COSMIC-BASED PROJECT MANAGEMENT IN AGILE SOFTWARE DEVELOPMENT AND MAPPING ONTO RELATED CMMI-DEV PROCESS AREAS

Enrico Berardi (TRS), Luca Santillo (Agile Metrics)

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Tecnologie nelle Reti e nei Sistemi T.R.S. S.p.A.

agile metrics

Authors

- Enrico Berardi
  - B.Sc. Physics, COSMIC/IFPUG certified; real-time & client-server Java development; agile methodologies for Software Development. Led TRS to CMMI ML3 certification.

- Luca Santillo
  - B.Sc. Physics, COSMIC/IFPUG certified consultant. President of GUFPI-ISMA, Honorary Treasurer at ISBSG, member of COSMIC Intl Advisory Council. IWSM/Metrikon/Mensura 2006 Best Paper on 'Error Propagation in SW Estimation'.
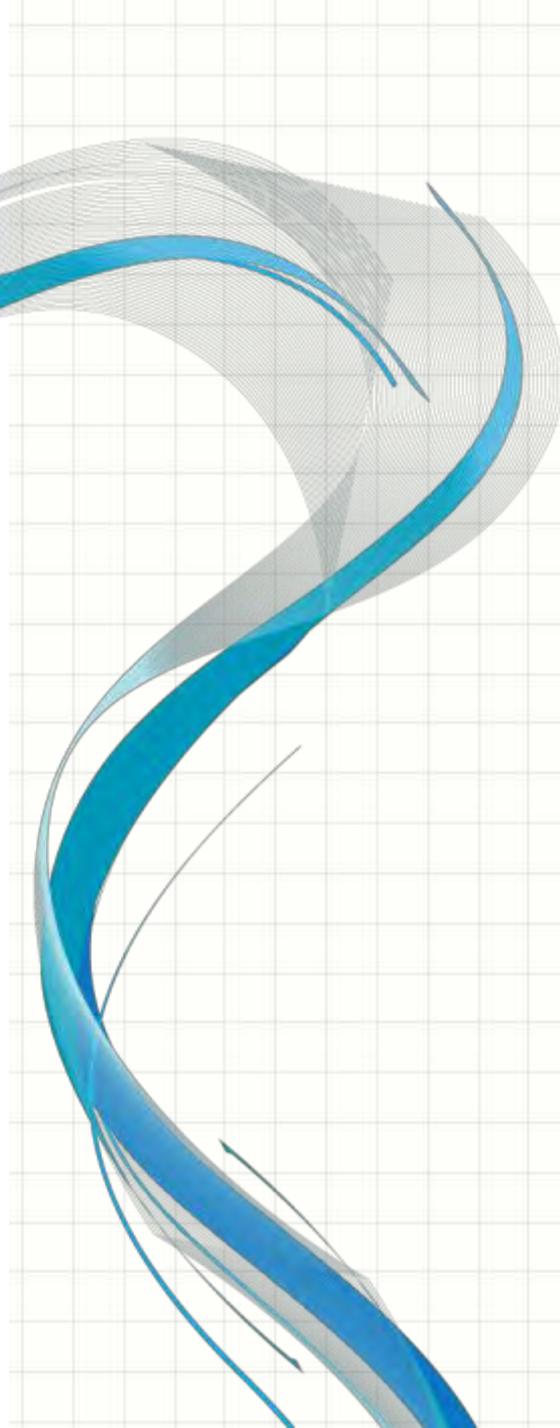
Agenda

- Our thesis – anticipated

- Applying COSMIC in Agile

  - Earned Value Analysis

  - Change Management

  - Mapping to CMMI-DEV

- Conclusions
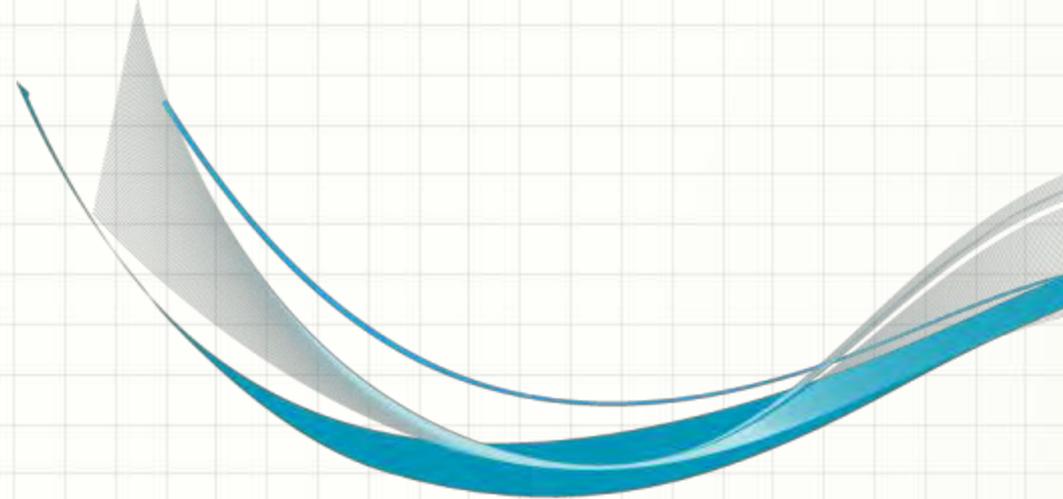
Agile

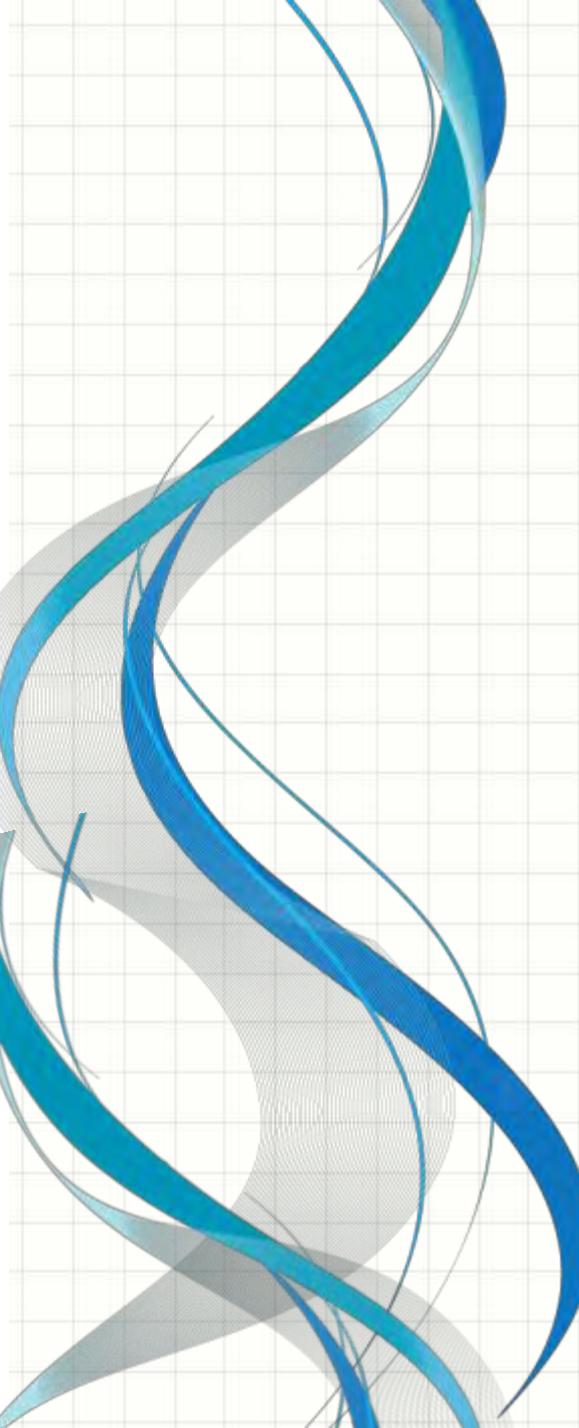## Iterations (Sprints)
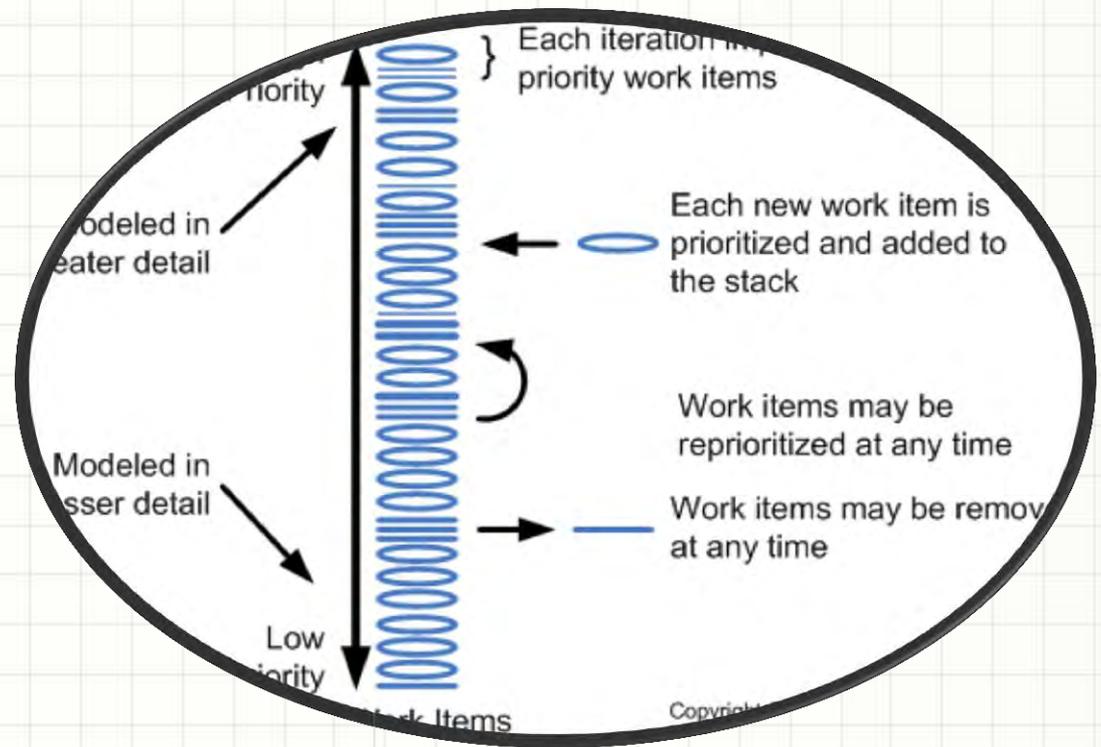
User Stories

«Story Points»

(productivity: s.p./p-h)

(velocity: s.p./iteration)

From

«story points»
to (COSMIC)

Function Points

«Adopting Functional Size Measurement in Agile provides valuable benefits to PM & SPI practices»

Expected benefits

1
- Homogeneous & standard measures (comparability)

2
- Enhanced collaboration of parties (ref. Agile Manifesto)

3
- Straight FSM application (no need to tailor)

Applying COSMIC in Agile Development

COSMIC – Software Model Principles

- … Functional user requirements of a piece of software to be measured can be mapped into unique *functional processes*….

- … Each functional process consist of *sub-processes* …

- … There are four types of *data movement* …

    / Entry (E)   Exit (X)   Read (R)   Write (W) /

- … A functional process shall include *at least* 1 E and either 1 W or 1 X …

COSMIC – Functional Process

- *An <u>elementary component of a set of Functional User Requirements</u> comprising a unique, cohesive and independently executable set of data movements.*
  [It is triggered by … an E /a triggering event/]
  *It is **<u>complete</u>** <u>when it has executed all that is required to be done</u> in response to the triggering event.*

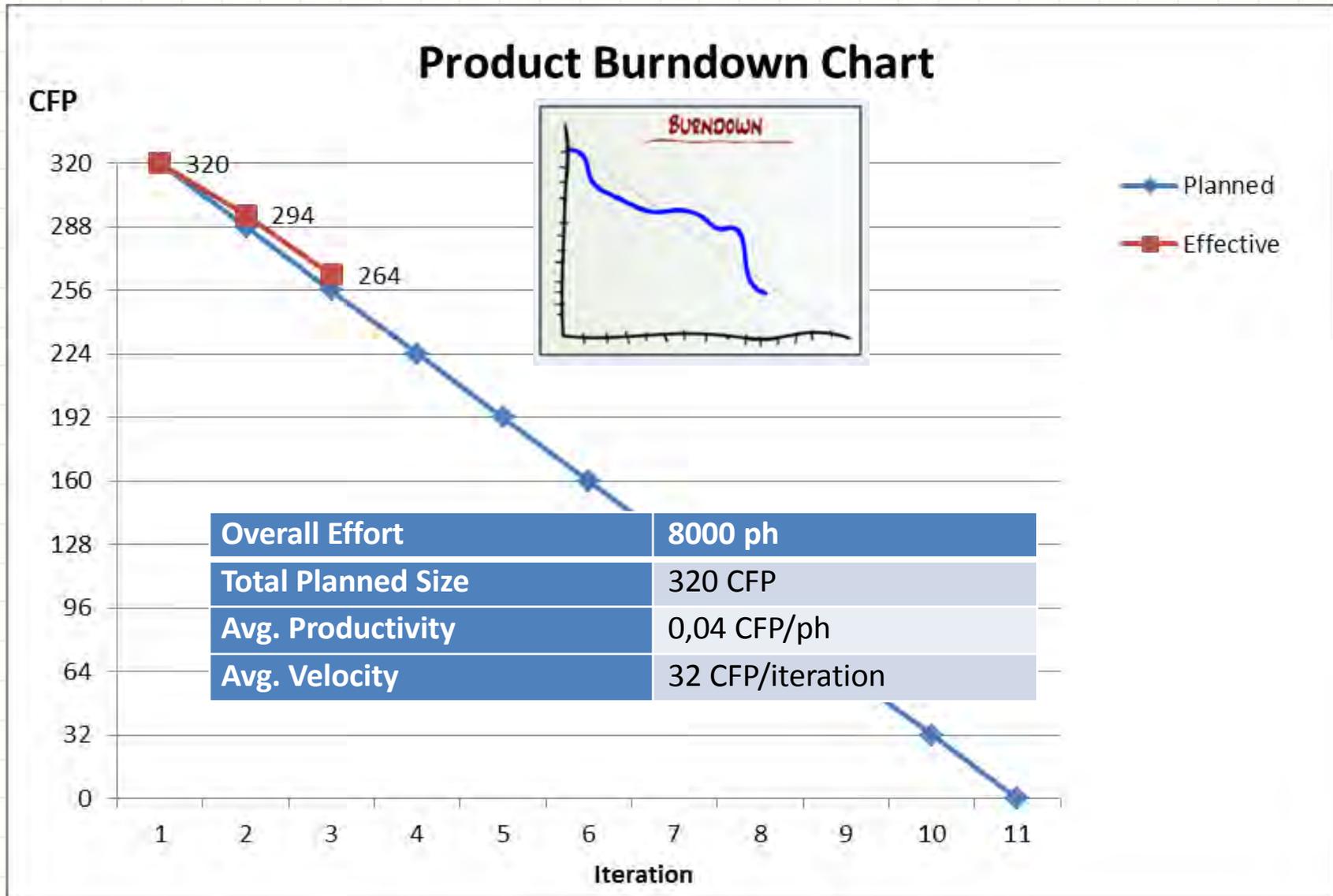 – Identification Principles & Rules – standardized in COSMIC MM

COSMIC in Agile – Initial Estimate

- Customer/Supplier – start sharing a "vision"
- IF a formal contract is needed, they need to agree a "guess" about the **overall budget** from the very beginning
  - scope analysis
  - it is possible to estimate a COSMIC size
    - not more complicated than making a global guess in *story points* or directly in effort
    - advantage: COSMIC size can be compared against productivity benchmarking data since the beginning

Initial Estimate – Example

- New application development
- Estimated functional size: 320 CFP
- Related benchmarks suggests productivity of 0.04 CFP/ph, or

  ca. 6 CFP/person-month

  (assuming 8 ph/day, 19 pdays/month)

- Overall effort estimate of ca. 8'000 ph

  (with a given error interval, or relative uncertainty)

Planning: Initial performance baseline

Product Burndown Chart

Overall Effort	8000 ph
Total Planned Size	320 CFP
Avg. Productivity	0,04 CFP/ph
Avg. Velocity	32 CFP/iteration

The Product Backlog (early stage)

Functional Area	Functional Process	Size (CFP)	Priority/Iteration	Done
F.A. 1	F.P. 1	8	1	
	F.P. 2	10	1	
	F.P. 3	8	1	
	F.P. 4	6	1	
High detail, functional size measured!	F.P. 5	4	2	
	F.P. 6	4	2	
	F.P. 7	8	2	
	F.P. 8	8	2	
	F.P. 9	8	2	
	F.P. 10	6	3	
	F.P. 11	10	3	
F.A. 2	F.P. 1	8	3	
	F.P. 2	8	3	
Less detail, estimated the number of f.p. with an average size	F.P. 3	8	4	
	F.P. 4	8	4	
	F.P. 5	8	4	
	F.P. 6	8	4	
	F.P. 7	8	5	
F.A. 3 *Low detail, Size estimated by analogy*		120	5 - 8	

Product Backlog (later stage)

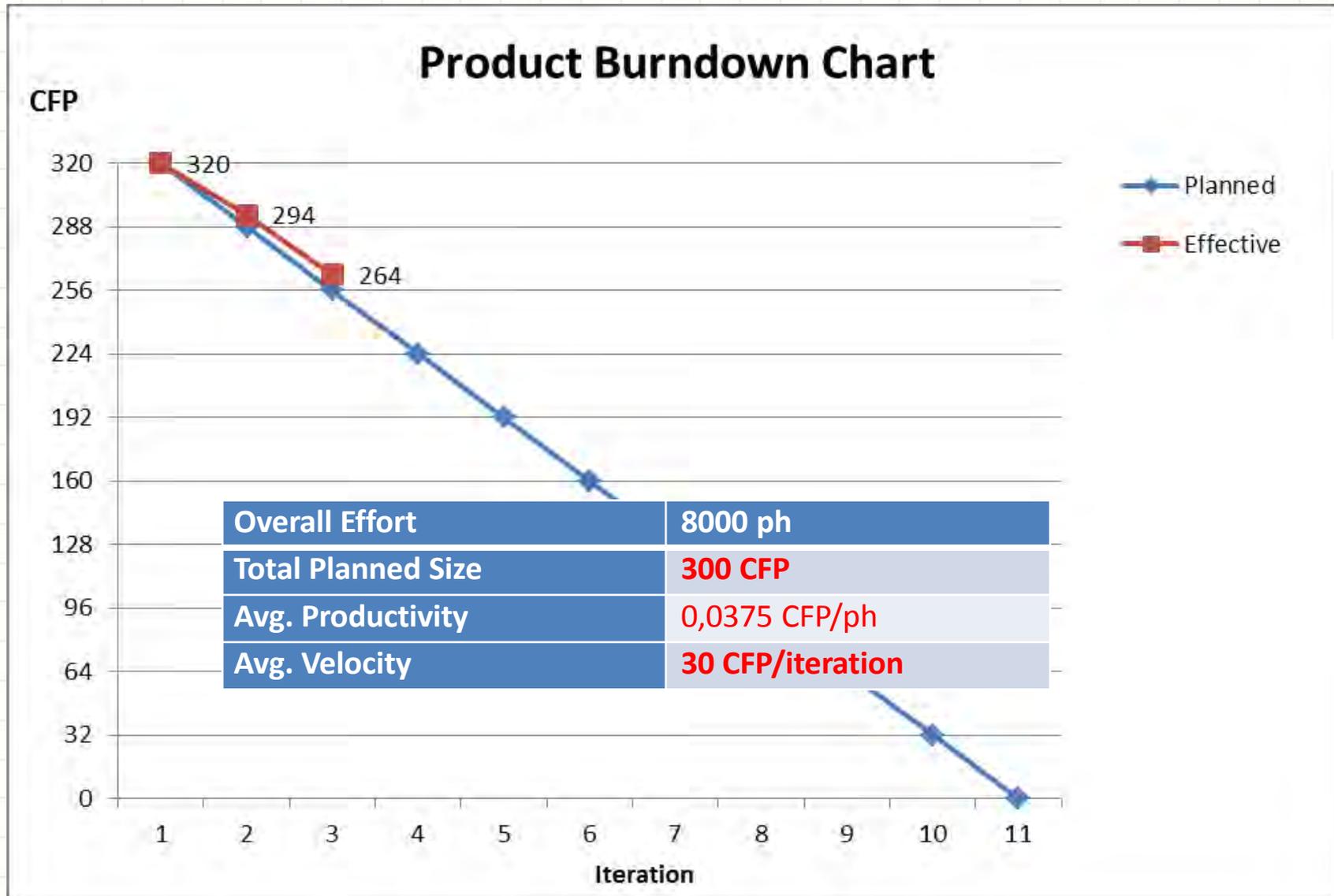| Functional Area	Functional Process	Size (CFP)	Priority/Iteration	Done
F.A. 1	F.P. 1	8	1	1
	F.P. 2	10	1	1
	F.P. 3	8	1	1
	F.P. 4	6	1	2
High detail, functional size measured!	F.P. 5	4	2	2
	F.P. 6	4	2	2
	F.P. 7	8	2	2
	F.P. 8	8	2	2
	F.P. 9	8	2	
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	F.P. 5	8	4	
	F.P. 6	8	4	
	F.P. 7	8	5	
F.A. 3 ...	...	...	...	...

On the meaning of «done»

- A basic concept in Agile – the criterion to mark an item as "completed" in the Backlog
- ***A Functional Process can be considered "done" if at least one acceptance test for each alternative path has passed with success***

- NOTE The team might implement **multiple (incremental)** versions of the same functional process(es) and put them in the Backlog as separate items
  - The same Functional Process (totalling 20 CFP) might appear in the Backlog as:
    - FP_Xv1 (12 CFP), and
    - FP_Xv2 (+8 CFP)

Measuring the progress of the project

- Example
  - in 1st iteration, the team has "done" 26 CFP
  - In 2nd iteration, the team has "done" 30 CFP
- Ref. productivity, the initial performance baseline was "optimistic"
  - Depending on the case, we might keep the budget but adjust the Scope (unless the team will increase its performance to stay with the initial goal)

    → Updated performance baseline

Planning: Initial performance baseline

Product Burndown Chart

Overall Effort	8000 ph
Total Planned Size	**300 CFP**
Avg. Productivity	0,0375 CFP/ph
Avg. Velocity	**30 CFP/iteration**

Percentage of Completion

$$PoC = Size_{done} / Size_{total}$$

$Size_{done}$ = Size implemented ("done") up to the ith given iteration

$Size_{total}$ = the Total Planned Size

In our example, after the 2nd iteration:
PoC = 56/300 = 18.7%.

Earned Value assessment

- EVA fully applicable and interestingly straightforward in Agile projects measured with COSMIC
- Main benefit: availability of a standard measurement unit for the software product to support numerical calculations.

$$Budgeted\_Cost\_of\_Work\_Performed = BAC \times PoC =$$
$$= BAC \times (Size_{done} / Size_{total})$$

(Budget_At_Completion is the overall project Budget)

$$Budgeted\_Cost\_of\_Work\_Scheduled = BAC \times (Size_{planned} / Size_{total})$$

(Size$_{planned}$ is the Size planned for implementation up to the ith goven iteration)

EVA / Performance Indicators

$$\text{Cost\_Performance\_Index} = BCWP / ACWP =$$
$$= (BAC / Size_{total}) \times (Size_{done} / ACWP)$$
or
$$CPI = \text{Actual Avg. Productivity} / \text{Baseline Avg. Productivity}$$

$$(\text{Actual\_Cost\_of\_Work\_Performed is the Effort spent for } Size_{done})$$

$$SPI = BCWP / BCWS = (Size_{done} / Size_{planned})$$

- In the our example
  - Baseline Avg. Productivity = 0,0375CFP/ph
  - Actual Avg. Productivity = the actual value measured, at any time during the project, as $Size_{done}$ /ACWP.

COSMIC-based
Change Management in Agile

- Agile: openness to change
  - refine requirements as development proceeds
  - make changes on portions already implemented
- COSMIC allows to distinguish
  - **Functional Size Developed** /ref. effort spent by supplier/
  - **Functional Product Size**   /ref. net result to customer/

$$Size_{DEV} = Size_{ADD} + Size_{CHG} + Size_{DEL}$$

$$Size_{PROD} = Size_{ADD} - Size_{DEL}$$

$$Rework\ Index = (Size_{DEV} - Size_{PROD}) / Size_{DEV}$$

Functional Process	Size (CFP)			Priority/Iteration
	ADD	CHG	DEL	
F.P. 1	8			1
F.P. 2	10			1
F.P. 3	8			1
F.P. 4	6			2
F.P. 5	4			2
F.P. 6	4			2
F.P. 7	8			2
F.P. 8	8			2
F.P. 7 v2	2	2	1	3
F.P. 8 v2	0	3	0	3
F.P. 4 v2	0	2	1	3
F.P. 9	8			3
F.P. 10	6			3
F.P. 11 v1	5			3
...	...			...

- $Size_{DEV} = 21 + 7 + 2 = 30$ CFP
- $Size_{PROD} = 21 - 2 = 19$ CFP

Size Trend over Iterations
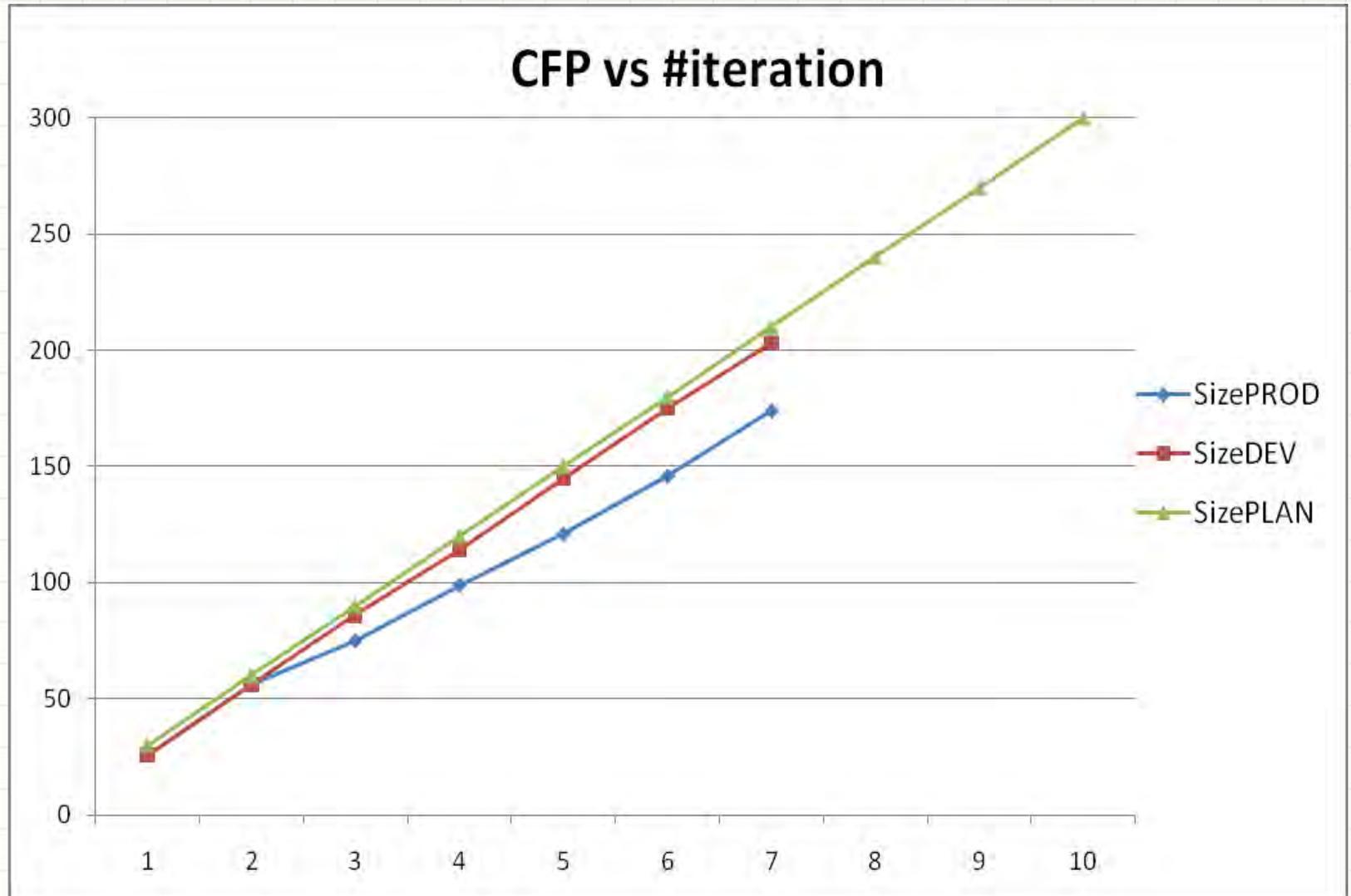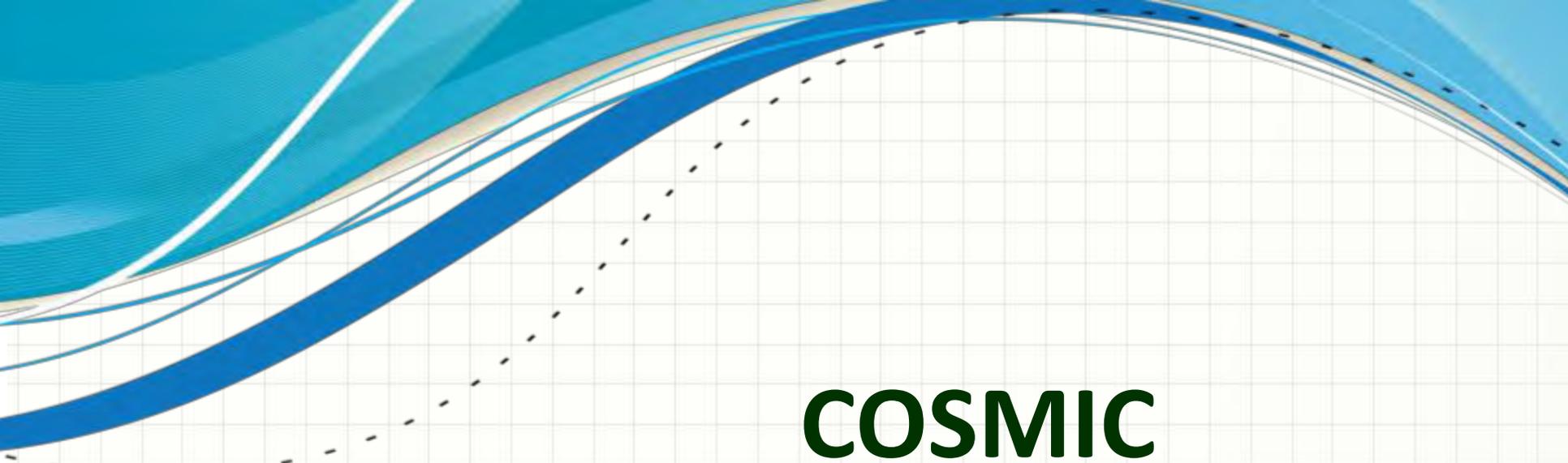
COSMIC SUPPORT IN SPI (CMMI-DEV)

Mapping COSMIC on CMMI-DEV

- COSMIC models – powerful tools for requirements elicitation, analysis and management
- COSMIC sizes can drive quantitatively planning and project monitoring
- by collecting historical productivity data, a local Repository can be easily built for further improvement in estimating projects
- the concept of Functional Processes provide a common basis for developers, testers and users in several process areas

Process Area: Requirements Mangement (REQM)	
Specific Goal 1: Manage Requirements (Requirements are managed and inconsistencies with project plans and work products are identified. The project maintains a current and approved set of requirements over the life of the project.)	The form of functional processes makes the understanding of the FUR easier for all the stakeholders. Changes and scope creep, with respect to a requirements baseline, can be measured in CFP.
Process Area: Project Planning (PP)	
Specific Goal 1: Establish Estimates (Estimates of project planning parameters are established and maintained. Project planning parameters include all information needed by the project to perform the necessary planning, organizing, staffing, directing, coordinating, reporting, and budgeting.)	Project Planning may be based on COSMIC measures and reference baseline values of Productivity and Velocity. Functional Size is the primary input to any estimation model.
Specific Goal 2: Develop a Project Plan (A project plan is established and maintained as the basis for managing the project. A project plan is a formal, approved document used to manage and control the execution of the project. It is based on the project requirements and the established estimates.)	A Release Plan can be organized as a Product Backlog, where the items to be developed are Functional Processes (COSMIC meaning), ordered by priority.
Process Area: Supplier Agreement Management (SAM)	
Process Area: Measurement and Analysis (MA) … … … …	

| Process Area: Process and Product Quality Assurance (PPQA)	
Specific Goal 1: Objectively Evaluate Processes and Work Products (Adherence of the performed process and associated work products and services to applicable process descriptions, standards, and procedures is objectively evaluated.)	COSMIC represents an objective way to evaluate requirements artifacts, at the product level. COSMIC manuals and certifications are an objective reference to assess correct measurements.
Specific Goal 2: Provide Objective Insight (Noncompliance issues are objectively tracked and communicated, and resolution is ensured.)	
Process Area: Requirements Development (RD)	
Specific Goal 1: Develop Customer Requirements (Stakeholder needs, expectations, constraints, and interfaces are collected and translated into customer requirements.)	A "problem domain" analysis based on COSMIC is an effective way to elicit and describe functional requirements, from the point of view of the final user.
Specific Goal 2: Develop Product Requirements (Customer requirements are refined and elaborated to develop product and product component requirements.)	COSMIC allows for multiple levels of decomposition. Separate Peer Components of the application can be identified and functional processes can be defined separately for each scope.
Process Area: Organizational Process Definition (OPD)	
Process Area: Verification (VER) … … … …	

Conclusions

- COSMIC usage results in benefits for both project management and process improvement
- COSMIC adoption is highly recommended
  - applicable over software domains and project phases
  - applicable in agile development / iterative approaches
  - accurate and standardized measurement results
- Guidelines are provided for COSMIC application in Agile
- COSMIC + CMMI-DEV + Agile methodologies allow for governance of software "rapid" development projects/processes
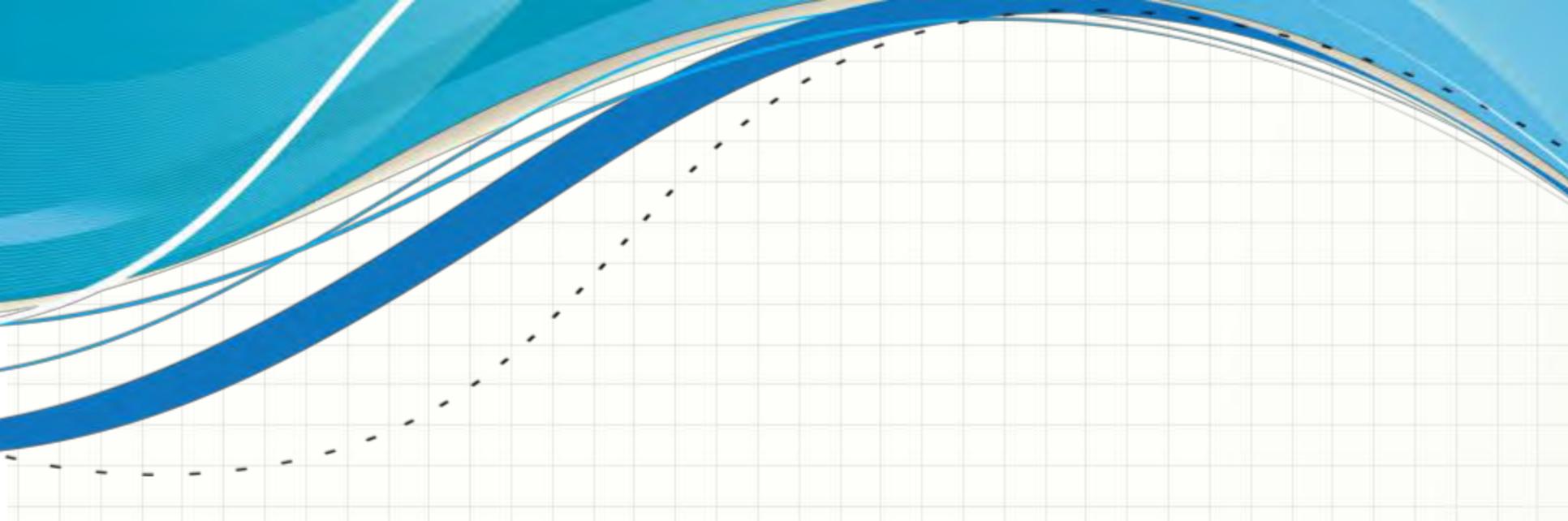
THANK YOU!
QUESTIONS?

ENRICO.BERARDI@TRS.IT

LUCA.SANTILLO@GMAIL.COM