Master Sistemi Embedded per Internet of Things

CORSO «ORGANIZZAZIONE, PROCESSI E CERTIFICAZIONI»

MODELLI DI MATURITA' DEI PROCESSI
CMMI – DEV
AUTOMOTIVE SPICE

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Riferimenti:

A. http://www.computer.org/web/swebok - Software Engineering Body of Knowledge (SWEBOK), version 3.0

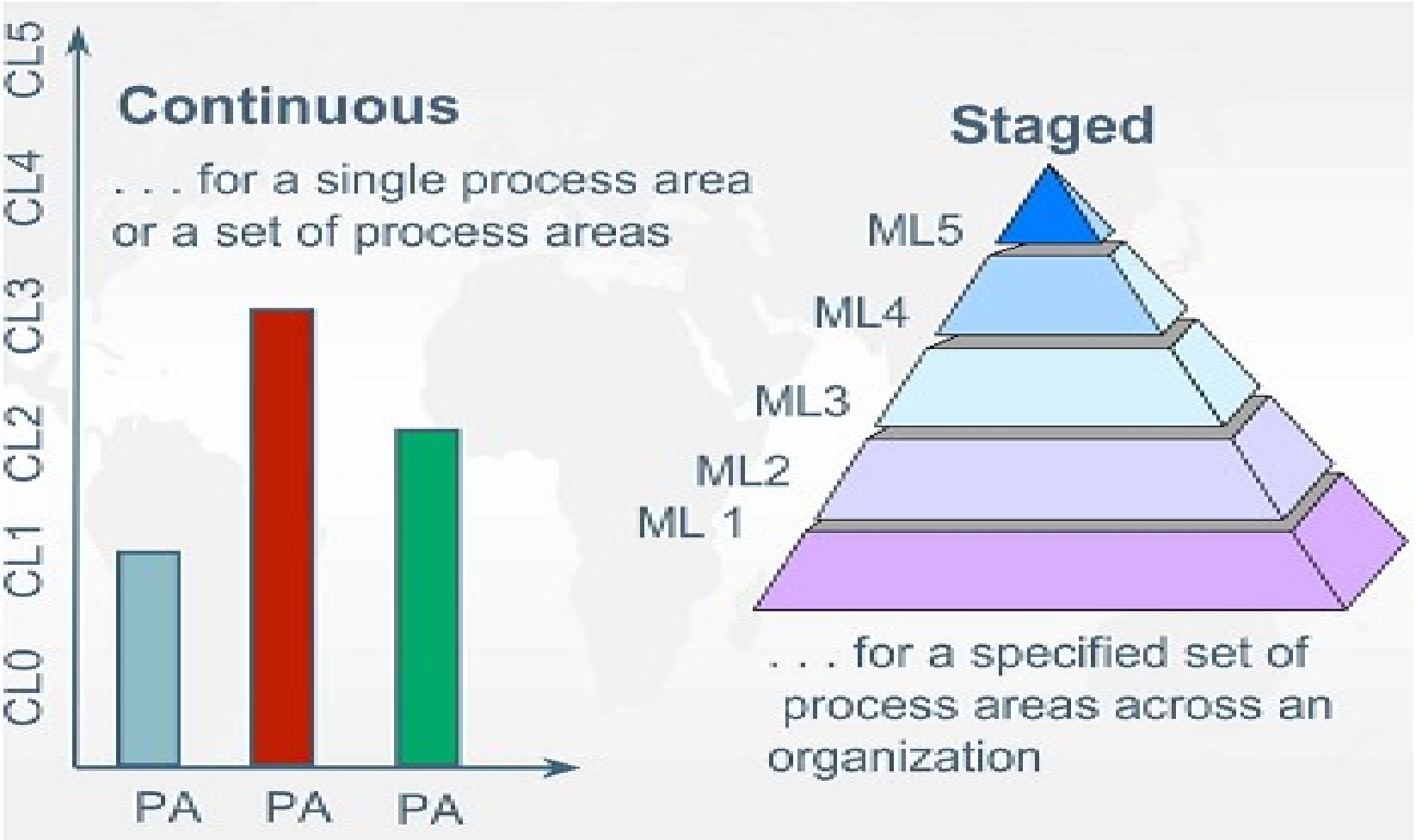
B. http://www.sei.cmu.edu/library/abstracts/reports/10tr033.cfm modello CMMI-DEV v. 1.3

C. http://www.automotivespice.com/fileadmin/software-download/Automotive_SPICE_PAM_30.pdf - Automotive SPICE PAM PRM v.3.0

- Models based on a **process improvement approach**
- Consist of **best practices** that address **development processes and activities**

Software process capability and **software process maturity** are typically **rated** to **characterize the capability or maturity** of the **software processes** used within an organization.

- A ***continuous*** rating system involves assigning a rating to each software process of interest
- A ***staged*** rating system is established by assigning the same maturity rating to all of the software processes within a specified process level.


CL0 CL1 CL2 CL3 CL4 CL5
Continuous
. . . for a single process area
or a set of process areas
PA PA PA
Staged
ML5
ML4
ML3
ML2
ML 1
. . . for a specified set of
process areas across an
organization

Continuous and staged representations can be used to determine the **order in which software processes are to be improved**.

- In the **continuous** representation, the different capability levels for different software processes provide a guideline for determining the order in which software processes will be improved.

- In the **staged** representation, satisfying the goals of a set of software processes within a maturity level is accomplished for that maturity level, which provides a foundation for improving all of the software processes at the next higher level.

CMMI – DEV
CAPABILITY MATURITY MODEL INTEGRATION

CMMI® - Capability Maturity Model Integration
(Software Engineering Institute of Carnegie Mellon University)

Il CMMI è un **modello di miglioramento dei processi** per lo sviluppo di prodotti e servizi.

Cos'è un modello di processi:

- è un **insieme strutturato di pratiche che descrive le caratteristiche di processi efficaci**.

Consiste in una serie di **best practices** che indirizzano e governano le attività di sviluppo e manutenzione lungo l'intero ciclo di vita del prodotto.

Il suo scopo è di **aiutare le organizzazioni** nel **miglioramento dei processi di sviluppo e manutenzione** sia per i prodotti che per i servizi.

- ISO è uno standard di "**auditing**" --- CMMI è un "**process model**"
- CMMI è un insieme di "**best practices**"
- CMMI è articolato in **5 livelli di maturità** --- ISO non ha un concetto di livelli
- ISO è una "**certificazione**" --- CMMI è un **modello da adottare**, rispetto a cui si ottiene un **rating**, che porta ad una "**registrazione**"

- Chiarezza di ruoli e processi
- Maggiore visibilità delle attività dell'organizzazione, per garantire la customer satisfaction
- Più efficace rilevazione ed evidenziazione di aree di miglioramento o di best practice
- Più efficace individuazione di aree di criticità, con maggiore possibilità di intraprendere azioni correttive
- Maggiore comunicazione interna tra i gruppi di lavoro
- Presenza di processi maturi, ripetibili, consistenti

Modelli CMMI

- CMMI-DEV : CMMI for Development – sviluppo di prodotti e servizi di qualità che soddisfino le esigenze dei clienti e degli utenti finali
- CMMI-ACQ : CMMI for Acquisition – gestione della acquisizione di prodotti e servizi che soddisfino le esigenze dei clienti e degli utenti finali
- CMMI-SVC : CMMI for Services – erogazione di servizi di qualità per i clienti e gli utenti finali
- People CMM : People Capability Maturity Model (People CMM) – migliorare la capacità della forza lavoro di un'organizzazione

Riferimenti:

- sito del SEI:

http://www.sei.cmu.edu/cmmi/

- link al modello CMMI-DEV v. 1.3

http://www.sei.cmu.edu/library/abstracts/reports/10tr033.cfm

- Processo – **una sequenza di steps eseguiti per uno scopo definito**
  - Il processo descrive come viene effettuato il lavoro
- Definizione CMMI di Processo → **un insieme di attività interrelate, che trasformano degli inputs in outputs, per ottenere un dato obbiettivo**
- I processi possono essere mappati su una o più **practices delle Process Areas CMMI** , e implementati in conformità alle indicazioni del modello per ottenere un miglioramento

Category	Process Areas
Process Management	Organizational Process Definition Organizational Process Focus Organizational Performance Management Organizational Process Performance Organizational Training
Project Management	Integrated Project Management Project Monitoring and Control Project Planning Quantitative Project Management Requirements Management Risk Management Supplier Agreement Management
Engineering	Product Integration Requirements Development Technical Solution Validation Verification
Support	Causal Analysis and Resolution Configuration Management Decision Analysis and Resolution Measurement and Analysis Process and Product Quality Assurance

I sei **capability levels** previsti dal modello CMMI sono:

- 0. Incomplete
- 1. Performed
- 2. Managed
- 3. Defined
- 4. Quantitatively Managed
- 5. Optimizing

Capability level 2 – Managed

Un processo a **CL2** è un processo "**gestito**", cioè:

- è eseguito e pianificato **secondo delle policy**;
- impiega **risorse formate** che possono produrre **output controllati**;
- **coinvolge** i relevant **stakeholders**;
- è **controllato, monitorato e rivisto**;
- è **valutato** nella sua **aderenza agli standard** di processo.

Il processo di livello 2 aiuta ad **assicurare che le pratiche esistenti siamo mantenute, anche in condizioni di stress**

Level	Focus	Process Areas
5 Optimizing	*Continuous Process Improvement*	Organizational Innovation and Deployment Causal Analysis and Resolution
4 Quantitatively Managed	*Quantitative Management*	Organizational Process Performance Quantitative Project Management
3 Defined	*Process Standardization*	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition +IPPD Organizational Training Integrated Project Management +IPPD Risk Management Decision Analysis and Resolution
2 Managed	*Basic Project Management*	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Initial		

AUTOMOTIVE SPICE

- **Automotive SPICE®** is a registered trademark of the **Verband der Automobilindustrie e.V. (VDA)**

- Developed under the **Automotive SPICE initiative** by consensus of the car manufacturers within the **Automotive Special Interest Group (SIG)**, a joint special interest group of Automotive OEM, the Procurement Forum and the SPICE User Group

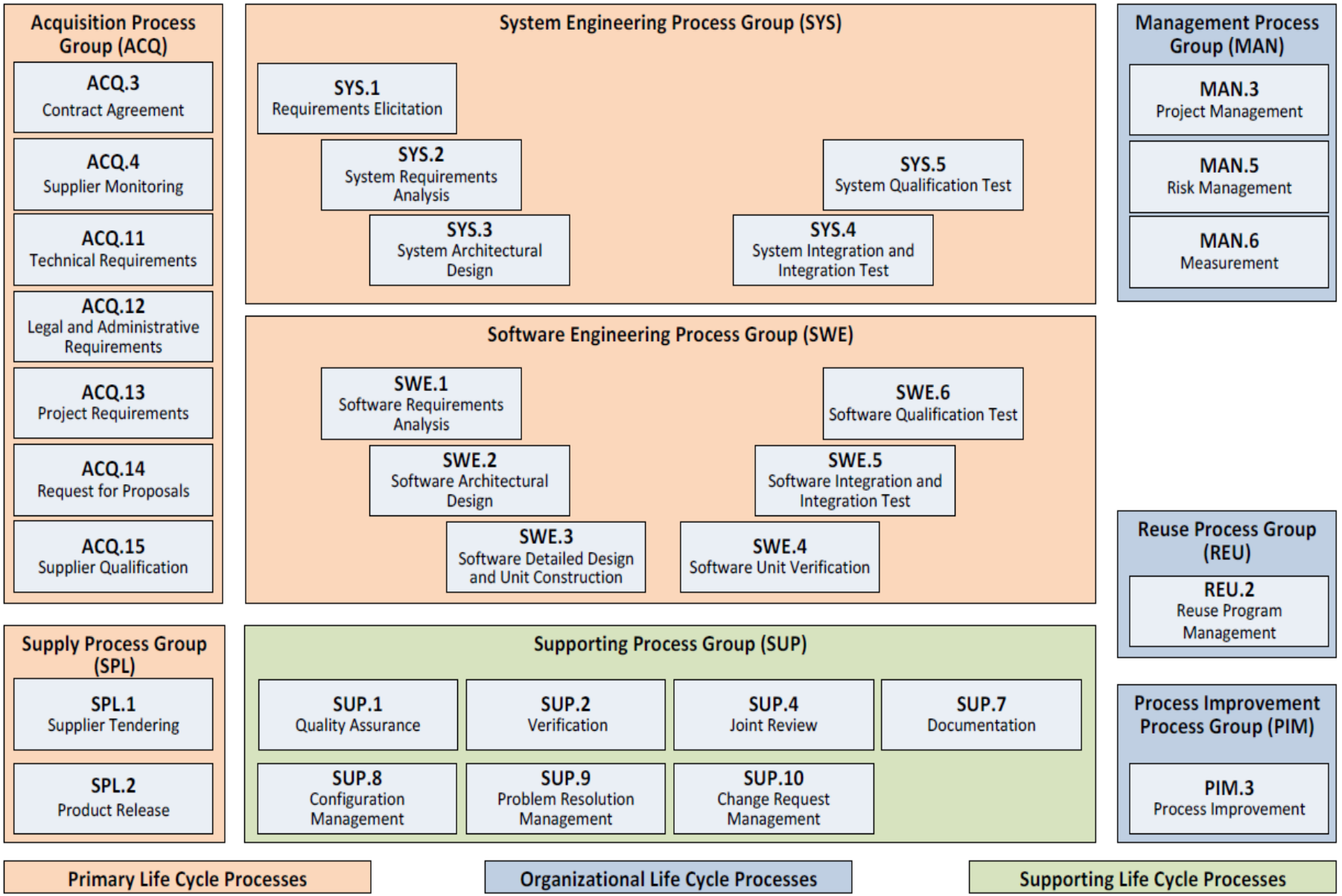
  - AUDI AG
  - BMW AG
  - Daimler AG
  - Fiat Auto S.p.A.
  - Ford Werke GmbH
  - Jaguar/Land Rover
  - Dr. Ing. h.c. F. Porsche
  - Volkswagen AG
  - Volvo Car Corporation

Automotive SPICE defines a **process assessment model** and a **process reference model**

- **Process assessment** is a **disciplined evaluation** of an organizational unit's processes **against a process assessment model.**
- The **Automotive SPICE process assessment model (PAM**) is intended for use when performing conformant assessments of the process capability on the development of **embedded automotive systems**.

- Automotive SPICE has its own **process reference model (PRM)**,
- The **PRM** is incorporated in the standard document and is used in conjunction with the Automotive SPICE process assessment model when performing an assessment.
- The Automotive SPICE **PAM** contains **a set of indicators** to be considered when **interpreting the intent of the Automotive SPICE PRM**
- These **indicators** may also be used when implementing a **process improvement program** subsequent to an assessment.

Automotive SPICE process reference model - Overview



There are two types of indicators:

- **Process performance indicators**, which **apply exclusively to capability Level 1**. They provide an indication of the **extent of fulfillment of the process outcomes**
- **Process capability indicators**, which **apply to Capability Levels 2 to 5**. They provide an indication of the **extent of fulfillment of the process attribute achievements**.

The **primary life cycle processes category** consists of processes that may be used **by the customer when acquiring products from a supplier**, and **by the supplier when responding and delivering products to the customer**

Consists of the following groups:

- the **Acquisition** process group;
- the **Supply** process group;
- the **System Engineering** process group;
- the **Software Engineering** process group.

Automotive SPICE - Process Capability Levels according to ISO/IEC 33020

- **Level 0: Incomplete process**
  - The process is not implemented, or fails to achieve its process purpose.
- **Level 1: Performed process**
  - The implemented process achieves its process purpose
- **Level 2: Managed process**
  - The previously described performed process is now implemented in a managed fashion (planned, monitored and adjusted) and its work products are appropriately established, controlled and maintained.
- **Level 3: Established process**
  - The previously described managed process is now implemented using a defined process that is capable of achieving its process outcomes.
- **Level 4: Predictable process**
  - The previously described established process now operates predictively within defined limits to achieve its process outcomes. Quantitative management needs are identified, measurement data are collected and analyzed to identify assignable causes of variation. Corrective action is taken to address assignable causes of variation.
- **Level 5: Innovating process**
  - The previously described predictable process is now continually improved to respond to organizational change.

Types of **process performance** indicators:

- Base practices (BP)
- Work products (WP).

Both BPs and WPs relate to one or more process outcomes.
BPs and WPs are always process-specific and not generic.

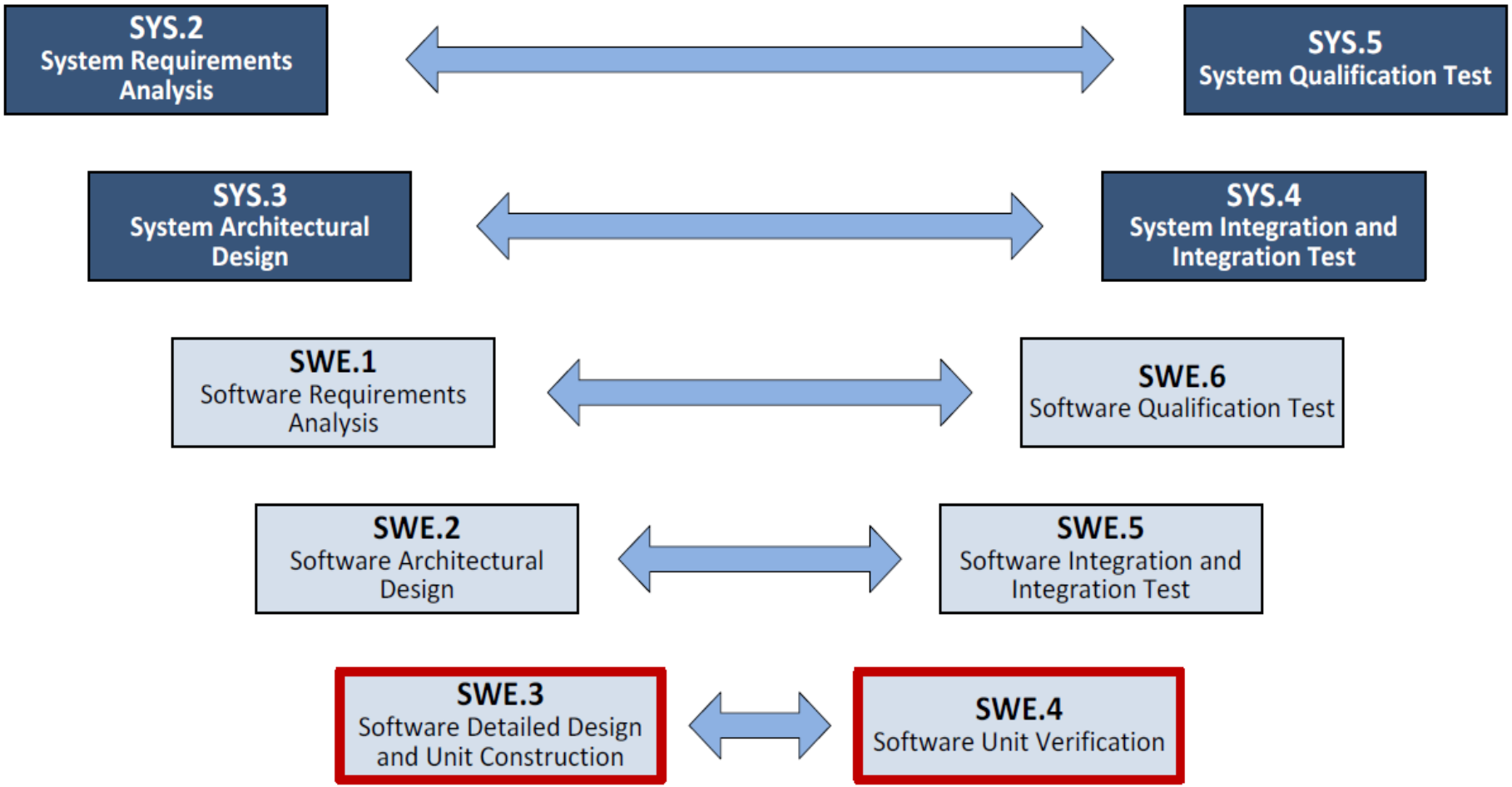
Types of **process capability indicators** are:

- Generic Practice (GP)
- Generic Resource (GR)

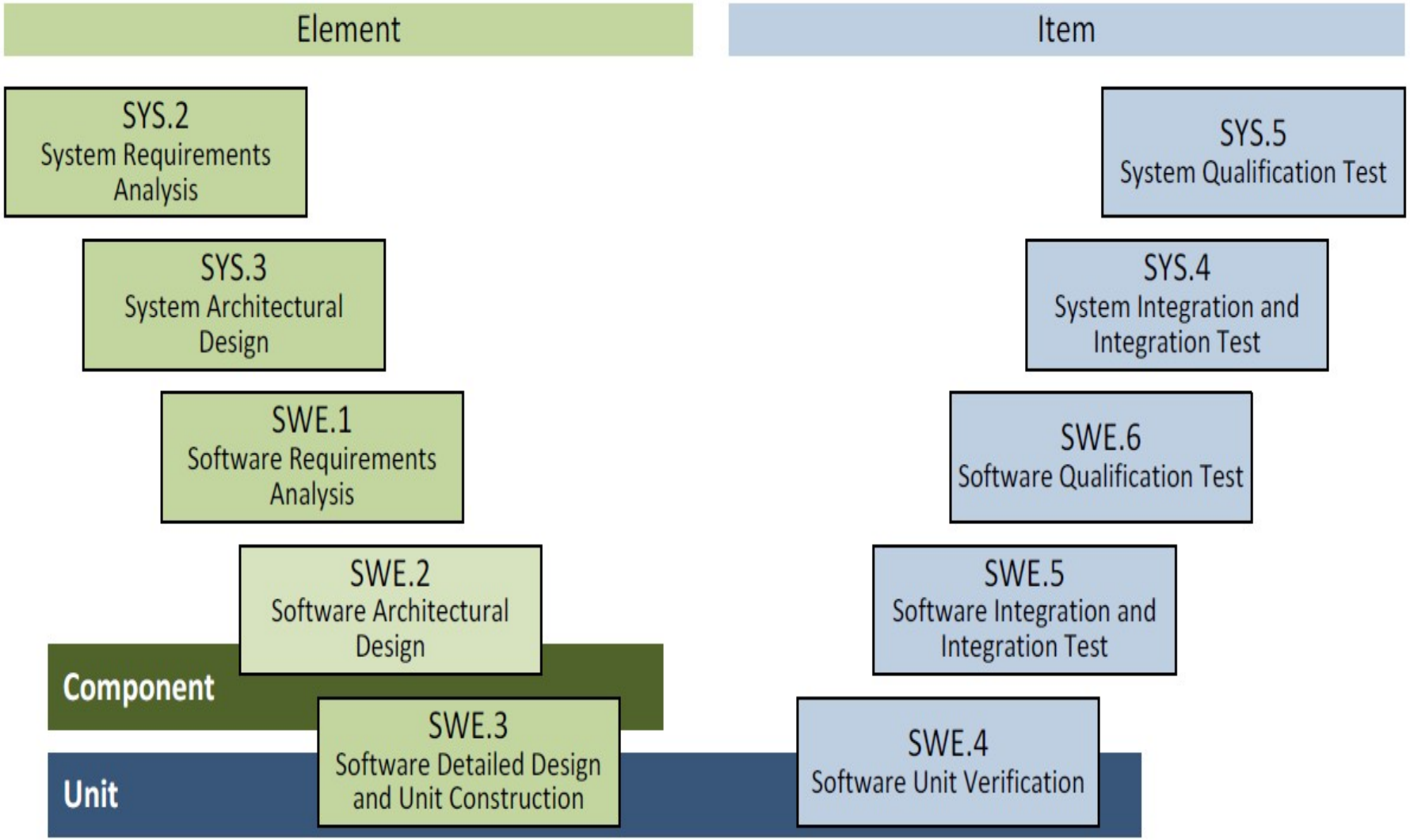
Both GPs and GRs relate to one or more PA Achievements. In contrast to process performance indicators, however, they are of generic type, i.e. they apply to any process.

Process reference model	Process ID	The individual processes are described in terms of process name, process purpose, and process outcomes to define the Automotive SPICE process reference model. Additionally a process identifier is provided.
	Process name	
	Process purpose	
	Process outcomes	
Process performance indicators	Base practices	A set of base practices for the process providing a definition of the tasks and activities needed to accomplish the process purpose and fulfill the process outcomes
	Output work products	A number of output work products associated with each process *NOTE: Refer to Annex B for the characteristics associated with each work product.*

All engineering processes (i.e. system engineering and software engineering) have been organized according to the "V model" principle in such a way that each process on the left side is corresponding to exactly one process on the right side



Relationships between element, component, software unit, and item :



- **Architecture** : consists of **architectural "elements"** that can be further decomposed into more fine-grained **architectural sub-"elements"** across appropriate hierarchical levels.

- **Software "components"** : **the lowest-level "elements"** of the software architecture **for which** finally **the detailed design is defined.**

- **Software "component" :** consists of **one or more software "units".**

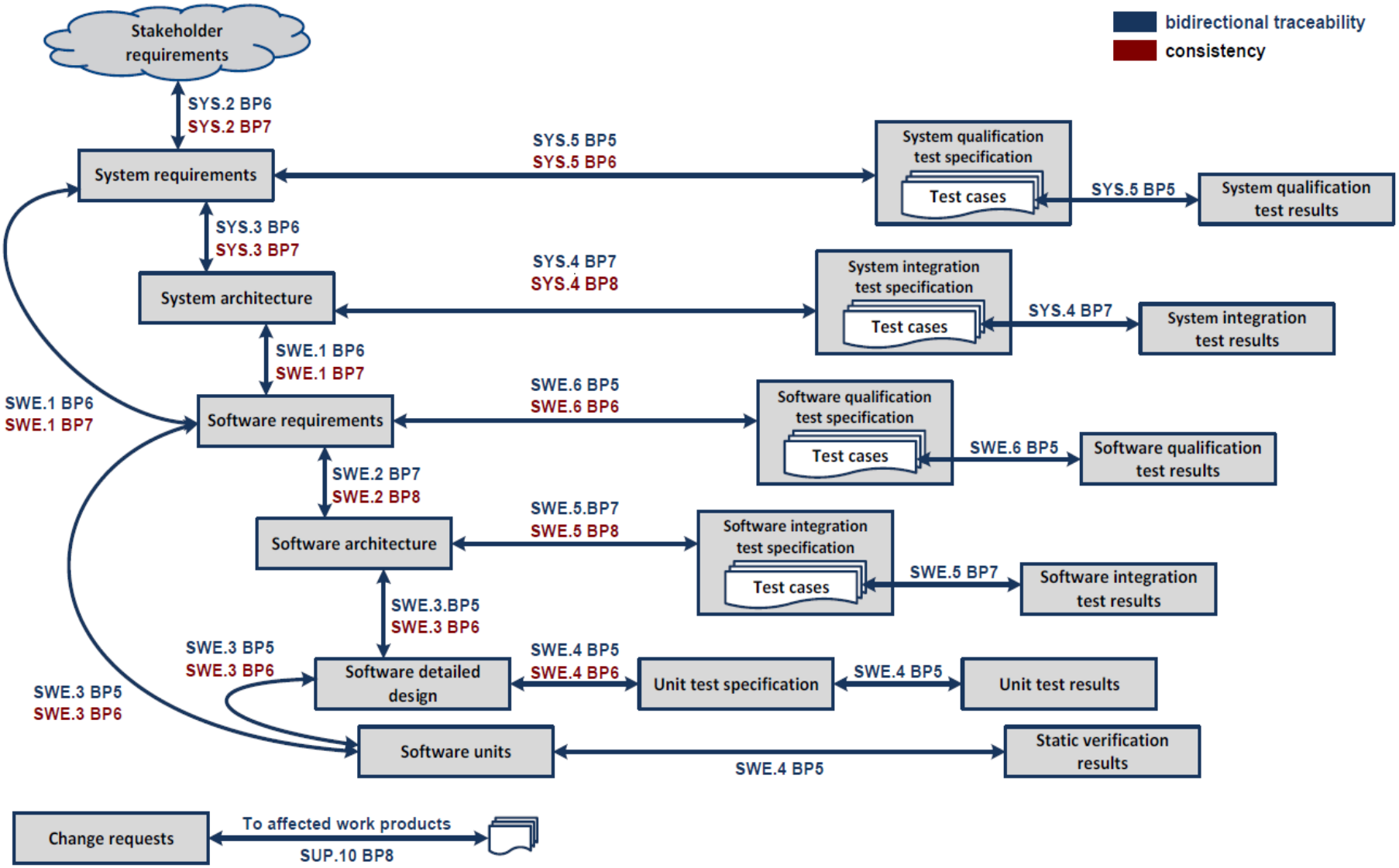
- **"Items" on the right side** of the V-model correspond to **"elements" on the left side.** This can be a 1:1 or m:n relationship

Traceability and consistency are addressed by two separate base practices in the Automotive SPICE 3.0 PAM.

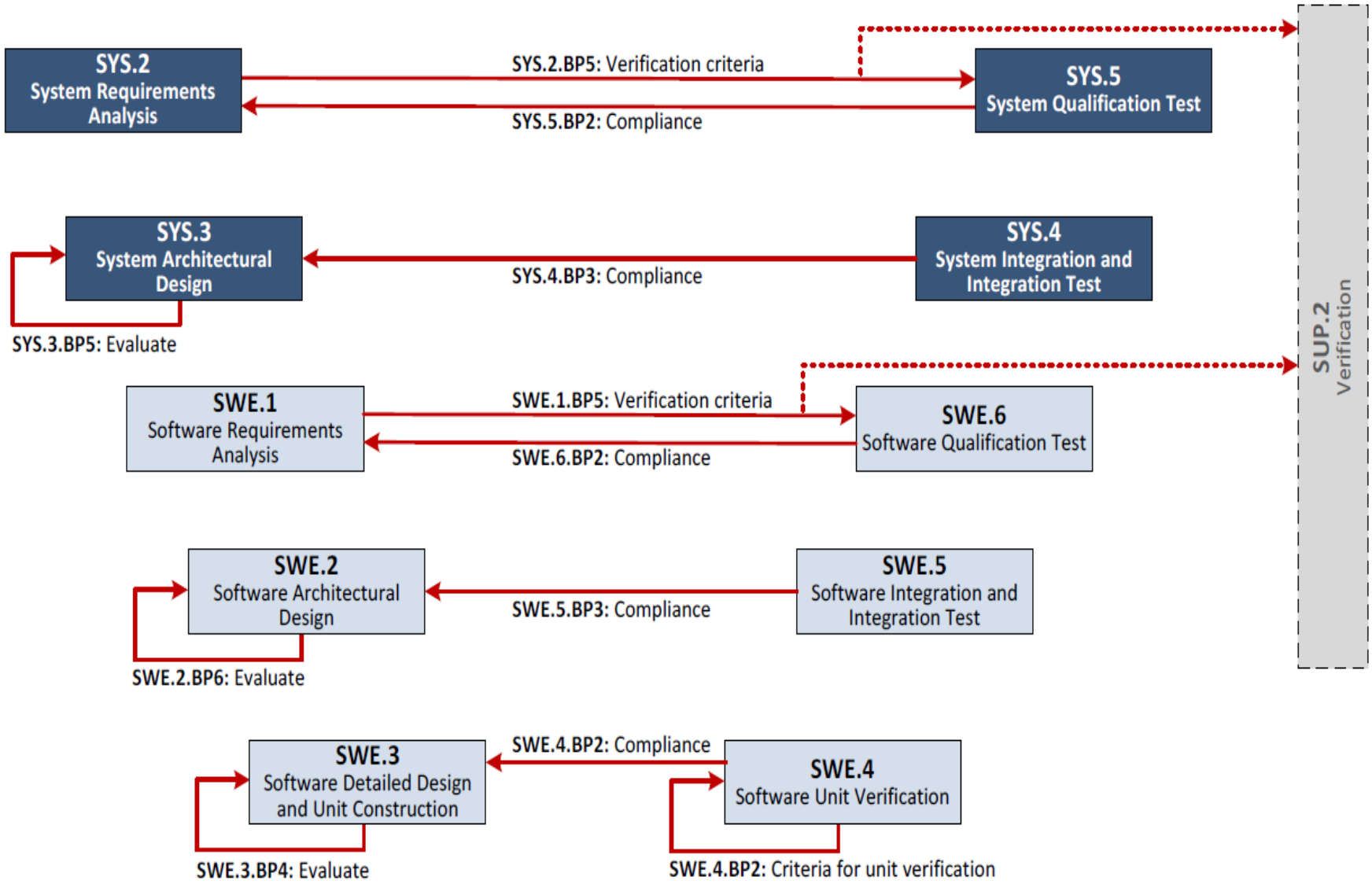
- **Traceability** refers to the **existence of references** or links **between work products** .
  - Supports **coverage**, **impact analysis**, **requirements implementation status tracking** etc.

- **Consistency** addresses **content and semantics**.

Automotive SPICE – Traceability and Consistency



Automotive SPICE – verification, testing, evaluation, and compliance.



Verification criteria

- used **as input for the development of the test cases or other verification measures** that ensures compliance with the requirements.
- **only used in** the context of **System Requirements Analysis** (SYS.2) and **Software Requirements Analysis** (SWE.1) processes.
- verification **aspects which cannot be covered by testing** are covered by the **verification process** (SUP.2).

Criteria for unit verification

Criteria for unit verification **ensure compliance of the source code with the software detailed design and the non-functional requirements.**

Possible criteria for unit verification include unit test cases, unit test data, coverage goals and coding standards and coding guidelines, e.g. MISRA.

For unit testing, such criteria shall be defined in a unit test specification.

Compliance with an architectural design

Compliance with an architectural design means that **the specified integration tests are capable of proving that interfaces** and relevant interactions between :

- the software units,
- the software items
- the system items

fulfill the specification given by the architectural design.

Evaluation of alternative solutions

Evaluation of alternative solutions is **required for system and software architectures** as well as for **software detailed designs**.

The evaluation has to be done **according to defined criteria**.
(es. quality characteristics like modularity, reliability, security, and usability, or results of make-or-buy or reuse analysis)

The evaluation result including a rationale for the architecture/design selection has to be recorded