Save Time and Costs
with Intelligent P&IDs and Smart 3D Model based
Management Information System
for Operating Industrial Plants

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Executive Summary

Common problems faced by operating plant personnel in engineering, operations, repair and maintenance:

- How to rapidly retrieve accurate information on equipment, piping, ducting, cable trays etc.?
- How to quickly arrive at an alternate process in case of failure of any pump, valve etc.?
- How to effectively train operations and maintenance personnel?
- How to quickly respond to an emergency?

- During retrofit / expansion projects,

  - How to route new pipes or make layout changes in and around congested areas?
  - How to ensure operability and maintainability requirements are met?
  - How to perform detailed engineering on newly routed or modified pipelines and arrive at a suitable support scheme?
  - How to rapidly generate updated construction drawings such as GA layout drawings, piping isometrics, spools etc. and reports such as Bills of Materials?
  - How to sequence and schedule construction activities based on available materials, and monitor works?

- How to assess the health of the plant and estimate its residual life? How to extend the life of the plant?

An ideal solution to these problems should

- include preparation of Intelligent P&IDs, as a minimum, for all critical systems,
- involve development of Smart 3D Plant Model for the "as-is operating" condition (at least of areas which include those critical systems) using lasergrammetry system
- capture new / updated / additional information (in the form of data, drawings and documents) related to design, engineering, procurement, repair, etc.,
- store information centrally and transfer relevant data to various application software modules through "middleware" interfaces,
- not force any client to use only vendor recommended application software and database products, and
- be customizable for any type and size of industrial plant.

INFOplant is a unique Integrated Plant Asset Management System that has been designed and built to meet the above demanding requirements.

Gaps in Information Flow cause bottlenecks;

No other system has solved this problem

The fundamental deficiency in the current life-cycle management of the plant is that any "intelligence" (in the form of data, drawings and documents) entered during any activity for any object in the plant (such as an equipment or a valve etc.) does not flow automatically to all downstream activities involving that object.

This basic flaw results in plant personnel anywhere experiencing the same set of difficulties in running and maintaining a plant.

- Spend enormous time to retrieve information related to design, procurement, maintenance etc.

- Take too long to arrive at a process-wise correct and practical alternate solution when a pump or a valve or a process equipment suddenly fails.

- Unable to impart comprehensive training to plant operations and maintenance personnel.

- Slow in arriving at effective responses to emergencies.

- Retrofit / expansion projects have been time consuming and expensive due to lack of the latest data / drawings / documents on the "as-operating" plant; in addition, design and detailed engineering, procurement and construction activities are still not seamlessly integrated.

- Inability to assess the health of the plant and extend its operating life.

Such difficulties are generally encountered at all types of operating plants worldwide, including Power (fossil & nuclear), Oil & Gas production (onshore & offshore), Refinery, Petrochemical, Fertilizers, Pharmaceutical, Food Processing, Sugar, Paper & Pulp, Steel & Metal Process, Waste Treatment etc.

The manual / semi-automated procedures currently followed by operating plants to overcome these difficulties are either slow or expensive or both, resulting in increased operating, maintenance and plant expansion expenses.

In addition, vendors who claim to close some of these "gaps in information flow" force the client to use only their software products. Such solutions neither provide the flexibility nor the freedom to the client to choose the best products for different applications from different vendors and integrate them. In effect, the client is held "captive" by its vendor.

What is an Ideal Solution?

An ideal solution would include all these capabilities:

- develops Intelligent P&IDs for the piping systems and if required for the ducting systems,

- builds Smart 3D Plant Model for the operating plant using lasergrammetry system,

- captures and stores in a Central Database any "intelligence" entered during basic design of schematics, detailed design, engineering, procurement, construction, commissioning and other downstream activities up to de-commissioning,

- transfers relevant data to applications software for pressure drop calculations, pipe stress analysis, structural analysis, project management etc. through "middleware" interface software, so that each client can continue using their chosen tools,

- works on any client-selected Intelligent P&ID module, 3D plant design system and any other application software,

- resides on any client-chosen relational database management system such as ORACLE, MS-ACCESS, MS-SQL, Sybase, Informix etc., and

- is customizable to meet client's requirements.

An integrated system has been purpose-built to meet all these stringent requirements of any operating plant. It is called INFOplant-The Integrated Plant Asset Management System. INFOplant, as described below, has been

- created by a technical team with hundreds of man-years of industry experience, and

- successfully implemented on

  - a new generic "green-field" plant, and
  - an operating "brown-field" plant.

INFOplant^{TM} - Integrated Plant Asset Management System

The INFOplant system schematically shown below integrates information (data, drawings and documents) related to design, engineering, procurement, construction, commissioning and other downstream activities of any industrial plant. The system consists of a Central Database and various functional software modules that are inter-connected through our "middleware" interfaces (represented by arrows) customized for each plant project. This integration allows the "intelligence" (i.e., attributes) entered at any time for any object in the plant to seamlessly flow to all downstream activities involving that object. For example, a key attribute such as "empty weight" entered for a valve while preparing an Intelligent Piping & Instrumentation Diagram (P&ID) would flow to Intelligent 3D Plant Model → Analyses software → Project Management tools → Drawing & Report generation modules → Procurement / Construction / Maintenance management systems, without re-entering that attribute ever again.

Note 1: INFOplant works on any Intelligent P&ID module and 3D design software and is customizable for any type of plant. The Central Database can be Oracle, Sybase, MS ACCESS, MS-SQL, etc. All our "middleware" interfaces represented by arrows in this diagram are customized for each project.

Note 2:

Prototype versions of Construction Sequencing & Scheduling software are already implemented.

The first step in implementing INFOplant system on any industrial plant is to develop Intelligent P&IDs for the systems involved using client-specified P&ID software.

> Intelligent P&IDs for piping systems are generated using symbols and keys as well as general elements such as title, size of drawings, etc. customized as per the client's procedure. The intelligence would consist of minimum required attributes for 3D design, analysis, procurement, maintenance etc. The engineering inputs for such intelligence would be originating from process flow sheets, instrumentation schematics, equipment data sheets, valve and instrumentation specification sheets, piping material specifications, etc. In addition, the information stored with each Intelligent P&ID can be in the form of drawings and documents.

The second stage in implementing INFOplant system on an operating "brown-field" plant is to develop Smart 3D Plant Model for the plant. A brief methodology is as follows.

> For an operating "brown-field" plant, the Smart 3D Plant Model is built using point cloud data captured by 3D laser scanning instruments installed at various locations of the operating plant. Intelligence related to design, engineering, procurement, construction and other downstream activities is then added to each object in the Smart 3D Plant Model.

Once the customized Intelligent P&IDs and the customized Smart 3D Plant Model are developed for the operating plant, all the corresponding data are automatically saved in the INFOplant's Central Database, which, in turn, is also customized to meet the information requirements of the entire plant / project. The customized "middleware" interfaces (represented by 1-way or 2-way arrows in the Flow Chart above) are then utilized to transfer relevant data from the Central Database to any application software.

In short, the comprehensive 2D-3D INFOplant system, once fully implemented on a plant, would serve through the remaining plant life, i.e. commencing from Design & Engineering through Procurement & Construction during retrofit / expansion projects to Operation & Maintenance phase and in Decommissioning.

The Integrated System saves time, effort and money

By implementing INFOplant system on an operating plant, the client derives so many benefits (some of which are listed below) that the client would recover the cost of INFOplant implementation in a short time just by saving on annual maintenance expenses incurred.

Benefits of Intelligent P&IDs of INFOplant system (over conventional non-intelligent P&IDs) are listed below.

- From Intelligent P&ID database, plant operating and maintenance (O&M) personnel could at any time rapidly retrieve attributes of equipment, nozzles, pipe lines, valves etc. For example, if a pipeline starts leaking, then the O&M personnel could immediately retrieve the Intelligent P&IDs that include this line and identify the valve(s) that should be closed to stop the leak.
- The plant O&M personnel could use Intelligent P&IDs to arrive at alternate processes in case of failure of any equipment (such as a pump), valve etc.

- Intelligent P&ID database can be extended to include customized inspection / maintenance management functions or can be linked directly to the client's in-house database systems.
- The Intelligent P&IDs will also help in any future retrofit / expansion projects.
- Since the Intelligent P&IDs generated for the operating plant are linked to the Smart 3D Plant Model, the discrepancies between the Smart 3D Plant Model database and the Intelligent P&ID database can be identified and corrected.

Additional benefits accrued from INFOplant system built on Smart 3D Plant Model are as follows.

- By way of an interface with project management software, the Smart 3D Plant Model with attached documents can be used for monitoring works during retrofit / expansion / shut down of the plant.
- Construction sequences can be identified in the 3D virtual plant in advance, thereby significantly reducing the construction time and costs.

- Construction scheduling can be dynamically decided based on the then inventory of available materials, leading to "just-in-time" procurement activities. Similarly, dismantling sequences can be worked out using the virtual 3D Plant Model.
- Project progress stages in terms of constructed area, under construction, under procurement, under testing and under design can be visualized.

- Smart 3D Plant Model updated to the "as-built" status and then continually updated to the "as-is operating" status helps in training operating and maintenance personnel. It is also helpful in performing safety studies and in rapidly deciding emergency response by accessing data instantaneously.
- This Smart 3D Plant Model can be further utilized during plant maintenance to record and query maintenance procedures, schedules, history, spare part list, spare part suppliers, inventory list etc., by either adding custom-made modules to our INFOplant system to perform these functions or interfacing with the client's in-house or third party maintenance management software system.

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About the Company

SST India Private Limited (SST India), incorporated in the year 1991, is a premier provider of Plant Engineering Software Solutions and Services offered through three distinct Strategic Business Units (SBUs).

- SBU 1: Plant Engineering Software Products
- SBU 2: Plant Design and Detail Engineering Services
- SBU 3: Integrated Plant Asset Management System (INFOplant™)

SST India provides the above SBU services and solutions to EPC Contractors, Owner Operators and Engineering Consultants in the field of Power (fossil & nuclear), Oil & Gas production (onshore & offshore), Refinery, Petrochemical, Fertilizers, Pharmaceutical, Food Processing, Sugar, Paper & Pulp, Water Treatment, Waste Management, Steel / Metal Process, Ship building, Heavy Engineering Industries etc.