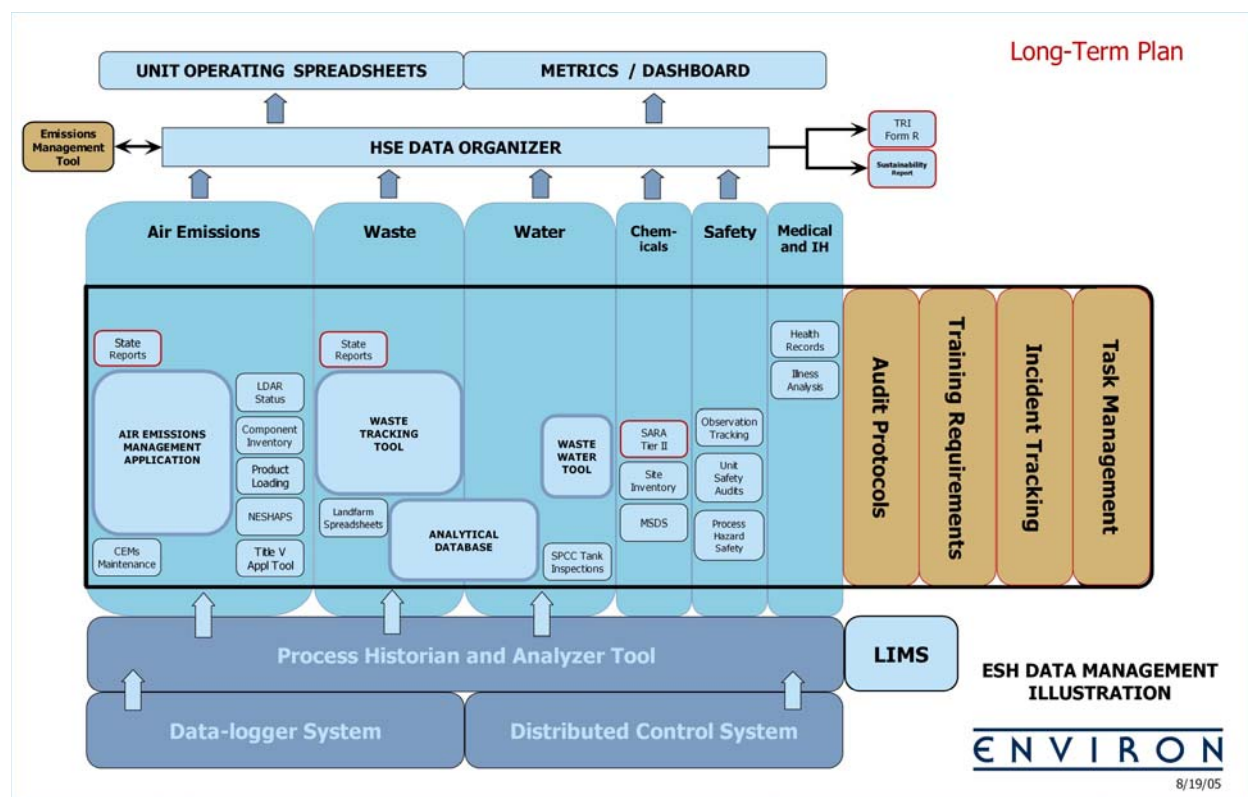


Figure 3 shows a number of key components that enabled the planning process to move forward.

1. An "Information Organizer" ("I-O") layer was placed above the silos as a way to retrieve and process data from underlying applications, which could remain in service. The I-O would support a metrics dashboard, as well as be a place to house custom applications.
2. For planning purposes, several applications within the silos were grouped to illustrate the functionality that could be replaced by new applications.
3. The formerly disconnected applications and tools on the right were conceptually linked to the silos, illustrating the need for future integration (of varying degrees).

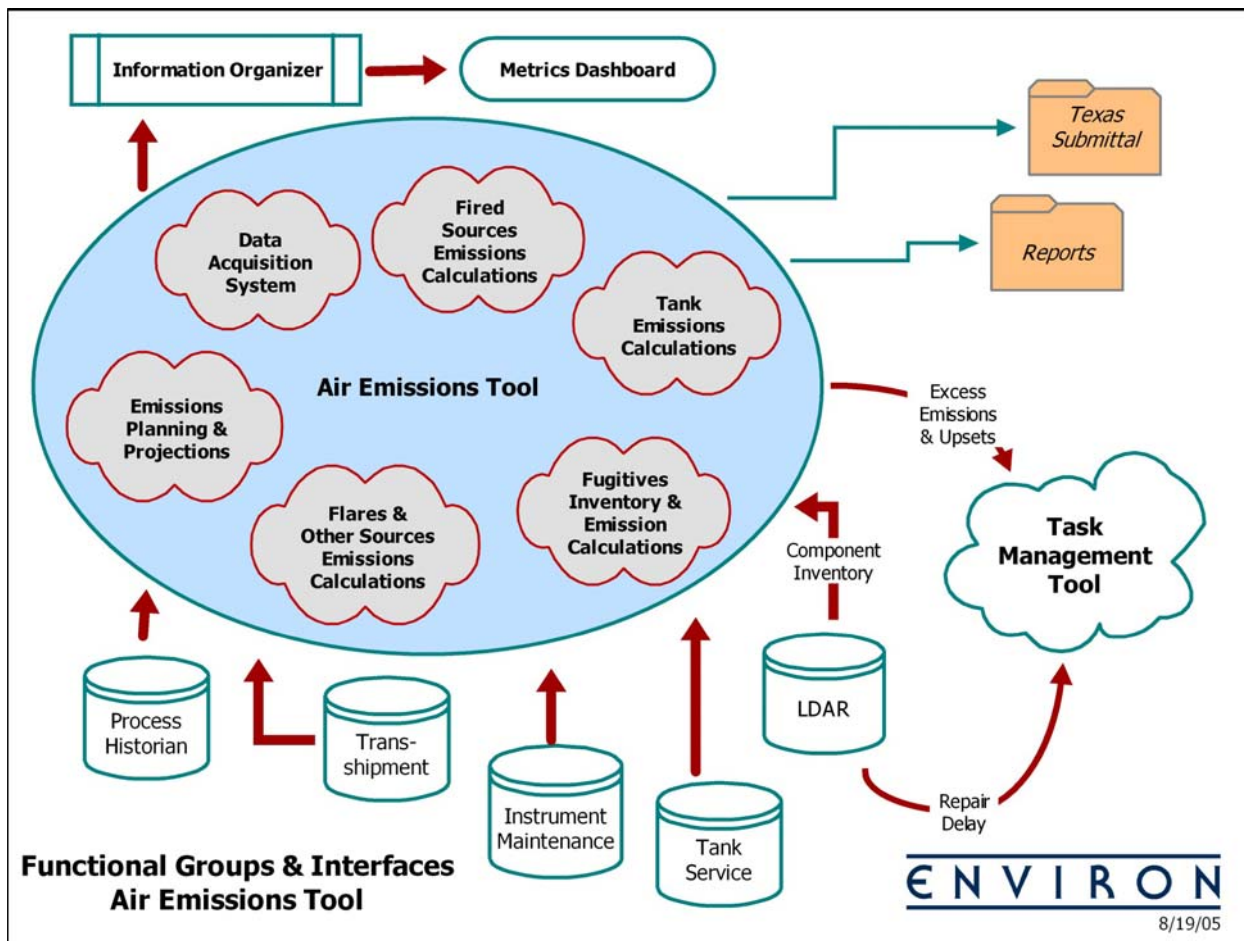
A further refinement of the Implementation Plans is shown on Figure 4, for long-term planning. The grouped tools have been replaced by the air tool and the waste tracking tool, and applications are built within the I-O (including export processing for the TRI and sustainability reports).

Figure 4
Example of Long-Term Planning Graphic



Within each of the priority software areas, planning proceeded into more detail. Figure 5 shows an example of the groups of functionality required by air emissions management. The links to other, existing applications (which will remain in service) are shown, which were also included in the planning. Links to the Task Management Tool are shown as “manual” connections (curved lines) as opposed to the other “direct” links. Grouping the functionality within the air tool allowed software evaluations to proceed without requiring that a single application meet all of the requirements. For example, the Data Acquisition System, which would integrate with the plant historians, could be a separate application from the “core” air functionality of emissions calculations (fired sources, tanks, fugitives, flares, etc.). Emissions Planning & Projections was also evaluated separately, as it was not a common component at the time of the evaluation.

Figure 5
Function Groups – Air Emissions Example



Section 4: Software Evaluations

Software evaluations proceeded separately for each of the highest priority applications. Links between the applications were specifically considered in the requirements analysis. The Information Organizer will facilitate data analysis from multiple applications; by planning for the I-O from the start, all necessary links can easily be planned.

With corporate and facility information technology staff, ENVIRON and RMT developed the high-level criteria for general application requirements. New, custom applications were considered as well, but would have to meet all of the general requirements to be considered as a viable alternative. Table 1 illustrates the results of a comparison of air emissions management tool vendors, as presented to the evaluation team. Note that Vendor 3 did very well, only missing a perfect screening by not having an acceptable database back-end in service (an MS SQL version was in testing).

Table 1
General Requirements Screening

General Requirement	Vendor 1	Vendor 2	Vendor 3	Vendor 4
Web-based, MS Internet Explorer	☹	☹	✓	✓
Intranet deployment	☹	☹	✓	✓
MS SQL Server or ORACLE database	✓	☹	☹	✓
Database open to other applications	✓	✓	✓	✓
Application built in MS “.NET” framework	☹	☹	✓	☹
Manuals, Help, Tips, Definitions within application	✓	☹	✓	☹
Training provided during configuration and setup	✓	✓	✓	✓

The software application evaluation proceeded in an “incremental/iterative” fashion, not unlike the software development model of the same name.

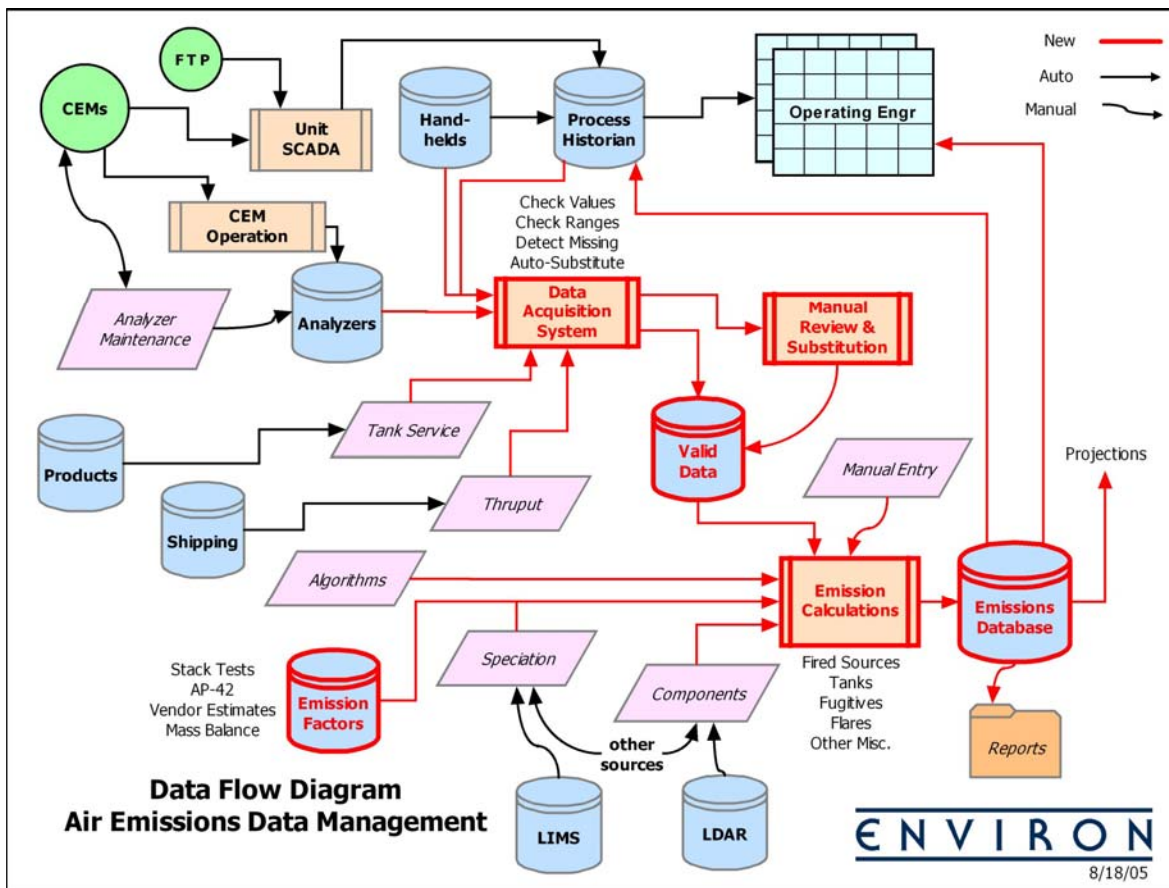
- A detailed listing of system requirements was developed with key users in each application area. Requirements were organized in the following categories: Business, Technical, Functional, Reporting, and Linkages. “Non-functional” requirements were also specifically captured when the team agreed that they should not be included. Requirements were prioritized as following: Necessary (the application will fail if not

met), Desirable (nearly everyone agrees it is important), and Optional (as in “might be nice”).

- ENVIRON and RMT began the process of screening and evaluating vendors with experience supplying applications of the breadth and scale as required by the facilities.
- Team meetings were held to further define the work flow in place at the facilities, which would become the standard for evaluating each application. By closely matching the data flow of the application with the work flow at the facility, the chances of success are dramatically increased.

Figure 6 is an example of a partial work flow developed for the air emissions tool. By definition, a custom application data flow should exactly match the facility work flow processes. Note the differentiation between new and existing connections, and between automatic and manual ones.

Figure 6
Air Emissions Management – Detailed Data Flow Example



All of the following steps were included in the evaluation and comparison process.

- Develop a long list: EHS staff, RMT, ENVIRON, World Wide Web
- Screen (possibly) potential candidate applications
- Conduct telephone interviews, involving technical sales representatives
- View a Web demonstration of application setup and use
- Determine the degree requirements are met
- Analyze pricing of modules and options

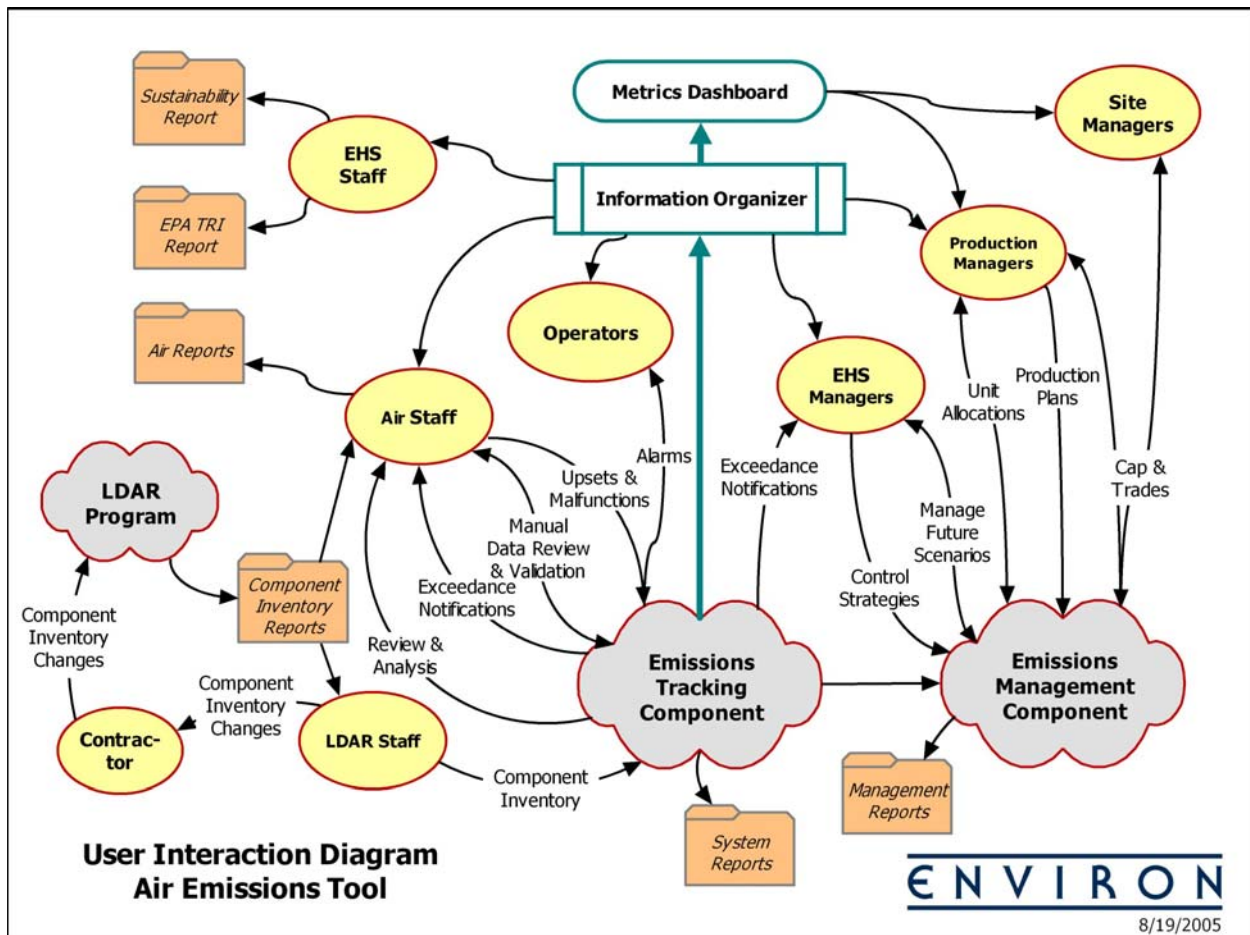
Table 2 shows a comparison of the leading vendors. A qualitative rating (essentially with 5 possibilities) was suitable for the teams' purposes. Note that none of the applications had a suitable module for emissions planning.

Table 2
Evaluation Criteria Comparison

Evaluation Criteria		Vendor 1	Vendor 2	Vendor 3	Vendor 4
Effectiveness	Data Acquisition	☹☹	✓	✓✓	✓
	Emission Calcs	✓✓	✓✓	✓✓	✓
	Planning	☹	☹	☹	☹
Implementable	Application	☹	-	✓	✓
	Interfaces	☹☹	-	-	-
	Vendor Record	☹	✓	✓	✓
	Ease of Use	-	☹	✓	☹
Costs	Software	\$35k ?	\$250k \$45k/yr	\$75k/yr -	?
	Implementation	☹☹	-	-	☹

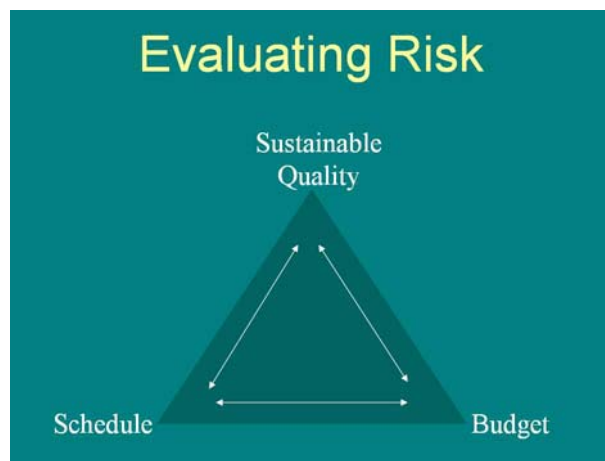
Important to the evaluation process was the way that users would interact with systems. User Interaction Diagrams helped the team visualize the different roles and responsibilities inherent in the implementation of large, complicated software projects, as well as who needs access to which components. Figure 7 is an example of such a diagram.

Figure 7
Air Emissions Management – User Interaction Diagram



Once it was determined to implement the recommendations of the Gap Analysis, the team established a Risk Management Plan which outlined the process and roles and responsibilities for managing risk. The team recommended a level of effort for risk management appropriate to the scale of the project using a cost-benefit approach.

During the requirements analysis phase of each project, the team used several published lists and meetings with facility staff to help identify relevant risks for each project.



For the software evaluation, the team determined a short-list of risks that were important in comparing the software and the software vendors. The list included contracting issues, previous experience with the vendors, product and vendor sustainability, degree to which the requirements were met or could be met, ability of the vendor to meet the expected schedule, and impacts from external dependencies and interfaces to other tools. The team rated each software package that passed the screening. It also rated the risks for building the software as a custom package. These

scores were presented to Innovene as part of the software evaluation (Table 3), with a score of 10 signifying the lowest risk. Once software was selected, risks were managed by the implementation project manager.

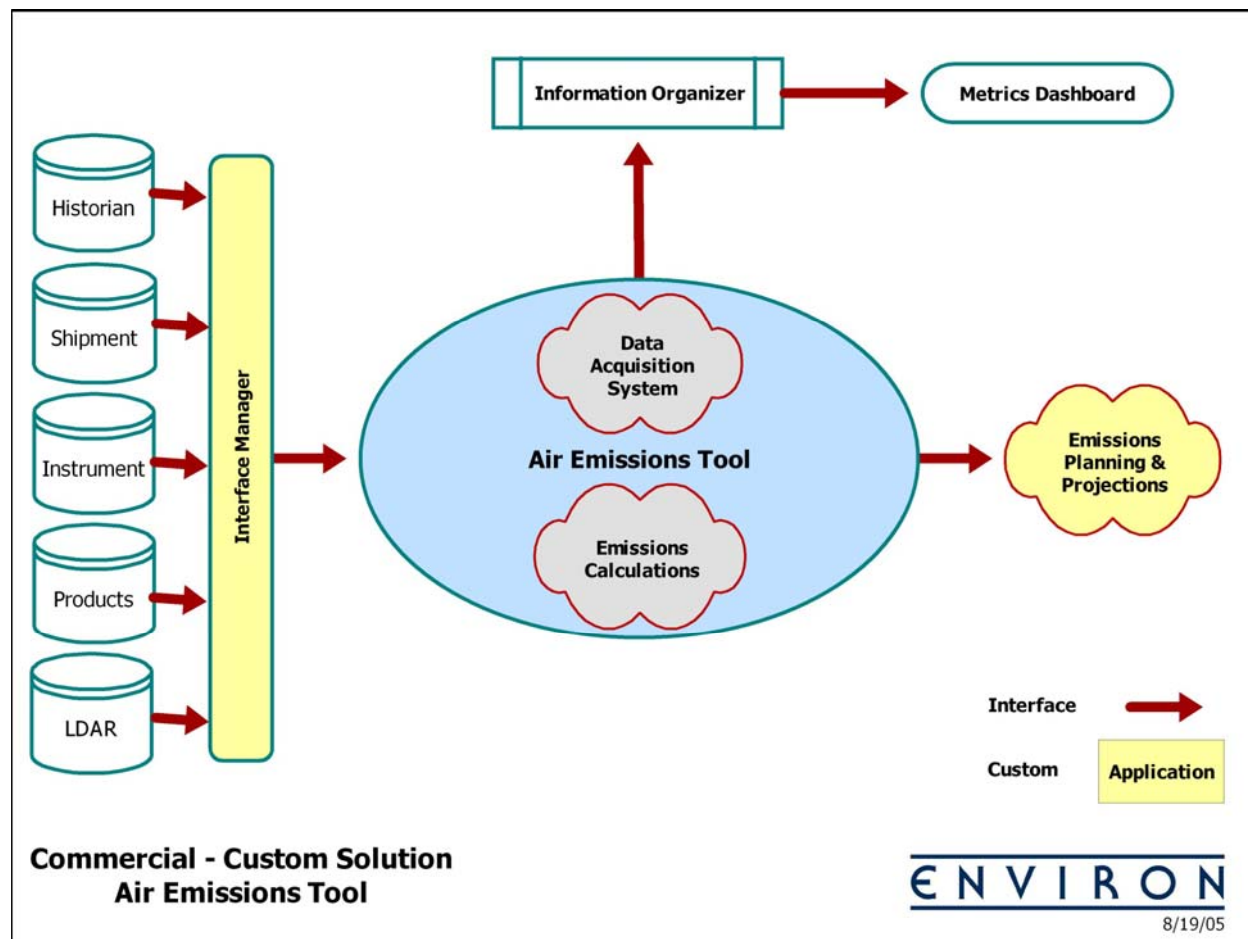
Table 3
Software Development – Relative Risk Evaluation

Risk issue	Impact	Vendor 1	Vendor 2	Vendor 3	Custom
Contracting	S	5	8	4	7
Experience with vendor	SBQ	7	7	2	9
Product sustainability	Q	7	7	8	6
Vendor sustainability	Q	7	8	8	2
Degree that necessary requirements are met as is	SBQ	2	5	7	0
Degree that necessary requirements can be met	SBQ	5	7	8	9
Vendor's ability to meet schedule	S	5	5	7	2
External dependency impacts	S	4	7	6	7
Interface impacts	SBQ	5	7	5	8

Under the "Impact" column on Table 3, S denotes Schedule, B indicates Budget, and Q implies a Quality impact. The greatest risks are shown as "0," the least are "9."

As the focus of the analysis narrowed, it was apparent that no one application could meet all of the requirements. While a fairly analytical scoring approach was used and a single application emerged as the best overall choice (for the air application), there was a need to adjust the implementation approach and develop a “combined” solution, as shown on Figure 8.

Figure 8
Example Combined Solution



A single vendor was selected for the Air Emissions Tool, combining the high-performance Data Acquisition System with the more routine Emissions Calculations package. Two custom applications were proposed:

1. Interface Manager – All of the direct link interfaces to existing applications will be managed via a single set of custom application links, and
2. Emissions Planning & Projections – A custom or separate commercial application will be implemented to manage all of the complex integration of turnaround schedules, upsets, outages, and emissions credits.

An example of an overall evaluation results summary is shown on Table 4. Over a dozen commercial packages were considered for the air emissions tool. The analysis displays how the focus was continuously narrowed to applications that had the highest potential to meet the system requirements while still minimizing risk. Note that in the final analysis, some of the key differentiating comments are qualitative in nature, illustrating the balance between a rigid analytical approach, and one that incorporates overall impressions.

Table 4
Air Tool – Example Evaluation Results Summary

Software Package / Vendor	Info Screen	Phone Screen	Demo	Requirements	Final Rank	Comments
Vendor 1	A	B	B	-	3	Minimal data validation
Vendor 2	A	A	B	B	2	Fragmented, no manual subst
Vendor 3	A	A	A	A	1	Robust, stable
Vendor 4	A	A	B	-	4	Limited scalability
Vendor 5	A	⊗	Web version not yet available for (minimal) air modules			
Vendor 6	A	⊗	Custom application for refinery; no commercial track record			
Vendor 7	B	⊗	Desk-top data management capability only			
Vendor 8	B	⊗	Minimal air capability; consider for waste tracking			
Vendor 9	⊗	Client/Server application; minimal functionality				
Vendor 10	⊗	Built for USAF; limited commercial applicability				
Vendor 11	⊗	Adapted application for commercial use				
Vendor 12	⊗	Similar in scope and functionality to competitive application				
Vendor 13	⊗	Limited existing applications; commercial packages years away				
Vendor 14	⊗	Mainly available as ASP; no internal data validation capability				

Section 5: Summary

Overall, it was an interesting and challenging effort, one that resulted in a template for other software evaluations. In summary,

- The “optimal” solution is a combination of commercial and custom applications for complicated facilities
- Links between applications are important unto themselves
- Existing tools can and should be retained where they meet the needs of the situation
- Be ready to retire “Classic” tools as they reach their end-of-life

The team was aggressive in specifying the latest development technologies, as they should be. By embracing the newest (yet proven) frameworks, they have the greatest chance to enjoy long-lived applications. Open applications allow linkages to be maintained and updated. Applications that are thus “loosely-coupled” allow one to be replaced or upgraded without having to modify or even replace related applications.

This template allows a flexible approach to EHS system architecture development, and can be used in a variety of situations, for large and small facilities.