



Practical Software and Systems Measurement

Size Measurement Constructs

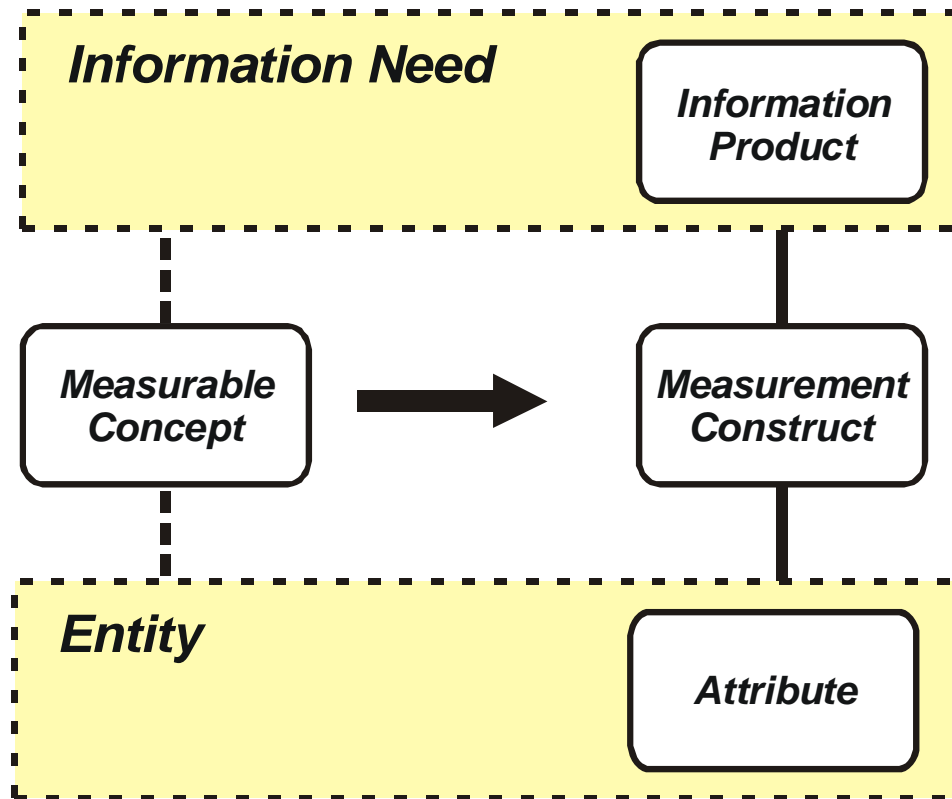
PSM UG Conference 2004
COSYSMO Workshop

SE Size Drivers

- ***Initial Tasking: Take SE Drivers and formalize them as Measurement Constructs***
- ***Observation:***
 - ***Role of SE Size Drivers is not aligned with a Measurement Construct, but rather a Base Measure***
 - ***Allow me to explain ...***

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High-Level View



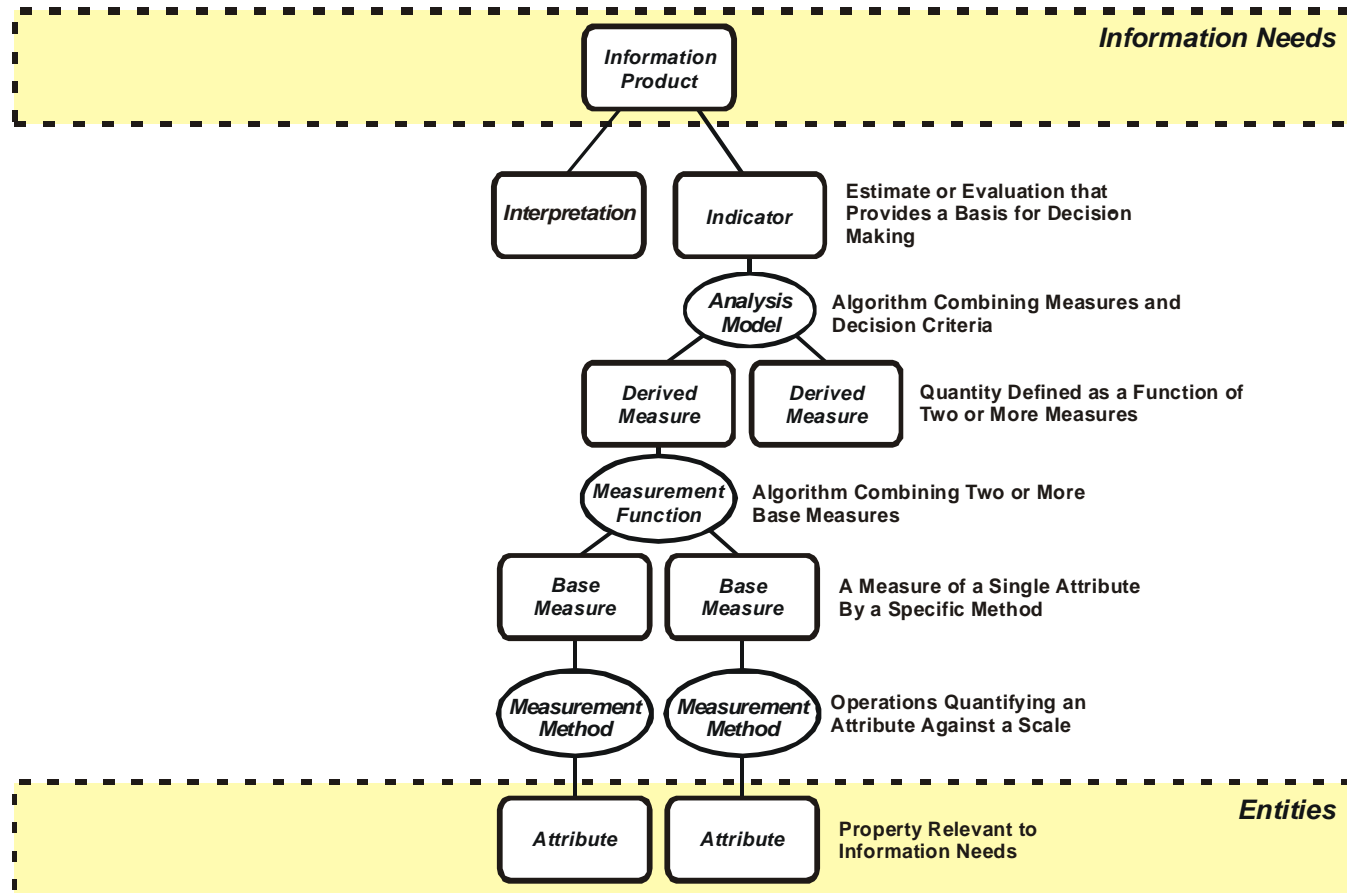
Adapted from ISO/IEC 15939 - Software Measurement Process

Measurement Construct

- ***A Specification of a Prospective Measure***
- ***A Specific Method for Implementing a Measurable Concept:***
 - ***Specific entities and attributes***
 - ***Pre-planned analyses***
- ***Consists of Base Measures, Derived Measures, and Indicators***
- ***The Information Product Is Comprised of a Collection of Measurement Constructs with Interpretations***
- ***Multiple Constructs May Be Specified for a Single Concept and Information Need***

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Measurement Construct



Adapted from ISO/IEC 15939 - Software Measurement Process

Measurable Concept

- ***An Idea About How an Information Need Can Be Satisfied:***
 - ***Possible entities and attributes to be measured***
 - ***Potential use of results in decision making***
- ***May Be Implemented in Many Different Ways***
- ***Each Measurable Concept Involves a Different Question***
- ***PSM-Defined Measurable Concepts Are Widely Used***

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- ***Assuming each SE Size driver is a base measure, we need to identify candidate entities and attributes***
- ***Once entity and attribute is identified, then an objective method and a ratio scale must be applied***

Entity - Attribute

Entities and Attributes are the basic elements of a measure.

- *An **Entity** is the object that is measured*
 - *Entities include processes, products, projects, and resources*
- *A Measurable **Attribute** is a distinguishable property or characteristic of the Entity*
 - *Attributes are either quantitative or qualitative - examples include hours, problems, source lines of code, and design units, e.g. classes*

Number of System Requirements

Number of System Requirements

This driver represents the number of requirements for the system-of-interest at a specific level of design. Requirements may be functional, performance, feature, or service-oriented in nature depending on the methodology used for specification. They may also be defined by the customer or contractor. System requirements can typically be quantified by counting the number of applicable “shall’s” or “will’s” in the system or marketing specification. Do not include a requirements expansion ratio – only provide a count for the requirements of the system-of-interest as defined by the system or marketing specification.

Easy	Nominal	Difficult
- Well specified	- Loosely specified	- Poorly specified
- Traceable to source	- Can be traced to source with some effort	- Hard to trace to source
- Little requirements overlap	- Some overlap	- High degree of requirements overlap

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Number of System Requirements

Candidate Entities (Attributes)

Anything that requires SE effort such as:

- **Requirements document (shall, shall/will statements)**
- **System Specification (shall, shall/will)**
- **RVTM (requirement records)**
- **Product Specification (shall, shall/will)**
- **Internal functional requirements document (# of statements)**

Consider “shoulds” and “mays” for some cases

- **System Discrepancy Report**
- **Tool output such as DOORS*, QFD, etc. (**

***granularity may be different**

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Number of Major Interfaces

Number of Major Interfaces

This driver represents the number of shared major physical and logical boundaries between system components or functions (internal interfaces) and those external to the system (external interfaces). These interfaces typically can be quantified by counting the number of external system interfaces and internal interfaces among ISE/IEC 15288-defined system elements.

Easy	Nominal	Difficult
- Well defined	- Loosely defined	- Ill defined
- Uncoupled	- Loosely coupled	- Highly coupled
- Strong consensus	- Moderate consensus	- Low consensus
- Well behaved	- Predictable behavior	- Poorly behaved

Number of Major Interfaces

Candidate Entities (Attributes)

- *Interface Control Document at system or subsystem level (interfaces, messages)*
- *System Architecture diagram (DoDAF SV1, SV2, OV1, OV2, Con Ops)*
- *System block diagram from the system specification (arrows)*
- *Specification tree (branches)*

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Number of Critical Algorithms

Number of Critical Algorithms

This driver represents the number of newly defined or significantly altered functions that require unique mathematical algorithms to be derived in order to achieve the system performance requirements. As an example, this could include a complex aircraft tracking algorithm like a Kalman Filter being derived using existing experience as the basis for the all aspect search function. Another example could be a brand new discrimination algorithm being derived to identify friend or foe function in space-based applications. The number can be quantified by counting the number of unique algorithms needed to support each of the mathematical functions specified in the system specification or mode description document.

Easy	Nominal	Difficult
- Existing algorithms	- Some new algorithms	- Many new algorithms
- Basic math	- Algebraic by nature	- Difficult math (calculus)
- Straightforward structure	- Nested structure with decision logic	- Recursive in structure with distributed control
- Simple data	- Relational data	- Persistent data
- Timing not an issue	- Timing a constraint	- Dynamic, with timing issues
- Library-based solution	- Some modeling involved	- Simulation and modeling involved

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Number of Critical Algorithms

Candidate Entities (Attributes)

- ***System Specification (algorithms)***
- ***Mode Description Document (algorithms)***
- ***Configuration Baseline (tech notes)***
- ***Historical database (# of algorithms)***
- ***Functional block diagram (# of functions that relate to algorithms)***
- ***Risk analysis (algorithm related risks)***
- ***Subsystem description documents****

****need to revisit***

Number of Operational Scenarios

Number of Operational Scenarios

This driver represents the number of operational scenarios that a system must satisfy. Such threads typically result in end-to-end test scenarios that are developed to validate the system and satisfy all of its requirements. The number of scenarios can typically be quantified by counting the number of unique end-to-end tests used to validate the system functionality and performance or by counting the number of use case sequence diagrams developed as part of the operational architecture.

Easy	Nominal	Difficult
- Well defined	- Loosely defined	- Ill defined
- Loosely coupled	- Moderately coupled	- Tightly coupled or many dependencies/conflicting requirements
- Timelines not an issue	- Timelines a constraint	- Tight timelines through scenario network

Number of Operational Scenarios

Candidate Entities (Attributes)

- ***Ops Con / Con Ops (functions, OVx, SVx, AVx, functional threads, scenarios)***
- ***System Architecture Document (use cases)***
- ***IV&V/Test Plans (test cases / use cases)***
- ***Engagement/mission/campaign models (scenarios)***

Back-up Charts

Base Measure Definition

- ***A Measure of a Single Attribute***
- ***A Base Measure Includes:***
 - ***A measurable attribute of an entity***
 - ***A method for quantifying the attribute***
 - ***A value resulting from applying the method***
- ***Related Concepts Include:***
 - ***Measurement scale (used by method)***
 - ***Unit of measure (used by scale)***
 - ***Observation (act of assigning a value)***
 - ***Unit of observation (i.e., type of entity)***

Specify Measurement Constructs

- ***Information Need***
- ***Information Category***
- ***Indicator***
 - ***Analysis Model***
 - ***Decision Criteria***
 - ***Base/Derived Measures***
- ***For Each Derived Measure:***
 - ***Measurement Function***
 - ***Base Measure(s)***
- ***For Each Base Measure:***
 - ***Measurement Method***
 - ***Type of Method***
 - ***Scale***
 - ***Type of Scale***
 - ***Unit of Measurement***
 - ***Relevant Entity***
 - ***Attribute***

NOTE: Details defined in the Measurement Information Model.