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Product Overview

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1 Introduction to the Journey

In this guide you will discover Opcenter Intelligence (Opcenter IN) through increasingly in-depth steps, starting from a general architectural overview to the description of the single components that make it up.
You are going to learn how this product fits into the latest technological innovations and proposes a highly flexible and extensible solution to retrieve data from heterogeneous systems, which can either be members of the Opcenter family or third-party products.

This guide does not aim to describe how operations can be performed, or how things are developed, or how the system can be installed and configured. It rather wants you to discover what can be achieved and through which technologies.

Who is coming with us on the journey?

This document has been written for business analysts and software architects who are in charge of making important evaluations or decisions about business solutions, process methodologies and technological changes.

2 Where Are We Starting From and Where are We Going?

Let's start with an overview on the destination of our journey: where is Opcenter Intelligence heading, what are the latest market changes and needs and which manufacturing trends does it fit into.
As a consequence of the deep influence of the latest technologies and trends on the business landscape, a more flexible solution is required to satisfy new customer requirements.
Flexibility means that our product must be able to interface with different technologies, which might rapidly change, and give the users the chance to easily customize the product so that it always stays in line with the manufacturing reality.

In this journey step we will concentrate on:

- The manufacturing software trends that drive software design and the concept of Manufacturing Operations Management (MOM).
- All the functionalities required to develop, deploy and maintain an Opcenter Intelligence Solution, in order to analyze manufacturing data according to standard and custom analytical contexts.
- The main concepts and features applied to provide a business intelligence ecosystem, where you can easily manage and analyze structured data and where the main ingested MOM data can be displayed and analyzed thanks to Opcenter Intelligence Solution Management.

2.1 What is the Manufacturing Operations Management?

To meet the latest software manufacturing trends, Siemens delivers a product based on a core of business operations and entities that can be modularly used and combined to model your IT manufacturing plant. These operations are identified as Manufacturing Operations and are used to model a custom logic that effectively interacts with Manufacturing Execution System (MES) level.

Manufacturing Operations Management (MOM) can be viewed as a manufacturing software layer which is placed on top of the traditional MES layer. This additional layer is designed to be highly configurable and flexible in order to quickly adapt to the rapid business changes required by the new plant models.

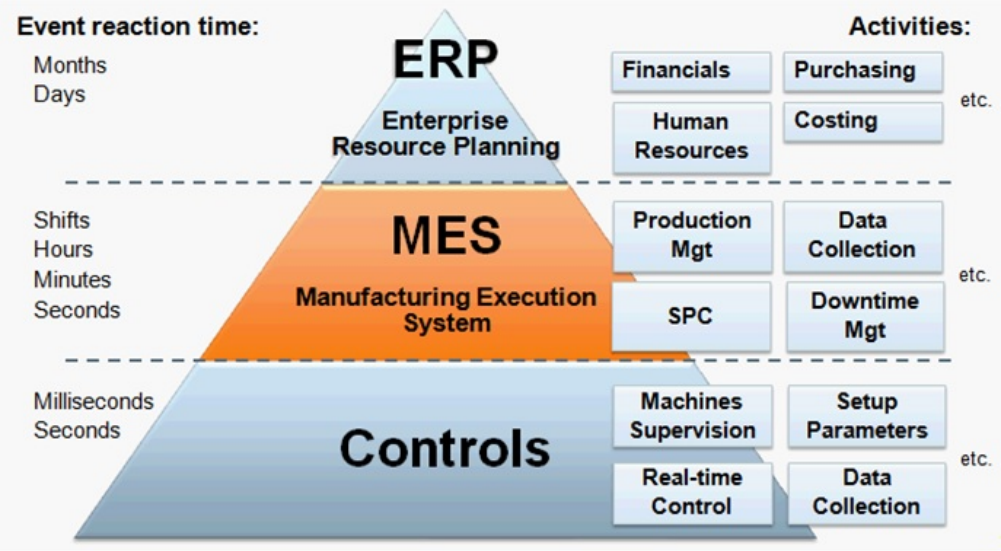
Opcenter Intelligence delivers a solution to analyze MOM data. This solution is deeply integrated with MES systems.

From Manufacturing Execution Systems (MES) to MOM Systems

In the early Nineties, industries acknowledged the need for a layer to integrate and link Business Systems with Control Systems. The term Manufacturing Execution Systems (MES) has been used from the start to specify all those functions and products that satisfy this need.

Initially, MES indicated an area where almost every application or product could not be clearly assigned to either the Business System or the Control System layer. Most of these products were spin-offs of applications developed by a System Integrator for a particular customer and were generally focused on a very specific area (for example, scheduling, laboratory, quality or tracking).

After some time, international organizations realized that a clearer definition of MES was required: MESA (Manufacturing Enterprise Solutions Association) and, as a consequence, ISA (Instrumentation System and Automation Society) later developed models that describe these levels and seek to standardize them.



Under the pressure of new business-driving forces that have been emerging in recent decades, Manufacturing Plants continue to play a major role. The globalization of both companies and production processes makes it necessary to create new models. Manufacturing is not a process that can be completed by a single self-enclosed entity, but extends beyond the bounds of the plant, the country and the business enterprise.

Therefore, MES cannot act simply as an interface between Business and Process layers, but requires a substantial number of functions that are crucial to a Company's success. Rather than remaining distinct from one another, connected solely by a data exchange layer, these functions need to be coordinated, in adherence to the Business and Production strategy.

ISA-95 documents point this out very clearly, describing the MES process in terms of both data and interaction between functions (for example, Order Dispatching or Resource Management).

The result is a new approach to MES, based on an architecture that makes it possible to describe business processes that orchestrate functionalities provided by a set of specialized and affordable components.

At the same time, this orchestration must also involve the automation and control level, thereby making both MES and control part of the same collaborative production management system.

Many early MES systems were not sufficiently configurable and flexible to quickly adapt to the changes of business models brought about by new market conditions. Consequently many vendors tried to differentiate themselves from MES by adopting the new Manufacturing Operations Management (MOM).

Manufacturing Operation Management (MOM) can be described as an approach which oversees all aspects of the manufacturing process, with a particular focus on increasing efficiency.

This approach aims to orchestrate all those activities that establish work unit definition and control, in the form of workflow or recipe control, to produce the desired end products. MOM systems, as a development of MES systems, analyze work data, maintain records and optimize the production process.

Service orientation offers great benefits to the retail enterprise in incrementally changing systems to meet business demands.

2.2 What is Business Intelligence?

Managers need to make quick and effective decisions, and to do this they need the right information at the right time, but they are often overwhelmed by data, which is scattered across different sources. For quick and effective decision-making, data must be:

- integrated into one place (a data warehouse)

- turned into clear and actionable information.

Business Intelligence systems typically supply dedicated client-side tools, which make easier the navigation between data and make analysis easy for non-technical users. One of the features of a BI system are for example dashboards, which provide an at-a-glance overview of key business data.

The general styles of Business Intelligence reporting are:

- Self-Service Analysis: it is dedicated to non-technical users that want to integrate data from different sources and perform drill-down operations in order to find the reason of data anomalies. It does not require a fixed-form reporting and analysis system, and consequently no IT involvement.
- Business Reporting: it is based on a set of formatted reports showing consolidated corporate data. These reports are created by advanced business users or analysts that are shared with managers and teams. In this case, the IT involvement is moderate.
- Operational Reporting: it is similar to the Business Reporting style, but is it based on fixed-format reports created and managed by IT. The main characteristics of this style are: consistency, scalability, manageability and automated distribution.
- Performance Monitoring: it is based on dashboards that allow executive users to monitor the business performances, providing them with an at-a-glance visibility on the business status.
- Scorecarding: it is based on a set of KPIs, meaningful for the business activity, which are measured against predefined targets. If necessary, this style can also be used to evaluate operational performances, but it usually belongs to a performance management program.

What is manufacturing intelligence?

In today's economic environment manufacturers are under constant pressure to optimize plant performance and consequently to reduce operating costs.
To accomplish this objective many manufacturers have installed Manufacturing Execution Systems (MES) that have proven to streamline production processes and facilitate the flow of information between the shop-floor and the rest of the enterprise.
As a result, every day Manufacturing Execution Systems process a very large amount of data. But, typically, this data is difficult to interpret, and must be accessed and transformed thus becoming understandable and actionable to users in a format they can use to optimize operations.

Manufacturing intelligence transforms plant floor data into key performance indicators and metrics that managers use to monitor and improve the manufacturing operations performance.
In this way, manufacturing Intelligence enables manufacturers to close the performance loop by gaining visibility across the production, inventory, assets and quality management aspects of manufacturing operations.

A manufacturing intelligence system enables close-loop performance management by:

- Aggregating data gathered from many sources.
- Contextualizing the data through a data model that will help users find what they need.
- Providing appropriate analytics that enable users to analyze data across sources and especially across production sites.
- Providing tools to create visual summaries of the data to alert decision makers and call attention to the most important information of the moment.
- Automating the transfer of the collected data from the plant-floor up to business systems such as SAP.

The main benefits of manufacturing Intelligence are:

- More Intelligence; Integration of analytical and visualization tools makes possible to monitor data in real time and inform appropriate decision-makers in case of non-conforming incident.
- Less Variability; Using manufacturing intelligence systems, manufacturers can better understand sources of variability in their production process and operate to improve process stability, plant capacity, and quality compliance.
- Less Costs; Reducing variability in the production process manufacturers can decrease operating costs.

2.3 What is a Data Warehouse?

A Data Warehouse is a repository that contains the data of a company or organization and is used to easily produce analysis and relations to support business decision-making.

In our context, the structure of the data warehouse conforms to international standards such as ISA-95 and is moving toward Industry 4.0 models.

This repository collects most relevant business data from the data model. It stores business information instead of detailed production data to allow the personnel responsible for plant and line operations to easily access business reports, providing constantly updated information.

Data provided by Siemens and third-party products can be read, injected or stored in the data warehouse by means of miscellaneous data processing systems, such as stream processing or the ETL (Extract, Transform and Load) system to update data model implementation and fit the data model of new data.

Data can also be exposed in order to enable KPI reporting and advanced analytical functions.

2.4 What are Measures and KPIs?

KPIs (Key Performance Indicators) are defined as quantifiable and strategic measurements that reflect the critical success factors of each organization. They are calculated comparing a measure against a target.
The main concepts relative to KPIs are the following:

- Measures (or Facts), which are properties that identify numeric values contained in the fact tables to provide the user with quantitative evaluations of business events (for example Produced Quantity, Scraps, Broken Bottles etc.). Measures can be combined in a formula to define other measures. Measures can only be expressed by numbers.
- Dimensions, which represent production entities that are typically used to contextualize the Facts (for example Equipment, Shifts, Products, Orders etc.). Dimensions show how the user wants to analyze data. They are always expressed by strings and can also be called contexts or attributes.

2.5 What is a Star Schema?

From a functional perspective, a star schema can be defined as a model used to organize information in a data warehouse for the purpose of allowing information to be viewed from many perspectives. The middle of the star consists of the basic, factual information. The points of the star represent various perspectives from which the factual information can be viewed.
From a technical point of view, a star schema is a database design that consists of: a fact table, which contains measurable, quantitative data about the business, and two, or more, dimension tables, which contain descriptive attributes. Each dimension table has a single field primary key (PK) which has a one-to-many relationship with a foreign key (FK) in the fact table.

2.6 What is Scale Up?

Vertical Scaling (Scale-up) refers to adding more power (processors and RAM) to an existing computer. It can improve the capabilities of a node or a server by giving greater capacity to the node but does not decrease the overall load on existing members of the cluster. That is, the ability for the improved node to handle existing load is increased, but the load itself is unchanged.

In a database where data resides on a single node, vertical scaling is done by spreading the load between the CPU and RAM resources of the machine.

2.7 What is a Columnstore Data Engine?

A columnstore is data that is logically organized as a table with rows and columns, and physically stored in a column-wise data format. It is a new way to store relational table data as opposed to a rowstore, where data is logically organized as a table with rows and columns, and then physically stored in a row-wise data format.

A columnstore index is normally used to store and query large fact tables in a data warehouse to enhance performance. In Opcenter Intelligence the data warehouse has been designed to support the columnstore method, which is automatically managed by the system.

2.8 What is an Analytical Tool?

An analytical tool is business intelligence software that allows small and big businesses to easily connect to qualitative and quantitative data by means of delivery and analysis services to visualize and create interactive, shareable dashboards.

The information gathered via these services can then be applied to customers, whether new or existing. Finally, data can circle back to meet the company's business objectives.

These tools provide “speed of thought” analysis, conforming to the way business analysts want to consume and interact with data. Applications built with these tools are useful for point-and-click filtering and drill-down to detail.

Opcenter Intelligence is natively integrated with a number of reporting applications in terms of data transfer and visualization capability.

2.9 What is Operational Reporting?

Operational reporting focuses on producing detailed reports of day-to-day organizational operations. These reports include data pertaining to production costs, records, resource availability and expenditures, in-depth examinations of manufacturing processes, personnel and equipment actually used to produce product, material consumed, material produced, and other relevant production data such as costs and performance results.
They come in different time intervals, but generally focus on the short-term. Operational reports can also be modified by specific stakeholders and tailored to their needs to provide clearer insights and are also used by personnel responsible for plant and line operations.

3 What is Opcenter Intelligence Composed of?

Opcenter Intelligence provides you with all the following basic functionalities:

- A Manufacturing Analytical Model (MAM) based on the international standard ISA-95 for entity definition.
- All the features required to extend and customize models and metrics.
- A smart support for semantic data mapping between the sources and the MAM.
- An application designed to manage and maintain an Opcenter Intelligence Solution.
- A presentation/collaboration layer where you can perform and share data analysis.

4 What is Opcenter Reporting Composed of?

Opcenter Reporting is integrated in the Opcenter Intelligence solution package and is the most cost-effective visualization tool supported by Opcenter Intelligence in order to easily benefit from the built-in reports provided by Siemens MOM products, like for example Opcenter Execution Core, Opcenter Execution Discrete or Opcenter Execution Process, for which out-of-the-box reports designed using Opcenter Reporting are available and where Opcenter Reporting can be embedded.

Installation Options

Opcenter Reporting installation options can be either of the following:

- As a stand-alone application.
- After the installation of Opcenter Intelligence, whose ISO root folder contains the **OpcenterReport** subfolder including Opcenter Reporting setup files.

Basic Functionalities

Opcenter Reporting provides you with all the following basic functionalities:

- Multiple data source connections: both SQL Server and Oracle server types are supported.
- Integration with Siemens User Management Component for user authentication and login management.
- Report structure design and selection of how to show the information that originates either from a source database structure relation or user-defined custom relations.
- Organization of reports within folders.
- Report cloning.
- Report export and import.

For more details on Opcenter Reporting installation, configuration and usage, see *Opcenter Reporting Installation Manual* and *User Manual*.

5 Overview of Opcenter Intelligence Main Components

Opcenter Intelligence Internal Components

- Opcenter Intelligence Core includes the business logic to interact with the User Management Component (UMC) and redistributes the calls to the Application Server.
- Opcenter Intelligence Web API is a Web API self-hosted server that includes the business logic.
- Opcenter Intelligence Application Client represents the Single Page Application Client.
- Opcenter Intelligence Configurator is the stand-alone application that performs all the post-setup configuration actions.

Databases

The following databases can be created and managed:

- Engineering Database
- Manufacturing Data Warehouse (MDW)
- Production Interfaces, i.e. third-party Relational Database Management Systems (RDBMS), Opcenter Sources, etc.

Opcenter Intelligence can also interact with other sources by creating views or by implementing the communication with additional interfaces.

External Engines

Opcenter Intelligence interacts with the following external engines:

- Data Engine: the storage for the data warehouse or its sources.
- Ingestion Engine: provides the APIs to transform data into information.
- Scheduler Engine: provides the APIs to schedule a data flow, including its data transformation.

6 Who are we traveling with?

Opcenter Intelligence supports different sources, which can be divided into the following groups.

For more details on the functionalities supported by these sources, see *Opcenter Intelligence Reference Manual*.

Entity Mapping Files for each data source are provided with the user documentation. These files contain the name of the source database and its physical tables, the entities and attributes of the manufacturing data warehouse and the corresponding source entities and UI items, as well as related mapping information.

Opcenter Products

- Opcenter Execution Discrete (Opcenter EX DS)
- Opcenter Execution Process (Opcenter EX PR)
- Opcenter Execution Core (Opcenter EX CR)
- Opcenter Execution Electronics (Opcenter EX EL)
- Opcenter Execution Pharma (Opcenter EX PH)
- Opcenter Quality (Opcenter QL)
- Opcenter Intra Plant Logistics (Opcenter IPL)

SIMATIC IT Unified Architecture Products

- SIMATIC IT Unified Architecture Discrete Manufacturing (UADM)
- SIMATIC IT Unified Architecture Process Industries (UAPI)

SIMATIC IT Products

- SIMATIC IT Line Monitoring System (LMS)
- SIMATIC IT Production Suite (PRS)
- SIMATIC IT Historian
- SIMATIC IT Reporting Framework (RF)
- SIMATIC IT Electronic Batch Recording (eBR)

CAMSTAR Products

- Camstar Enterprise Platform (CEP) Core

QMS Products

- QMS Professional

Third-Party Systems Products

- SQL-based Systems
- Oracle-based Systems

7 Deep Dive into Opcenter Intelligence Concepts

In this step of our journey we want to present the main concepts of Opcenter Intelligence.
We will see how the product organizes its data model, how it executes commands at runtime, and how you can create your own data model entities and business logic in order to develop and deploy a manufacturing solution.

7.1 What is a Manufacturing Analytical Model?

The Manufacturing Analytical Model defines the analysis model (i.e. entities and relationships), which is based on ISA-95 International industry standard.

The analytical model makes the best use of the BI paradigms provided by Kimball and Inmon, in particular by taking advantage of the development speed of Kimball's approach and of the stability of Inmon's model. The manufacturing analytical model can manage information consistently and univocally and can expose it as a dimensional model when the user needs it, providing a view of the data based on specific data structures such as star schemas. Each is modeled with a central table, known as the fact table, surrounded by a set of dimension tables.

The MDW data model represents the physical implementation of the Manufacturing Analytical Model (MAM).
The data model uses the vocabulary of the domain. That is a key point of the architecture, because it allows any third-party software to connect and retrieve data from the MDW data model without any additional knowledge but the domain model semantics.

7.2 What is an Opcenter Intelligence Solution?

A Solution is a container of objects that allow the user to perform information ingestion (that is the process of obtaining and importing data for immediate use or storage in a database) in one or more data warehouses. It can be composed of:

- Projects
- Scenarios
- Flows
- Environments
- Smart Views

The Solution describes the entire project and includes:

- A definition of data sources
- A data collection approach
- A selected smart view

The virtual solution can be deployed on multiple physical systems (for example test and production) after defining the real system nodes (for example, the server name or the database name). You can therefore create different technological scenarios (for example SQL Server and Oracle) and then you can tailor each scenario to development, test, QA or production.

7.2.1 What is a Project?

A Project is a set of different configurations whose execution results in information ingestion, that is the process of obtaining and importing data for immediate use or storage in a database. Every part of this project manages the transformation of information and does not depend on the scenario (for example on the number of servers, the server types or the hardware distribution).

A Project represents the metadata integration rules of the project. To define these rules, the following items should be determined:

- A set of project functionalities.
- One or more sites.
- A set of project sources.
- One or more timeline schedules.

7.2.1.1 What are Functionalities?

Functionalities are user-functional concepts, that is the functions that the user is configuring regardless of how they are implemented. Once you have selected the component to be used as a data source, the system can automatically configure the internal tables and data mapping according to the selected functionalities.

For more details on each functionality, see *Opcenter Intelligence Reference Manual*.

Data source configuration is based on the following functionalities:

- Certification Management
- Completed WIP
- Container Management
- Context Management
- Defect and Non Conformance
- Device History
- Downtime Management
- Equipment Capacity
- Equipment Management
- Equipment Performance
- Inventory Management
- Labor Management
- Labor Performance
- Location Management
- Maintenance Management
- Material Consumption
- Material Container History
- Material Management
- Operational Performance and Quality
- Product and Material Traceability
- Production Definition
- Production Execution
- Production Scheduling
- Quality APC
- Quality SPC
- Sampling Management
- Tag Management

7.2.1.1.1 What are Models?

Data modeling is an abstract representation of the data structures to be used in the tables of a database to easily organize the data you have to store and the data you want to retrieve and show.

A data model organizes entities and their relationships, standardizes how these elements relate to one another and provides a way to access them without directly writing on the database or reading from it.

Models describe specific MOM functionalities and refer to ISA-95 standard.

For a list of the models and more details on each model, see *Opcenter Intelligence Reference Manual*.

7.2.1.2 What are Sources?

A source is the entity that supplies data. Manufacturing data is collected from a variety of data sources, including:

- MOM Platform
- Historian system
- Third-party and legacy systems

As data is collected from multiple sources, Opcenter Intelligence provides the structure and context to help users retrieve the required information regardless of where it comes from. Manufacturing data can be collected on-schedule.

7.2.1.3 What are Extensions?

Adding an extension means adding information to the out-of-the-box data warehouse. All entities in the data warehouse are described by means of a metamodel. Therefore, adding entities means adding entities or information to the metamodel.

Knowledge can be added in the form of a new entity or by adding properties to already existing entities. In both cases, you can add simple information like new alphanumeric properties or complex information such as relations with other entities.

The entity description requires the definition of the columns that make up the entity. Each column can have a semantic type that does not specify the data type used by the system to store the information, but the meaning of that data for the user during the analysis phase.

The purpose of extension modeling is to create data marts if the customer wants to extend the analytical system, that is create business intelligence analyses based on data or hybrid relational tables if extensions are created to generate reports. This type of modeling leads to limitations for the entities that can be created as model extensions. The following types are possible:

- **Analytical Facts**: a fact table, which contains measurable, quantitative data about the business. The fact table can only include numerical data.
- **Analytical Contexts**: dimension tables, which contain descriptive attributes. Each dimension table has a single field primary key (PK) which has a one-to-many relationship with a foreign key (FK) in the fact table. As a consequence, dimensions can only contain textual data.
- **Generic Entity**: entity type that is not strictly related to star schema modeling but that permits to model entities that contain both numeric and textual information useful for the generation of reports.

7.2.1.4 What are Schedules?

A schedule is the planning for loading data into a data warehouse according to flows based on ETLs.

You can generate one or more periodic schedules in order to run ETL incremental load to keep the data warehouse aligned with the sources.

7.2.2 What is a Smart View

A Smart View is the representation of manufacturing entities, ideas and events, along with their properties and relations, according to a system of categories. In many fields it can be created to limit complexity and help organize manufacturing information. At data warehouse level, a smart view is a constellation schema, that is a collection of star schemas.
Smart Views:

- Aim at simplifying the complexity of relationships among entities.
- Translate the system data vision into one that is more comprehensible to data analysts.

- Simplify the data warehouse model by producing a usable format for data analysts and their tools.
- Provide the formal naming and definition of properties and relationships within each specific industry domain.

In our context, given the manufacturing data warehouse provided out of the box, a smart view is a part or a projection of the data warehouse content specified to facilitate a particular purpose or user activity. It is, basically, a partial and/or redefined visualization of the logical schema of the data warehouse.

Smart View Concepts

In the following linked pages you can find some important concepts you need to know to properly configure smart views:

- Smart View Types
- Measures and Attributes
- Contexts
- Smart View Deploy

7.2.2.1 Smart View Types

A smart view can be of type:

- **Physical**: data warehouse tables are physically created in columnstore mode and the schema has the same name as the view.
- **Virtual**: the information is managed by creating SQL views on top of the data warehouse. This mode involves transformations each time the user makes a query, and is therefore demanding in terms of resources and possible system slowdowns. It should therefore be used responsibly, in particular when prototyping scenarios are involved or if the data warehouse does not contain a huge amount of data.

If you want to change the smart view type, the structures that have already been created will not be changed. This means that the model remains the same for the user and if any reports or dashboards have been created using one type or the other, they will still be available after the change. If you change the type from virtual to physical, an initial load will be necessary: this operation will require a long time.

7.2.2.2 Smart View Measures and Attributes

The smart view reflects the star schema concept in common BI scenarios. This means that to simplify the analysis and the usage of market BI tools, like Amazon QuickSight (on cloud), Tableau® (on-premises) and others, data is organized in fact tables, where there are all the aggregable numbers and typically contain a large amount of data (numbers can be called measures) and dimensions or contexts where you can find all the filtering or grouping labels and typically contain less data (labels are called attributes).

To produce a set of star schemas, where every star schema is useful to calculate a set of KPIs or to display related data in a dashboard, we provide the creation of the smart view, a simplified way to select meaningful information that the user wants to use to calculate KPIs or display in dashboards. The first step is to choose the required measures. This means that all the numbers he wants to aggregate, display, or use in KPI formulas need to be selected. This selection leads to the creation of fact tables (one for each card) in the star schema, which will include all the selected measures in columns. However, to create a complete star schema the dimensions/context are also required.

To do so, the user has to perform a selection on the **Attributes** tab, where the system automatically displays all the available dimensions/contexts related to the selected measures. Not all the dimensions/contexts are available for every fact table and this is not so evident in the page, because all the dimensions/contexts are shown together and when measures that belong to different cards are selected, in the selection of attributes no hint is given to understand which measures those dimensions/contexts can be associated with.

> To understand which fact tables are linked to the contexts, the use of the Contexts functionality is recommended (**Contexts** tab between the **Measures** and **Attributes** tabs).

After you have selected the attributes, the system can create the “beam” of the star schema, where the name of the dimension/context is the name of the card and the columns are the selected attributes. The result is a “constellation schema” (smart view), i.e. a set of star schemas where measures are used to perform aggregations and attributes are used to filter or group information.

The names of the single measures, attributes, fact tables and dimensions/contexts can be customized by the user.

7.2.2.3 Smart View Contexts

The **Contexts** tab is located between the **Measures** and the **Attributes** tabs on the **Smart View** page. In the **Contexts** tab you can add dimensions/contexts that the system cannot automatically relate to the fact table. Every card is made up of two sections:

- **Standard** includes all the dimension/context automatically related by the system.
- **Custom** include the dimension/context that you can manually relate to the fact table. “Manually” relate means that you need to customize the scripts in the **Scenario >Database** to link the information to the fact table.

  > This is an advanced operation and must be performed by users with a good knowledge of the data warehouse structure.

7.2.2.4 Smart View Deploy

The deployment of the smart view creates all the entities of the smart view: fact tables, all the dimensions/contexts tables (star schema) related to the fact tables and the infrastructure required to load them. Smart view data is loaded starting from the base entities (bm20) and for smart views of type Physical the load starts immediately after the deployment. When you create a smart view of Physical type, you can choose how often it will be updated incrementally (only new data or modified data is loaded). For Virtual smart views, on the contrary, no data load is performed, so this configuration is not required as data is available in real-time.

The smart view deploy is based on the difference between existing and new data, so existing data is maintained. Any new measures/attributes selected before the current deploy are filled as soon as the deploy is completed. However, if you deliberately want to destroy and recreate the smart view with the consequent new data load, you have to undeploy the smart view and deploy it again. Consequently, if the deploy of a Physical smart view is executed again and a big amount of data was stored in the system, the duration of the data load will last a long time.

You have to deploy a smart view every time any changes are made to the smart view configuration: schedule time, smart view type, measures/attributes selection.

> If new sites are added to the data warehouse project, you do not need to deploy the smart view again, because data will be loaded automatically.

7.2.3 What is a Scenario?

A scenario is the model of hardware and software resources for the project. This model is the abstract representation of the distribution of servers, services, databases and flows in a network. A solution can have more scenarios. In a scenario the user can design the resource architecture without assigning Domain Names or IP

addresses. The definition of a scenario starts with the selection of a Project and the definition of a number of services made up of databases and flows. A scenario can be associated with one or more environments.

What is a Flow?

A flow allows loading data from a source database to a data warehouse in either Initial or Incremental mode. The initial load must be run once when the target database is empty. The incremental load is run periodically to load all the changes which occur in the source database. To perform these operations, dedicated ETLs (Extract, Transform, Load) are provided. After populating an empty database with data (initial load), it is necessary to schedule a periodic run of ETL incremental loads in order to keep the data warehouse aligned with the sources. Initial loads are specifically designed to move very large amounts of data in a quick and optimized manner, whereas incremental loads move moderate amounts of data.

What is an Environment?

An environment represents the physical implementation of a scenario. While configuring an environment, all items included in the scenario are mapped on real items that exist in a physical environment. Each physical machine to be associated with those configured within the scenario requires specific services (that vary according to its role). The configured scenario is then mapped on a real environment to which it will be deployed in order to make it operational.

What is a Deploy?

The deploy of a solution or of a smart view is a set of operations performed to make operational all the items included in the project, according to the details defined during the creation of the environment or of the smart view. The deploy engine performs the two following actions:

- Deploy of all project items.
- Update of existing items.

7.3 What are Opcenter Reporting Concepts?

In this step of our journey we want to present the main concepts which are considered prerequisites to understanding how to work efficiently with Opcenter Reporting.

- Reports
- Data Sources
- Custom Relations
- Designer
- Custom Entities

7.3.1 Reports

Reports provide a high-level and detailed view of a company's present assets, which is useful for rapid decision-making. Reports are most beneficial when they provide granular data in real time, as outdated information would make them less effective. A manufacturing firm, for instance, can measure several key aspects of its production chain to make daily improvements. An operational report in this case could include data on resource costs and usage, production efficiency and equipment status.

In Opcenter Reporting reports are typically produced in tabular format and include some charts. They can be easily retrieved and printed, organized in a hierarchical folder structure and exported and reimported into another system.

7.3.2 Data Sources

Users can define the sources that supply data for reports by creating data source connections that they can use when they create a report. Opcenter Reporting can only be connected to the databases of Siemens MOM products. The connection to third-party databases is not allowed.

In Opcenter Reporting:

- Multiple data sources can be configured (both SQL Server and Oracle are supported).
- Either Windows authentication (only for SQL Server sources) or Database authentication are available.
- Data sources can be validated by testing the connection.
- Relations between tables or views (not already available in the source database) can be added.

7.3.3 Custom Relations

Reports are created or modified by using the source database structure relation. Further relations between tables or views which are not present in the source database can also be defined and imported in Opcenter Reporting. A script to be imported for a specific data source must be defined.

7.3.4 Designer

Combit® List & Label Designer is the tool integrated into the application to author and modify reports created in Opcenter Reporting. The first time the Designer is launched, the user is prompted to download and install it.

In the Designer you can add simple tables, comprehensive master-detail reports/subreports, charts, RTF text, barcodes, graphics, PDF objects, user-defined objects etc. You can also employ a wide variety of charts and gauges to enhance reports with professional-quality visuals and drill down the hierarchy from summary information to more detailed data.

For information and instructions on how to use the Designer, see *List & Label® Designer Manual* provided with *Opcenter Reporting Documentation*.

7.3.5 Custom Entities

In Opcenter Reporting, a custom entity represents report data that is returned from running a query on an external data source. The custom entity depends on the data connection that contains information about the external data source. The data itself is not included in the report definition. The custom entity contains a query command.