Multi-Paradigm Modelling for Cyber-Physical Systems (MPM4CPS)

COST Action IC1404

some personal experiences

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FLANDERS MAKE
MANUFACTURING INNOVATION NETWORK

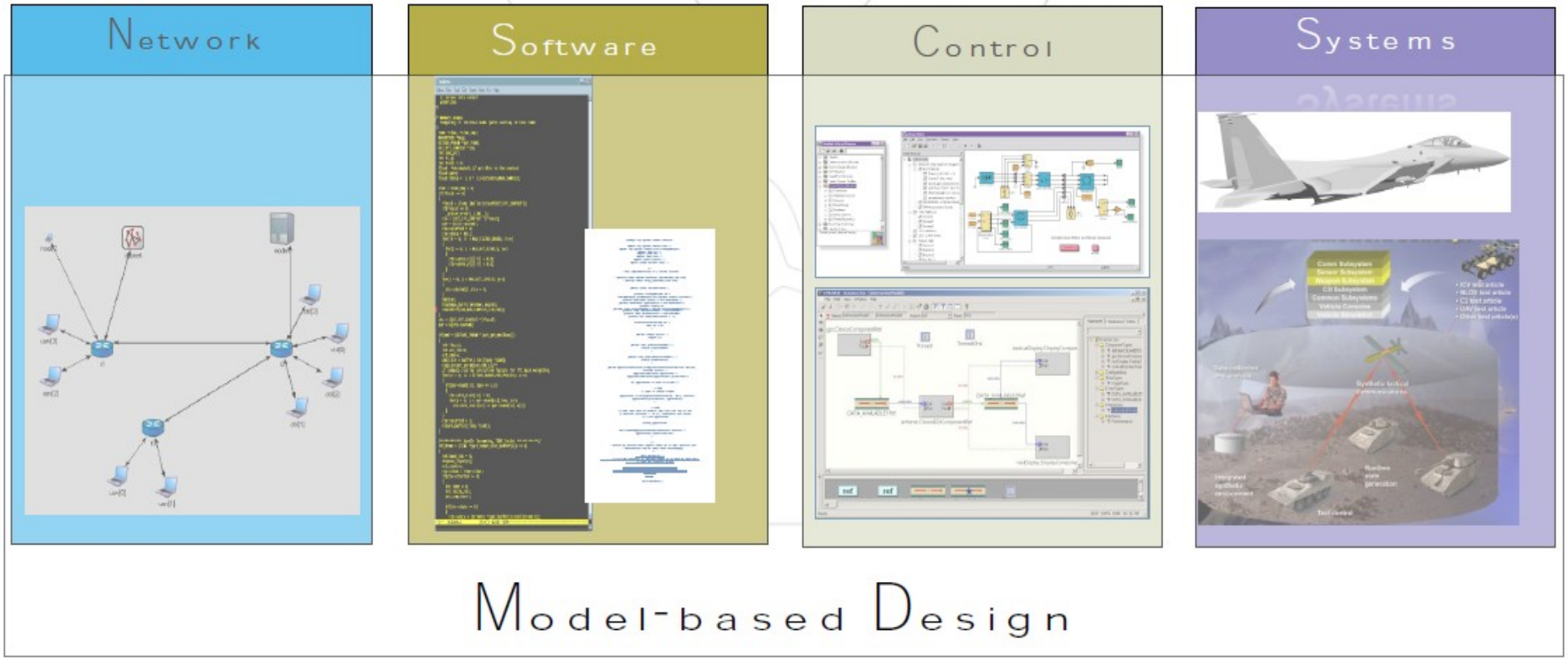
Working Definition of Cyber-Physical Systems

CPS are engineered systems where functionality and salient characteristics emerge from the networked interaction of computational and physical components

Janos Sztipanovits
(Model Integration Languages)

Term coined around 2006 and tended by “instigators”:
Gill, Kumar, Lee, Midkiff, Mok, Rajkumar, Sastry, Sha, Shin, Stankovic, Sztipanovits.

Based on the recognition that convergence in engineered systems in -



is deeper than an interdisciplinary approach would enable

Typical CPS: networked car

Typical CPS: smart city (incl. building automation)

ICT COST Action IC1404

Multi-Paradigm Modelling for Cyber-Physical Systems (MPM4CPS)

Descriptions are provided by the Actions directly via e-COST.

Truly complex, designed systems, known as Cyber Physical Systems (CPS), are emerging that integrate physical, software, and network aspects. To date, no unifying theory nor systematic design methods, techniques and tools exist for such systems. Individual (mechanical, electrical, network or software) engineering disciplines only offer partial solutions.

Multi-paradigm Modelling (MPM) proposes to model every part and aspect of a system explicitly, at the most appropriate level(s) of abstraction, using the most appropriate modelling formalism(s). Modelling languages' engineering, including model transformation, and the study of their semantics, are used to realize MPM. MPM is seen as an effective answer to the challenges of designing CPS.

We aim to promote the sharing of foundations, techniques, and tools and to provide educational resources, to both academia and industry. This will be achieved by bringing together and disseminating knowledge and experiments on CPS problems and MPM solutions.

Action details

MoU	044/14
CSO Approval date	14/05/2014
Start of Action	25/11/2014
End of Action	24/11/2018

Participations

Country	Date	Status
Austria	09/10/2014	Confirmed
Belgium	19/05/2014	Confirmed
Bosnia and Herzegovina	03/02/2015	Confirmed
Croatia	09/06/2014	Confirmed
Czech Republic	19/08/2014	Confirmed
Denmark	09/05/2015	Confirmed
Estonia	19/08/2014	Confirmed
France	16/10/2014	Confirmed
fYR Macedonia	29/05/2014	Confirmed
Germany	22/05/2014	Confirmed
Greece	07/05/2015	Confirmed
Hungary	03/07/2014	Confirmed
Ireland	19/06/2014	Confirmed
Italy	19/08/2014	Confirmed
Netherlands	16/10/2014	Confirmed
Norway	13/06/2014	Confirmed
Poland	09/01/2015	Confirmed
Portugal	03/07/2014	Confirmed
Romania	27/05/2014	Confirmed
Serbia	05/09/2014	Confirmed
Slovenia	28/05/2014	Confirmed
Spain	30/05/2014	Confirmed
Sweden	07/07/2014	Confirmed
Switzerland	20/08/2014	Confirmed
United Kingdom	20/05/2014	Confirmed
Total: 25		

Intentions to participate

Country	Date	Status
Bulgaria	-	Intention
Israel	-	Intention
Latvia	-	Intention
Turkey	-	Intention
Total: 4		

COST International Partner Countries

Institution Name	Country
Victoria University of Wellington	New Zealand
Georgia Tech	United States of America
MathWorks	United States of America
McGill University	Canada

Choose your MC members well:

- **in proposal vs. once accepted**
- **MC ultimate decision body**
- **CNC appoints (initially)**
- **senior/famous vs. junior/available/ balance (chair & vice-chair)**

graph grammars, model transformation, computational design synthesis, optimization and search including solution space generation	Prof Didier BUCHS University of Geneva Computer Science Department [Proposal Participant] [Potential MC Member] [WG Member] Expertise: ICT - formal specification methods, validation techniques and testing techniques for real size distributed systems

DE - Germany

Dr Wladimir SCHAMAI European Aeronautic Defence and Space Company Innovation Works [WG Member] Expertise: ICT - Model Driven Engineering, Aerospace Engineering, Aeronautical Engineering, Aerospace, Aerodynamics, Aircraft, Flight Dynamics, Flight Control	Prof Bernhard SCHATZ Fortiss Software & Systems Engineering [Proposal Participant] [Potential MC Member] [WG Member] Expertise: ICT - Analysis and Design of Dependable Systems, Optimized Design Space Exploration, Model-Based Engineering Tools, Smart Grid, Automotive, Automation
Prof Holger GIESE Hasso Plattner Institute for Software Systems Engineering at the University Potsdam System Analysis and Modeling [Potential MC Member] [WG Member] Expertise: ICT - model-driven development of embedded real-time systems, traceability management, code generation, model transformations, self-adaptive systems, distributed embedded real-time systems, formal verification	Prof Colin ATKINSON University of Mannheim Software Engineering [WG Member] Expertise: ICT - Multi-level modelling, Deep Modeling, Orthographic Software Modeling

ES - Spain

Prof Juan DE LARA Universidad Autonoma de Madrid Escuela Politecnica Superior, Departamento de Ingenieria Informatica [Potential MC Member] [WG Member] Expertise: ICT - Meta-Modelling, Model Transformation, Simulation, Visual Languages, Transformations and Models at run time, Model Abstraction, Domain Specific Languages, Semantics	Prof Antonio VALLECILLO Universidad de Malaga Lenguages y Ciencias de la Computacion [Potential MC Member] [WG Member] Expertise: ICT - model-driven development, open distributed processing, multiview modelling
Prof Pedro GARCIA LOPEZ Universitat Rovira i Virgili Departament d'Enginyeria Informatica i Matematiques [WG Member] Expertise: ICT - software architectures and models, software interception, peer-to-peer networks, smart cities, cloud storage services	

MPM4CPS

Home | News | Past Events | Activities | Working Groups | Contacts

Welcome to the COST Action IC1404 Multi-Paradigm Modelling for Cyber-Physical Systems

01 **ABOUT**

Mission - Organization - Become a member!

02 **ICT COST Action IC1404**

Introduction - Memorandum of Understanding

03 **DOCUMENTS**

Newsletters - Dissemination Materials -

- Calls (STSMs, Schools, etc.) -

- Internal Reports and Minutes -

- Administrative Information

04 **NEWS AND UPCOMING EVENTS**

05 **USEFUL LINKS**

Contacts - Related Projects -

- COST Administration (E-COST) -

- Partner COST Actions - Related Events

06 **INTERNAL SERVICES**

Management Commitee (MC) -

- Administrators (Zope management)

COST is supported by the EU Framework Programme Horizon 2020

ANNOUNCEMENTS

Do you feel you can contribute to MPM4CPS? Become a collaborator! Fill the form.

The reports of the 2015 STSMs can now be consulted here.

EVENTS

MPM4CPS 1st Training School at Tallinn University on the 21-24 March, 2015. READ MORE

MPM4CPS WG meeting will be co-located with CPSWeek, and will take place at Vienna, Austria, on the 15-16 April, 2016. More details to be known soon!

MPM4CPS Vienna **Workshop** 14 – 15 April 2016

CPS Week 2016 Vienna

4 Conferences:

HSCC, ICCPS, IPSN, RTAS

20 Workshops, 6 Tutorials,

1 Competition, 4 Summits

Joint ARTEMIS-IA Spring Event 2016

RiSE & LogiCS Spring School

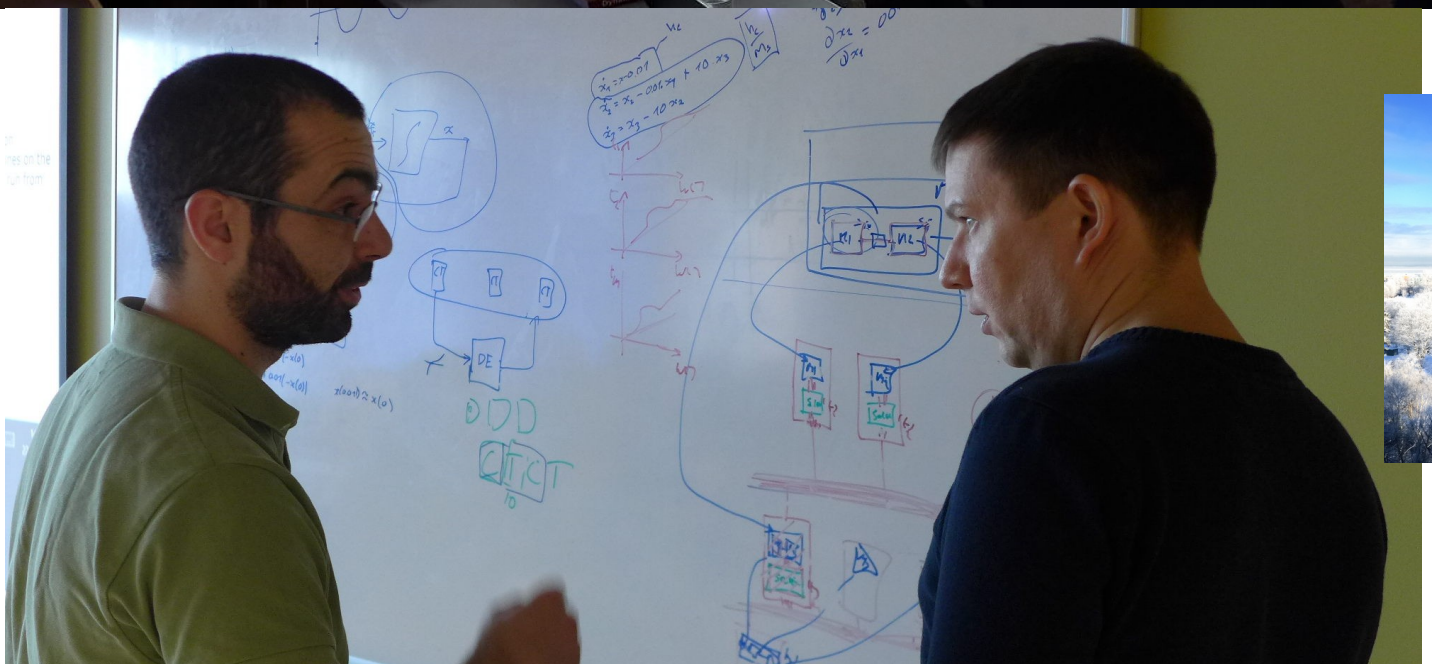
Vienna, Austria

11 - 14 April 2016

MPM4CPS **Young Researcher Workshop**
Twente University, The Netherlands 17-18 December 2015

MPM4CPS Tallinn **Training School**

21 – 24 March 2016



2016 STSMs (approved by the MC 1/5/2016)

The approved applications of 2nd STSM call are the following:

- Bart Meyers, Visiting Chalmers University of Technoloy, Goteborg (SE), 6. 11. 2016 - 17. 11. 2016
- Dominique Blouin, Visiting Universidade Nova de Lisboa, Lisboa (PT), 15. 1. 2017 - 21. 1. 2017
- Ken Pierce, Visiting Fortiss GmbH, Munich (DE), 22. 1. 2017 - 28. 1. 2017
- Loli Burgueno, Visiting TU Wien, Vienna (AT), 20. 3. 2017 - 28. 3. 2017
- Michalak Krzysztof, Visiting Institute for Biocomputation and Physics of Complex Systems (BIFI), Uni. de Zaragoza, Zaragoza (ES), 7. 11. 2016 - 7. 12. 2016
- Rima Al-Ali, Visiting Telecom ParisTech engineering school in Paris, Paris (FR), 6. 11. 2016 - 13. 11. 2016
- Tanja Mayerhofer, Visiting INRIA, Rennes (FR), 6. 2. 2017 - 13. 2. 2017

Spreading the Word:
MoDELS **conference**
October 2015
Ottawa, Canada

Before the proposal:

(1) perceived need
(2) (ambitious) vision
(3) community … beware: enough critical mass at startup
(3) core group of proposal writers with opportunity to meet

DSM TP 2013
Theory and Practice

4th International Summer School
on Domain Specific Modeling

Santiago de Compostela
2 - 6 September

- DSM-TP Home
- School Program
- The Speakers
- Program Committee
- Registration

Welcome

The main goal of the DSM-TP International Summer School, is the creation of a space for learning and discussion about Domain Specific Modeling.

This DSM-TP 2013 edition will happen from the **2nd to the 6th of September** , and will be hosted this year by CiTIUS in the University of Santiago de Compostela in the beautiful Medieval Spanish city of Santiago de Compostela (Software Engineering College) and jointly co-organized by the following institutions:

http://dsm-tp.org

Do you **really** want to

be the Action chair?

+visibility
+develop vision
- inclusiveness vs. implementing MoU “herding cats”

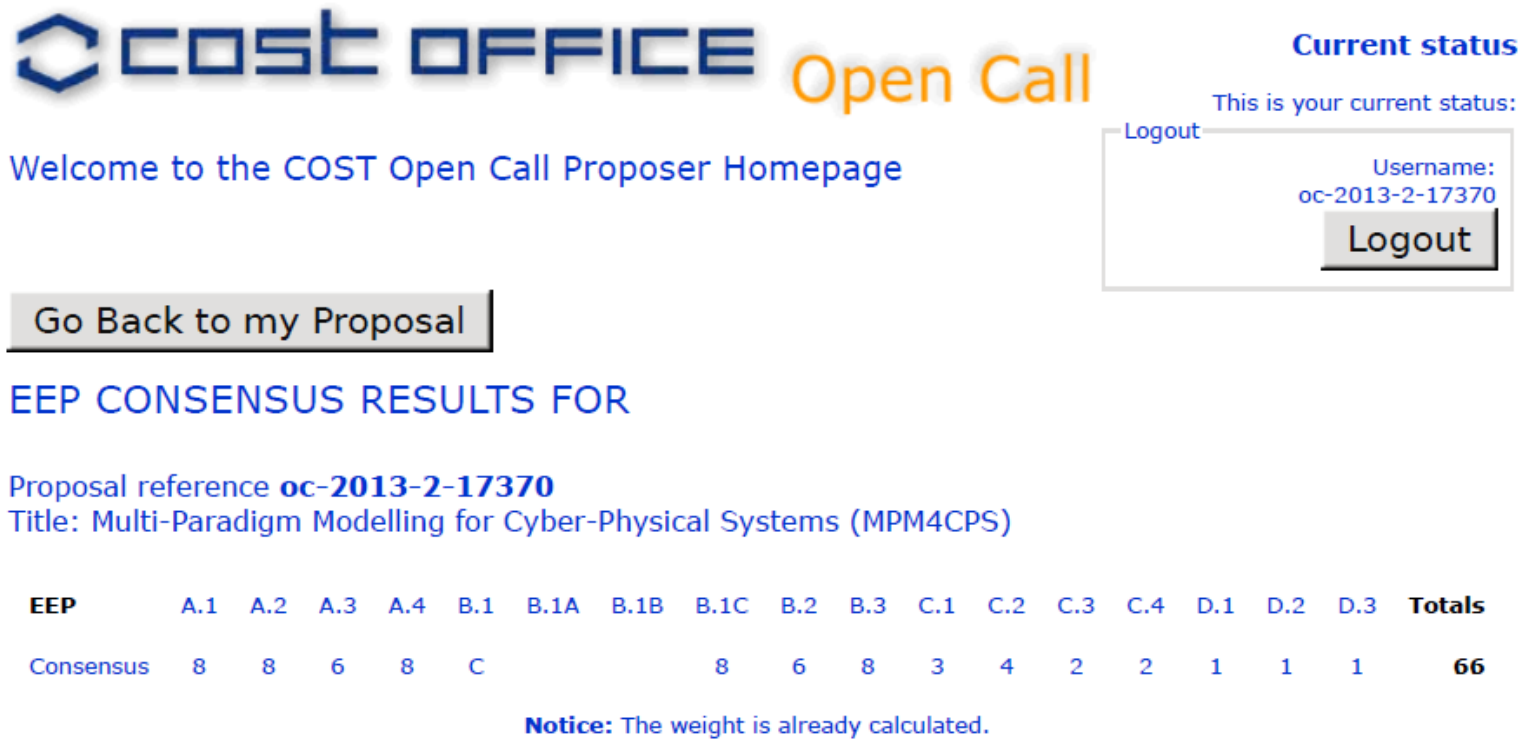
Do you **really** want your institution to

be the Grant Holder?

+FSAC (Financial and Scientific Administration and Coordination) 115% ~13k
- Financial rules of your institution wrt.
  * “flat rate” (no VAT vs. honorarium);
  * TRR (Travel Reimbursement Request) “strong authentication”

Timeline:

13.09.27.preProposal/
14.01.24.proposal/



cost OFFICE Open Call

Current status

This is your current status:

Logout

Username:
oc-2013-2-17370

Logout

Welcome to the COST Open Call Proposer Homepage

Go Back to my Proposal

EEP CONSENSUS RESULTS FOR

Proposal reference **oc-2013-2-17370**
Title: Multi-Paradigm Modelling for Cyber-Physical Systems (MPM4CPS)

EEP	A.1	A.2	A.3	A.4	B.1	B.1A	B.1B	B.1C	B.2	B.3	C.1	C.2	C.3	C.4	D.1	D.2	D.3	Totals
Consensus	8	8	6	8	C			8	6	8	3	4	2	2	1	1	1	66

Notice: The weight is already calculated.

14.03.13.hearing/
14.03.28.preProposal/
14.05.15.MoU/
14.10.14.welcome2COST.Brussel/
14.11.25.KickOffAndFirstMCmeeting.Brussel/

Relationship with existing EU projects

- complementarity
- active in, connected with

The main **objective** of this Action is to enhance the **quality, visibility and impact** of **European research and industrial adoption** in the **trans-disciplinary** area of CPS.

This goal is pursued by building a **network of researchers, educators, industrial practitioners and policy makers** in order to establish the **foundations and methods** of CPS Engineering enabled by MPM.

This will allow coordinating and shaping the efforts on **research, education and application** in this emerging research field.

- Define a worldwide **baseline for CPS** (exemplars)
- Develop a new **unified trans-disciplinary CPS engineering foundation** (methods, techniques, tools)

Transformative (academia, industry, education)

Global (world) impact, European Academic/Industrial leadership

Ambitious … yet, be careful what you promise (MoU is contract)

Working Groups

WG 1 : Foundations - Intra and Inter-Disciplinary Interaction

WG 2: Techniques

WG 3: Application Domains

WG 4: CPS Education and Dissemination

WG 0: Cross-WG Activities, Showcases

Clear Working Group structure with goals, responsibilities, management

Have Working Group chairs and vice-chairs in mind (MC will have to vote though)

WG 0: Cross-WG Activities, Showcases

Objectives:

- Bundle **cross-WG activities** in order to ensure their **cohesion**, boost inter-disciplinary collaborations, while avoiding the natural clustering (e.g., the creation of micro-communities per workgroup) within the large network formed by the Action

Activities:

- Monitor possible **duplication of efforts** across WGs
- Be a conduit for **passing information** between Wgs
- Encourage and sponsor **inter-WG visits and presentations**

Deliverables:

- Report of activities (define and measure success of cross-WG activities) (yearly)
- Showcases (Y3 - Y4)

Clear Management plan

Realistic deliverables (MoU = contract)

WG 1 : Foundations - Intra and Inter-Disciplinary Interaction

Objectives:

- Develop MPM foundations for CPS

Activities:

- Characterize/categorize ("**chart**") existing modelling languages (using an appropriate language) used in the different disciplines using typical **industrial CPS scenarios** (see also WG 4)
- Develop an **MPM framework** to relate/combine (unify) modelling languages and techniques
- Apply and mostly combine MPM, Control, Hybrid Systems, ... while dealing with the heterogeneity of CPS, and identifying common formalisms and ontologies used in CPS

Deliverables:

- Report. State-of-the-art report on current formalisms (and processes) used in CPS development:

  1) a structured **catalogue** of tools and modelling languages (Y1, updated yearly)

  2) a **glossary of terms** (domain ontology) to be used throughout CPS (Y2, update yearly)

- Report (yearly). **Framework** to describe (model), relate and combine modelling languages and techniques

Realistic deliverables with their timing (MoU = contract)

WG 2 : Techniques

Objectives:

- Conceptualize usable and efficient **MPM integrated environments for CPS development** while increasing CPS development's productivity (e.g., by means of increased interoperability, and use of visual modelling languages) and reducing the complexity of CPS testing, simulation and certification procedures.

  Secondary objective: CPS **standards** that can be used by Europeans regulators in order to increase performance, security and safety of industrial CPS in Europe, and worldwide.

Activities:

- Investigate **current standards and best practices** (modelling languages, interfaces for interoperability, processes, ...) used in CPS
- Survey s**tate-of-the art on MPM tools and techniques** used in different disciplines for CPS development

  including an efficiency evaluation of MPM tools and techniques on CPS
- Investigate **requirements for future** MPM4CPS modelling tools and techniques

Deliverables:

We did change (refine) one deliverable

- Reports.

  1) current standards and best practices used in CPS, suggest where new standards might be beneficial (Y1, updated yearly)

  2) state-of-the art on MPM tools and techniques used in different disciplines for CPS development including an efficiency evaluation of MPM tools and techniques on CPS (Y3)

  3) suggestions for future MPM4CPS modelling tools and techniques (Y4)

WG 3 : Application Domains

Objectives:

- Investigate p**ractical constraints** in the use of MPM modeling in two representative and **distinct CPS application domains**:
  1) embedded systems, control systems, mechatronics, ... where CPS has emerged from (e.g.,automotive, aeroespatial)
  2) more networked, unanticipated changes (both structure and behaviour) and less of the traditional plant/controller architecture, which may have emergent behaviour (e.g., smart-cities, complex traffic management).
- The **specific needs and priorities of the industry** in these domains have to be taken into account in order to successfully implement the scientific improvements gained by the Action.
  WG3 will work together with **industrial partners** to ensure a bilateral feedback between the scientific and industrial CPS communities.

Activities:

- Definition of **Benchmark Case Studies**
- Assess the **current industrial state of CPS** and CPS modelling at a **national** level
- Collect the **requests and requirements** of each application domain, and rewrite them from a CPS perspective, look for commonalities/differences.
- Assess the **suitability** of the different application domain models from a CPS perspective (e.g., completeness, usability, interoperability with existing tools, etc.)
- Compile **recommendations** on the proper use of different models and methodologies and the reliable assimilation of current application domain models in the perspective of CPS modeling.

Deliverables:

- Benchmark Case Studies (Y1 preliminary, Y3 fully developed)

- Reports.
  1) current industrial state of CPS (Y2)
  2) requirements of each application domain (Y2)
  3) suitability of the different application domain models from a CPS perspective (Y3)
  4) recommendations on the proper use of different models and methodologies (Y4)

WG 4 : CPS Education and Dissemination

Objectives:

- Bring MPM4CPS contents (from WGs 1 – 3) into a **suitable format** for educational and dissemination purposes.

  Targets: academia (students, young/senior researchers), industry, commission

Activities:

- Identify the adequate **profile(s) of CPS experts** (i.e., the minimum required knowledge)
- Identify **existing courses** in the realm of CPS and MPM4CPS in Europe, and the need for new courses on topics relevant to CPS not yet covered by the European Universities
- Lay basis for an **European Master/Phd Program** in MPM4CPS involving several European leading Universities (and companies) and set up the respective discipline roadmap
- Promote **literature** on the topic (books, articles), while defining course material (online, etc)
- Promote and organize thematic **Training/Summer Schools** on MPM4CPS
- Make young students (future researchers and practitioners) aware of and **enthousiastic** about the topic of CPS in events such as a “CPS Hacker School”

Deliverables:

- Reports
  1) profile of CPS expert (Y1)
  2) list of existing MPM4CPS courses, description of needs (Y1, updated yearly)
  3) plan for European Master/Phd Program in MPM4CPS (initially lightweight, via Erasmus) (Y1-Y4)
  4) annotated bibliography, annotated who's who, WG reports, (non-)technical publications (Y2, updated yearly)

- MPM4CPS workshop (yearly)

- MPM4CPS poster, leaflet (Y1)

- www.mpm4cps.eu (beginning of Action, updated regularly)

- Thematic Training/Summer Schools on MPM4CPS (yearly)

- Engaging event such as a “CPS Hacker School” (yearly, from Y3)

Some Actions:
workshops = mini conferences

Publish together (multi-country)

Governance

Management Committee (MC) consists of up to two representatives of each COST Country having accepted the MoU of the Action. MC Members are nominated by the COST National Coordinators (CNC) of the COST Countries they represent. The Action MC decides upon all budget-related questions, devises the general Action strategy and manages the organisation of the Action's scientific and technological activities.
The Chair and Rapporteur of the MC will be responsible for liaison with and reporting to their COST National Co-ordinator and with the Action Scientific Secretary.

Frequency: yearly in-person meeting, co-located with yearly workshop; on-demand teleconference meetings

Note: several of our proposed Action members and some MC members are **Early-Stage Researchers** (ESR)

Core Group (CG) consists of the Chair and a Vice-Chair of the MC and the Leaders of each WGs.

Objectives: **Quality Control**: CG and ultimately the Chair will ensure that the Action is on schedule and that specified WG objectives are met.

Activities: (teleconference) meetings to assess and take action when needed, meet in-person at MC meeting
Frequency: frequent (once per month)

Some actions plan this in detail

Deliverables: reports to MC

Industry Advisory Board is highly relevant, but covered by the large industry participation in this Action
External Experts will be invited to selected workshops and CG/MC/WG meetings

AIRBUS GROUP

SIEMENS
Siemens PLM Software

Editorial Board

Description: During the production of the State-of-Art report, Final Report and Promotional Material (such as a leaflet), an Editorial Board, nominated by MC, will coordinate the work and collect the necessary information from the Working Group members.

Objectives: Preparing documents for Dissemination

Activities: support to WG leaders and MC
Frequency: when needed (depends on frequency of reports etc.)

Deliverables: Newsletter. Leaflet. State-of-Art. Reports.

STSM Selection Committee

Description: Very high priority will be given to Short Term Scientific Missions (STSM) to foster personal contacts between researchers and diverse communities .Highest priority will be given to Early-Stage Researchers (ESR) and female applicants. The STSM Evaluation Committee is nominated by the MC. I will assess the impact of the scientific visits and their output. Calls for proposals will be regularly (twice per year) planned. The CG decides on allocation.

Objectives:Selection of applicants for Short-Term Scientific Missions (STSM).

Activities: Selection of the STSM applicants from the action and reporting to CG/MC
Frequency: when needed (twice per year)

Deliverables: To select STSM applicants

Not easy:

- low funding, long procedure, wait for reimbursement (inclusive?)

- contribute to *your* action

Training Schools Committee

Description: Training/Summer Schools will take, when possible, be organized co-located with the workshops organized by the COST Action. The challenges, concepts, methods, techniques and tools of MPM4CPS will be taught. The intended audience are PhD students, young scientists (including from industry), early-stage researchers (ESR).

Objectives: Organization Training Schools and their programme.

Activities: Prepare Program of TrainingSummer Schools (Lecturers, Trainees, Place, Venue, Location, etc.) and reporting to the MC.
Frequency: when Training/Summer Schools are organized (once per year)

Deliverables: four Training/Summer Schools (one per year)

(Gender/Geographic/Age/Inclusiveness) Balance Committee

Description: the technological and scientific sector is male-dominated. A balanced participation of women and men will be sought.

Objectives: Definition and promotion of gender/inclusiveness balance in all parts of the Action's operation

Activities: Prepare a Plan to promote involvement of Women/participants from inclusiveness groups; active outreach (such as talks)
Frequency: continuous activity; in-person meeting once per year

Deliverables: To increase female/inclusiveness participation rate in the COST Action through new inclusions

Once running:

Progress Report **KPIs**:

- MoU objectives
- MoU deliverables
- Co-authored publications and FP7/H2020 proposals
- Added value of networking
- Extent of networking
- Impacts
- Dissemination and Exploitation
- Action Successes
- Participation balance

Tips and tricks:
E-COST magic, Local Organizer Support (LOS), travel cost, hotel cost, …