4.3.4.2 Data Integrity

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Data Integrity is the completeness, accuracy and consistency of data throughout the entire data lifecycle of the data as well as when the Data is at Rest, Data-in-Motion and Data-in-Use.[1)]

Figure 1 shows the five levels Automation Pyramid and the functionality usually associated with each one. There is Data-at-Rest at each level of the pyramid. As the data transitions up and down from level to level within the pyramid, the Data is in Motion. Within each level, the data will most likely be accessed therefore, the Data is in Use.

Table 1: The five levels of the Automation Pyramid.

Automation Level	Description
Field Level	The Field Level where products are produced. In other words, this is where the physical work plus monitoring occur. Electric motors, hydraulic and pneumatic actuators to move machinery, proximity switches used to detect that movement or certain materials, photoelectric switches that detect similar things will all play a part in the field level.
Control Level	The Control Level uses the control devices to “run” the devices in the Field Level. The Control Devices make decisions based on information provided by sensors, switches, and other input devices to complete the programmed task.
Supervisory Level	The Supervisory Control and Data Acquisition (SCADA) is combines the Field and Control Levels to provide oversight from a single location. This is usually accomplished using Graphical User Interface (GUI), or Human-machine interface (HMI), to remotely control operations. For example, water plants often employ this technology to control remote water pumps.
Planning Level	The Planning Level uses Manufacturing Execution System (MES) to monitor the entire manufacturing process. For example, in a factory to plan for everything from raw materials to the finished products. This allows management to visualize the current state of operations and aids them in making decisions and adjust raw material orders or shipment plans based on real data received from Supervisory, Control and Field Levels.
Management Level	The management level uses the companies integrated management system such as as Enterprise Resource Planning (ERP). Corporate management visualize and control operations. This level allows the businesses monitor all levels (i.e., manufacturing, to sales, to purchasing, to finance and payroll). The integration of an ERP promotes efficiency and transparency within a company by helping to communicate the levels.

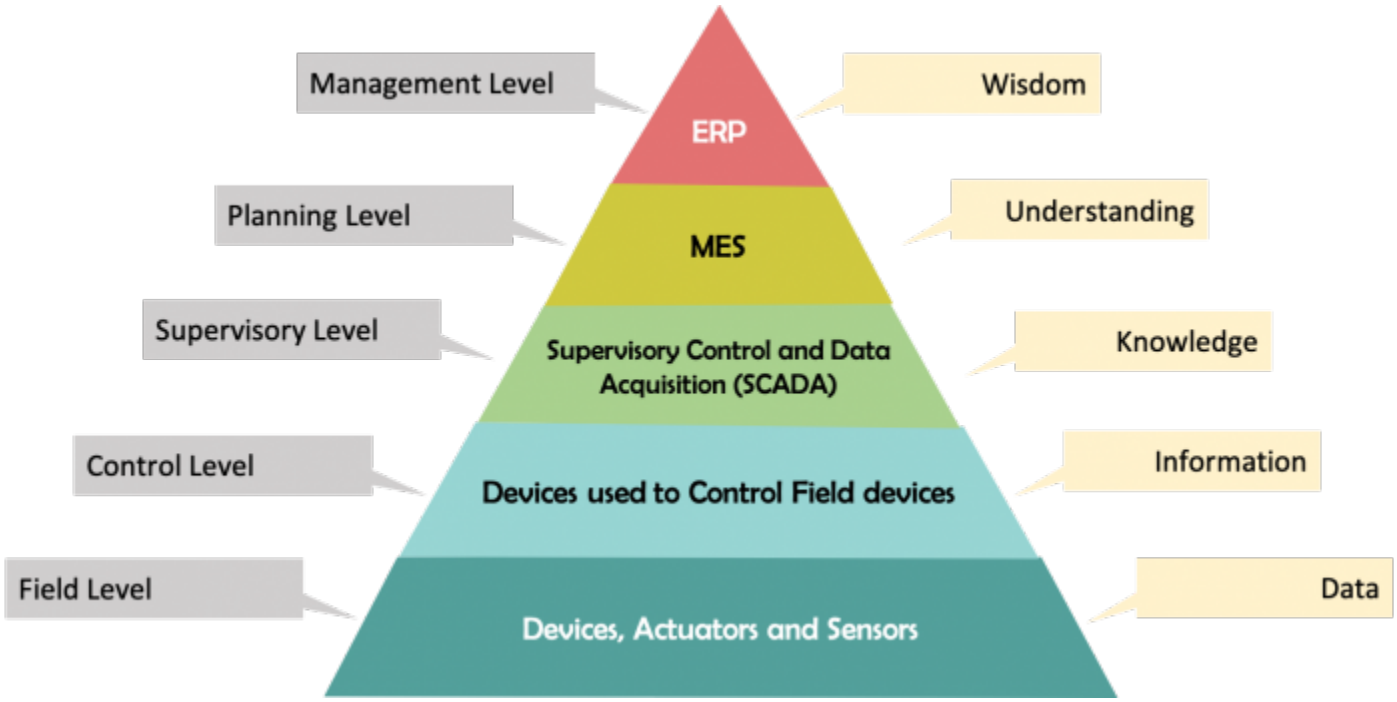


Figure 1: Automation Pyramid

At each level, the Data at Rest can be categorized as one of two kinds of data integrity both of which are a collection of processes and methods intended to enforce Data Integrity.

- Physical Integrity protects data's wholeness and accuracy as it's being used. When expected or unexpected down times occur (i.e., natural disasters strike, power goes out, or hackers disrupt database functions) physical integrity is compromised. Some other issues which can compromise the integrity of the data are Human error, storage erosion, or a host of other issues making it impossible for data processing managers, system programmers, applications programmers, and internal auditors to obtain accurate data.
- Logical Integrity keeps data unchanged as it is accessed. Logical integrity protects data from some of the same issues as Physical Integrity (i.e., human error and hackers as well) but in different ways. There are four types of logical integrity.
  1 - Entity Integrity - supports unique values that identify any particular data entry and that the key is not null.
  2 - Referential Integrity - ensures that references to other data entries exist.
  3 - Data Integrity - ensures that domain rules (i.e., data restrictions) are enforced for the data within the Data Structure. For example, minimum, maximum, number of decimals, nullable, etc. are enforced.
  4 - User Defined Integrity - ensures that business rules are enforced. For example, if a value is set, another value must also be set (unset); if a value exceeds a threshold, a notice must be sent.

Note: Data integrity is not Data Security and not Data Quality.

- Data Security defines the steps taken to prevent corruption from within and from outside attacks by people or processes.
- Data Integrity defines the steps taken to keep the data intact and accurate from internal people and processes and for the entirety of the data's existence.

DIDO Specifics

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☐ *TBD - to be added/expanded in future revisions of the DIDO RA (look at spec in DDSF)*

1)

What is Data Integrity, Accessed 8 July 2020, https://www.talend.com/resources/what-is-data-integrity/

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