IMPLEMENTATION OF EARNED VALUE MANAGEMENT TOOLS IN THE WENDELSTEIN 7-X PROJECT
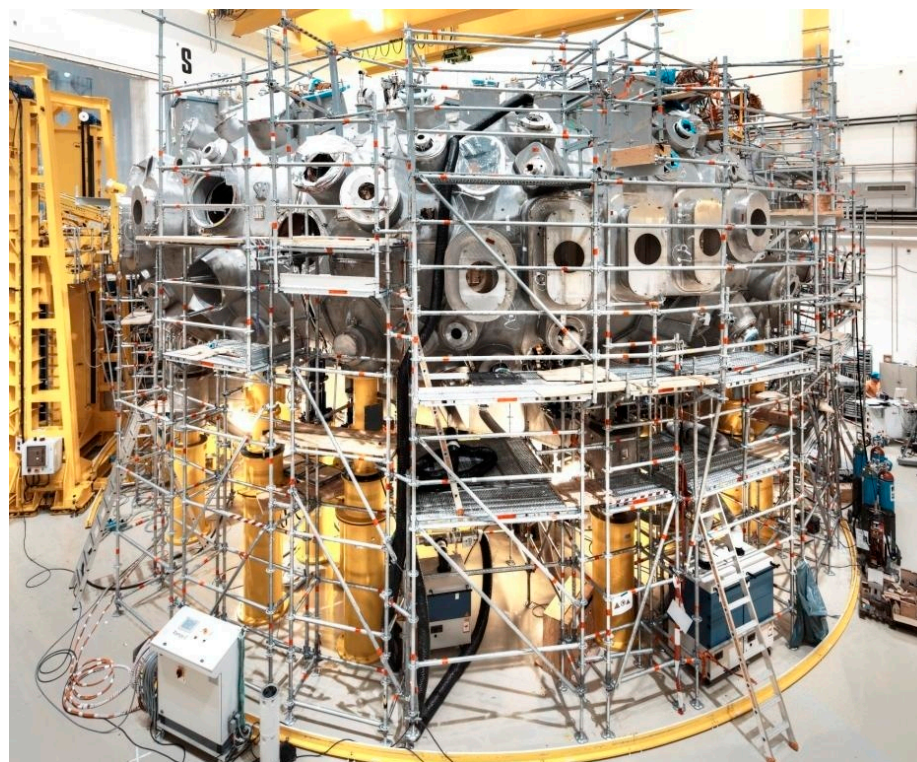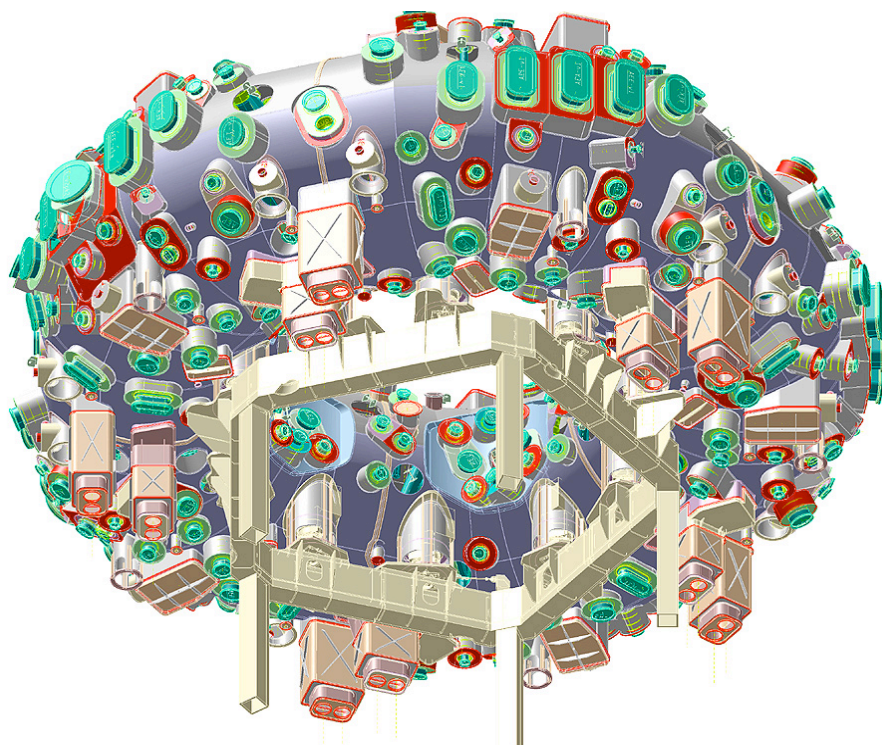
A. Lorenz and Project Control Team

IPP Greifswald, Germany
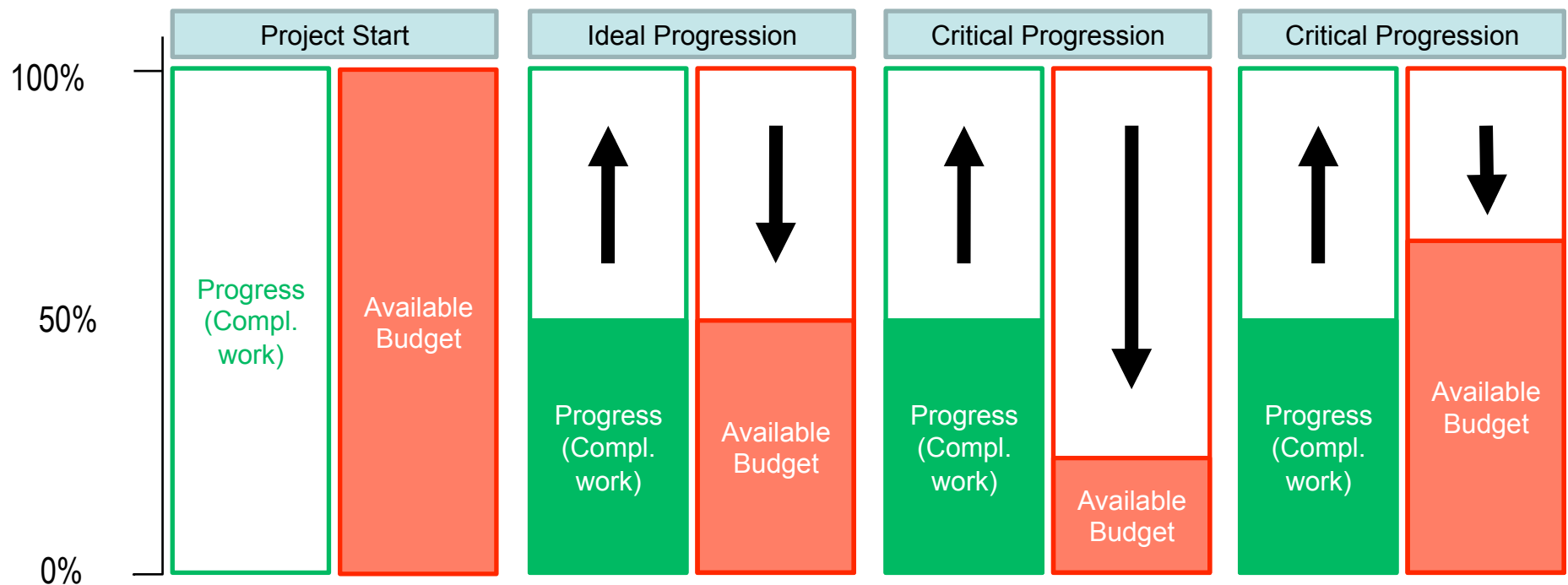
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Motivation and Method

EVM tools for:

    1. W7-X Assembly

    2. Diagnostic Engineering

    3. In-vessel Component Manufacturing

Lessons learned

- „Traditional" project analysis separates cost and time
  - in many cases reasonable and sufficient, but: progress not always proportional to cost.

- EVM gives transparent project status for resource driven projects (e.g. Information technology)

- W7-X assembly and a number of other internal projects seemed well suited to introduce EVM
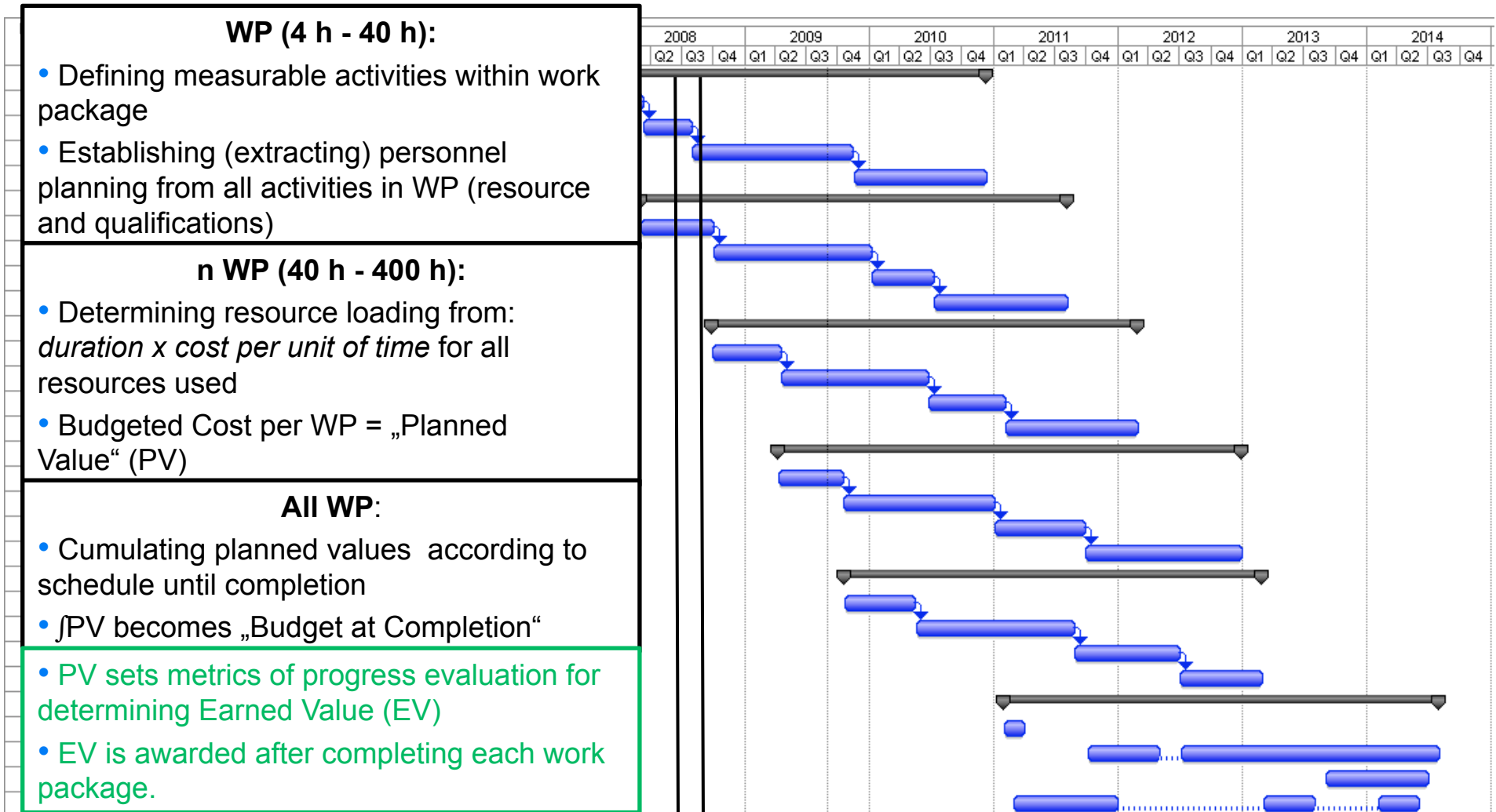
Reference: Econum Unternehmensberatung GmbH, 2009, *Begleitung von Großprojekten durch externes Projektcontrolling*

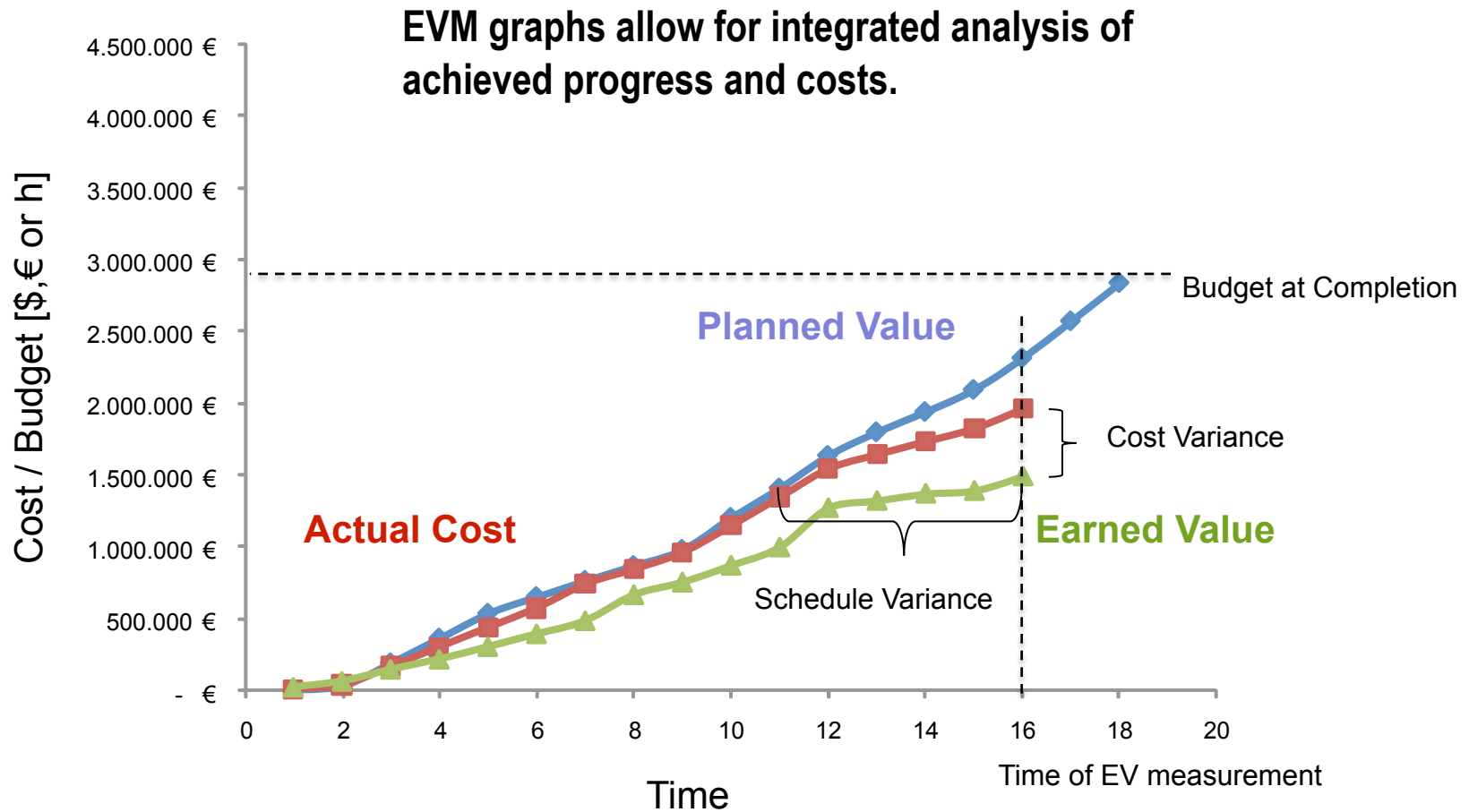**All activities of schedule require work breakdown (WBS) with <u>measurable </u>work packages (WP)**

Nr.		Vorgangsname	Dauer	Anfang	Ende
1		**1. Module (#5)**	**1495 Tage**	**Mo 21.03.05**	**Fr 10.12.10**
2		Pre-Assembly	773 Tage	Mo 21.03.05	Mi 05.03.08
3		Coil services	103 Tage	Do 06.03.08	Mo 28.07.08
4		Module assembly	339 Tage	Di 29.07.08	Fr 13.11.09
5		Port assembly + piping	280 Tage	Mo 16.11.09	Fr 10.12.10
6		**2. Module (#1)**	**897 Tage**	**Mi 27.02.08**	**Do 04.08.11**
7		Pre-Assembly	155 Tage	Mi 27.02.08	Di 30.09.08
8		Coil services	329 Tage	Mi 01.10.08	Mo 04.01.10
9		Module assembly	133 Tage	Di 05.01.10	Do 08.07.10
10		Port assembly + piping	280 Tage	Fr 09.07.10	Do 04.08.11
11		**3. Module (#4)**	**895 Tage**	**Mi 24.09.08**	**Di 28.02.12**
12		Pre-Assembly	145 Tage	Mi 24.09.08	Di 14.04.09
13		Coil services	311 Tage	Mi 15.04.09	Mi 23.06.10
14		Module assembly	159 Tage	Do 24.06.10	Di 01.02.11
15		Port assembly + piping	280 Tage	Mi 02.02.11	Di 28.02.12
16		**4. Module (#2)**	**971 Tage**	**Do 09.04.09**	**Do 27.12.12**
17		Pre-Assembly	135 Tage	Do 09.04.09	Mi 14.10.09
18		Coil services	318 Tage	Do 15.10.09	Mo 03.01.11
19		Module assembly	190 Tage	Di 04.01.11	Mo 26.09.11
20		Port assembly + piping	328 Tage	Di 27.09.11	Do 27.12.12
21		**5. Module (#3)**	**877 Tage**	**Di 20.10.09**	**Mi 27.02.13**
22		Pre-Assembly	149 Tage	Di 20.10.09	Fr 14.05.10
23		Coil services	333 Tage	Mo 17.05.10	Mi 24.08.11
24		Module assembly	220 Tage	Do 25.08.11	Mi 27.06.12
25		Port assembly + piping	175 Tage	Do 28.06.12	Mi 27.02.13
26		**Torus assembly**	**913 Tage**	**Di 01.02.11**	**Do 31.07.14**
27		Final adjustment of modules	43 Tage	Di 01.02.11	Do 31.03.11
28		Module connections incl. KiP	696 Tage	Mo 03.10.11	Do 31.07.14
29		Completion of torus	216 Tage	Mo 02.09.13	Mo 30.06.14
30		Heating systems	413 Tage	Di 01.03.11	Fr 30.05.14

Schematic, not current schedule

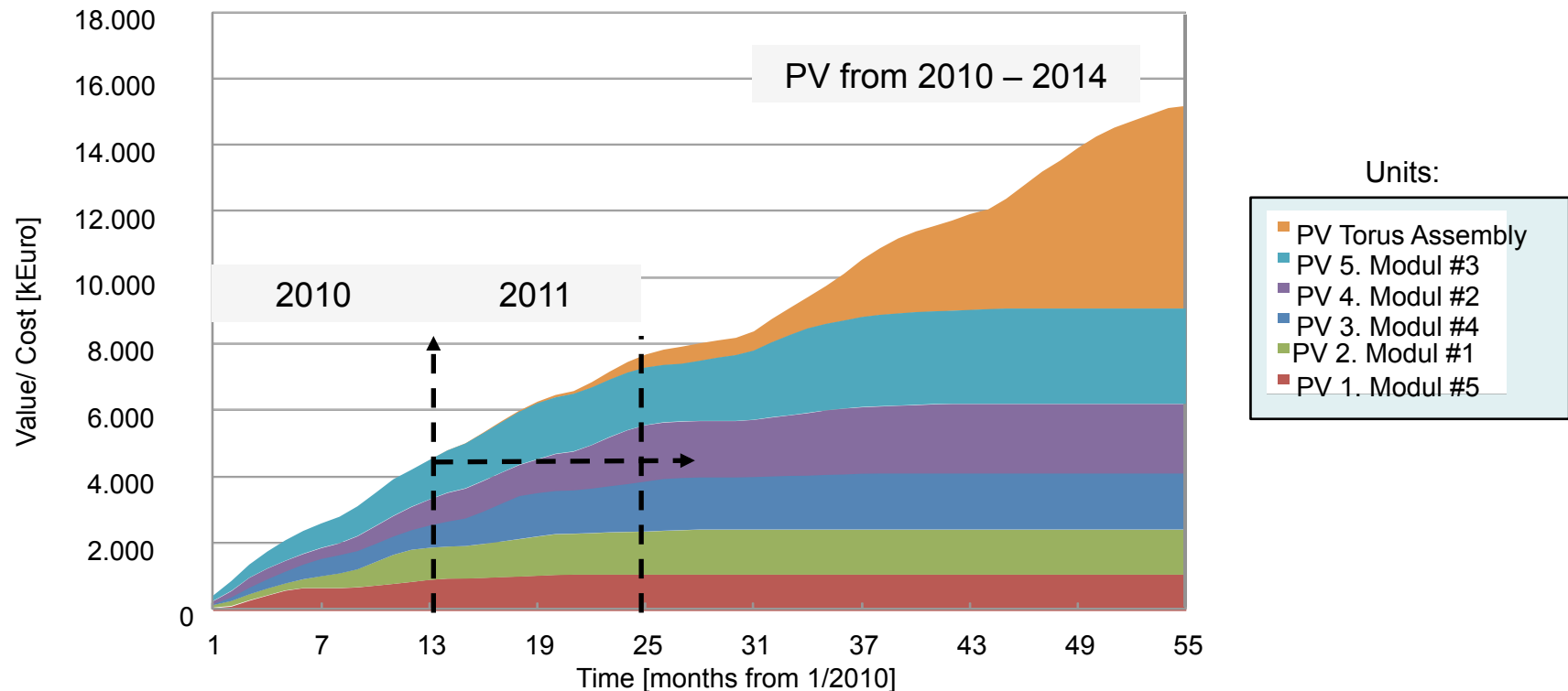**All activities of schedule require work breakdown (WBS) with <u>measurable</u> work packages (WP)**

WP (4 h - 40 h):

- Defining measurable activities within work package
- Establishing (extracting) personnel planning from all activities in WP (resource and qualifications)

n WP (40 h - 400 h):

- Determining resource loading from: *duration x cost per unit of time* for all resources used
- Budgeted Cost per WP = „Planned Value" (PV)

All WP:

- Cumulating planned values according to schedule until completion
- ∫PV becomes „Budget at Completion"

- PV sets metrics of progress evaluation for determining Earned Value (EV)
- EV is awarded after completing each work package.

Schematic, not current schedule

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EVM graphs allow for integrated analysis of achieved progress and costs.

Project Management Institute, Philadelphia, 2005, *Practice Standard for Earned Value Management*

2. EVM tool for monitoring W7-X Assembly

- Goal: - Monitoring complex, costly and time critical process as comprehensible as possible
- Boundary C.:   - EVM set up after project start – large effort and performance compromises (AC),
- Requirement: - Detailed resource loaded assembly planning (work packages)
- Implementation: - Aggregation of work packages into "steps" and "units" cumulating assembly of 5 identical modules and assembly of torus and installation of peripheral systems
 - Adaptation of AC readout to existing SAP system

2010

- EV matching PV exactly end of year
- AC saving despite catching up with new personnel
- PV Base line adjustment for 2011 to adapt to new overall schedule and resource breakdown

2011

- EV: Strong performance due to repeated assembly steps
- Emphasis on AC monitoring after baseline change

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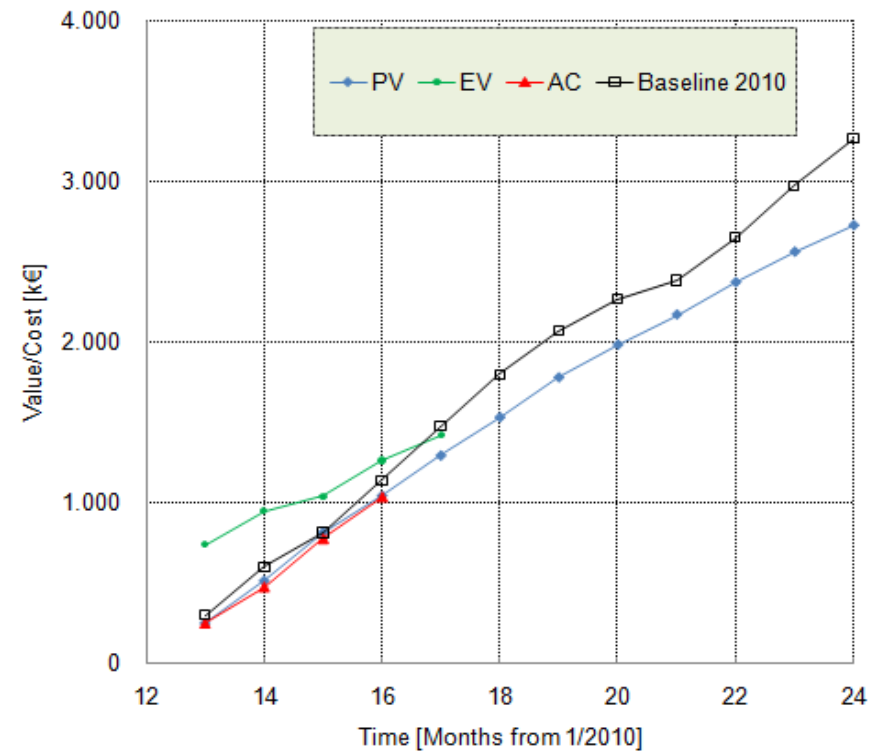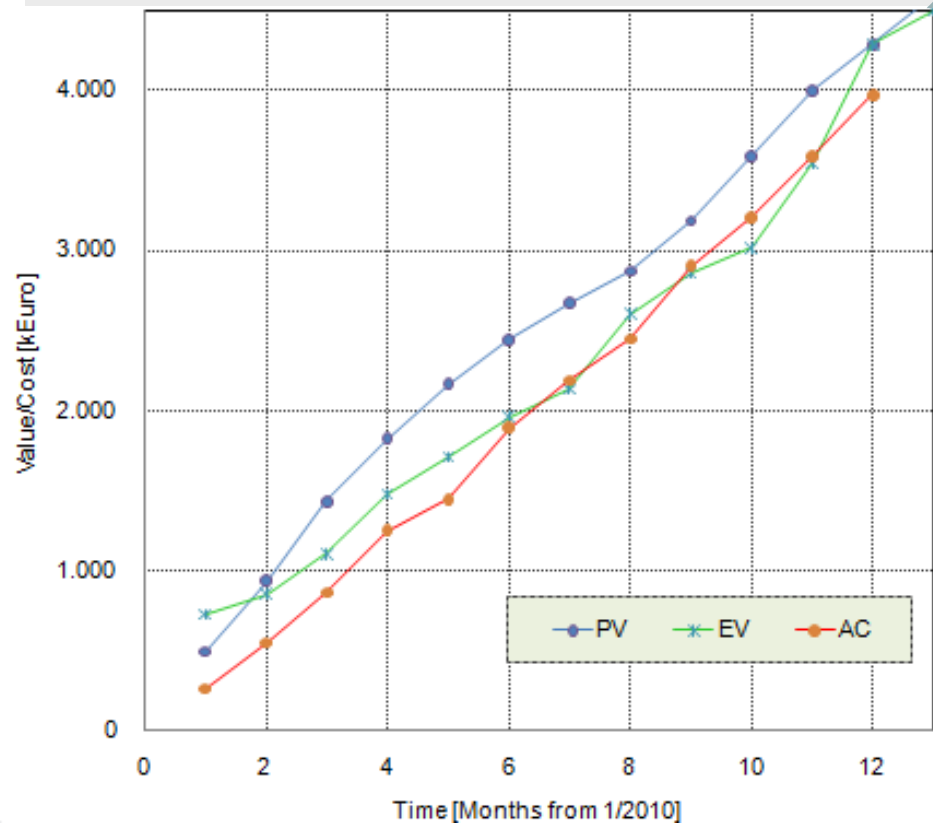
- Goal: Monitoring time critical design process of appr. 25 diagnostics, prone to changes

- Boundary C.: Catching start of reinforced engineering

- Requirement: Sharp definition of engineering work packages – agreed between various departments

- Implementation: - Simplified PV using fixed design time of 33 hours/week (guideline)
  - Maximum possible resolution AC data: collection on weekly basis (immediate)
  - Management meeting for monthly analysis, conclusions and decisions

Hα Endoscope - regular EVM
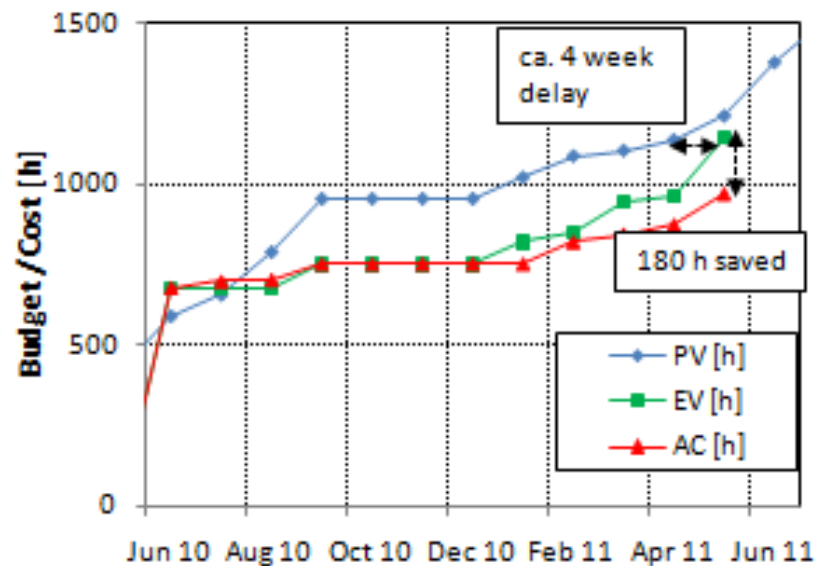
Bolometer – evolution of project

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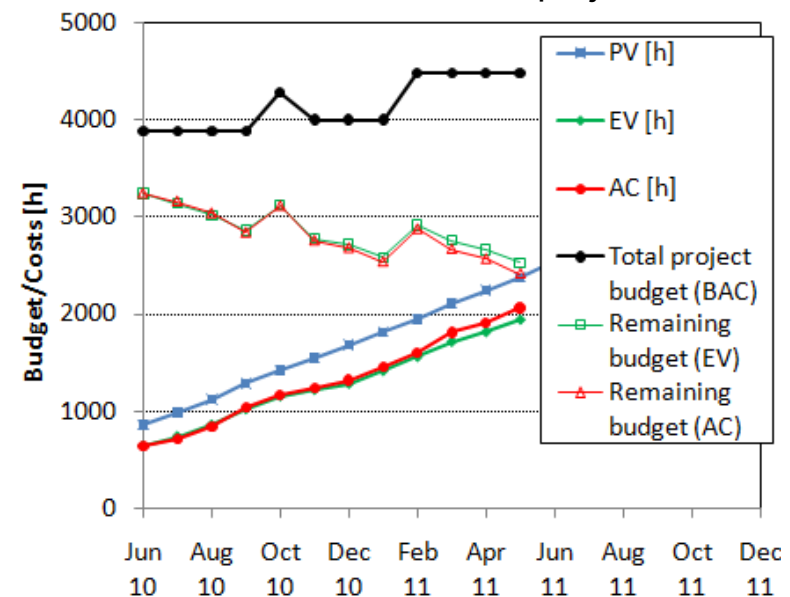
- **Complimentary tool for overall schedule monitoring - implemented thanks to simple set up:**
- **Progress check against requirement dates for handover of design work packages, e.g. models or drawings – in line with assembly dates**

Bolometer
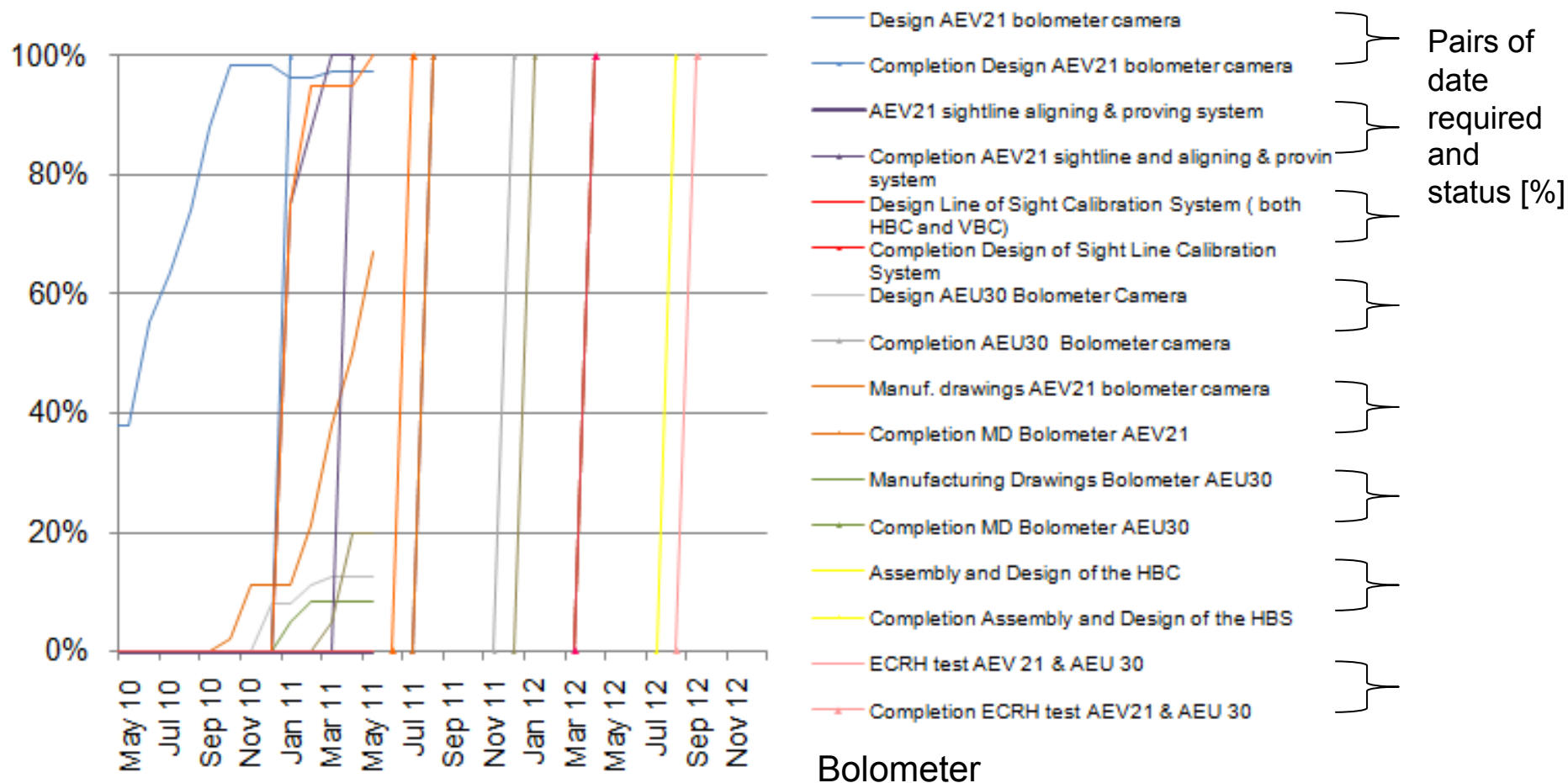
4. EVM tool for monitoring In-vessel component manufacturing

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- Goal: Monitoring small series fabrication (up to 200 pc) of complex IVC in internal workshop

- Boundary C.: EVM set up after project start – large effort and performance compromises (PV, EV)
  IPP administrative system allows for accurate allocation of AC

- Requirement: Synchronizing WBS work package with manufacturing lots - detailed and baseline

- Implementation: - Cumulating manufacturing hours per order
  - Extracting data from existing SAP databases
  - Main tool for cost containment and budget planning (quarterly)

Baffles

Plug-Ins (Cooling water supply into vessel)

Boundary condition:
Process involving personnel rather than external procurement contracts

Boundary condition:
Organizational set up for allocation of AC to respective work packages

Boundary condition:
EVM setup after project start compromises performance

Possible goals

- „Only" Reporting tool (high level summary), project steered via other tooling

- Monthly follow up for strategic project control

- Weekly monitoring of progress to steer resources

Requirements for:

- PV: detailed project planning – but not rigid - "just" robust and flexible WBS

- EV: Sharp definition of expected results and "earning rules" for each activity to avoid subjective EV measurement (0 or 100%)

Implementation

- Initial effort to integrate data from several sources.

- Concept to be detailed sufficiently

- Decision on software package

- Execution requires discipline (data quality, regular data intervals, project communication)