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Domain 2 – Area 2

Maintenance, Repair, Re-use

Scientific/Technical goals of the supported area

Methodologies and tools for the sustainable, predictive maintenance of production equipment (FoF.NMP.2012-2)

Innovative strategies for renovation and repair in manufacturing systems (FoF.NMP.2013-8)

Innovative re-use of modular equipment based on integrated factory design (FoF.NMP.2013-2)

Intelligent production machines and 'plug-and-produce' devices for system adaptivity (FoF.NMP.2012-3)

Scientific/Technical goals of the supported area

	Production systems	Customer/Targets
iMAIN	Machine-tools (Forming presses), all other highly loaded mechanical systems	OEM/Users
Power-OM	Machine-tools (milling)	OEM (Machine manufacturer, CNC)
EASE-R³	Machine-tools	OEM
T-REX	M-T, spindles, Robotics, Transport systems (Lift Trucks), Batteries	OEM
SelSus	Manufacturing devices, assembly lines, fixtures	OEM (Maintenance) / Users (Operators)
eFBorn	Machinery, Robotics, in-line manufacturing (AM)	OEM/System integrators and component suppliers
whiteR	White rooms: Robots, effectors, transportation, dna fixturing systems	End users (component manufacturer for laser machines, Manufacturer of solar cells) / OEM
SUPREME	Paper industry	OEM/Users

Current and Expected impact(s) of the supported area

- Increase availability of production systems & OEE.
- Energy consumption reduction (10%)
- Reduction of around 20% of renovation and repair costs
- At the end-of-life stage, contribution towards a 80-100% reuse of production system components in new life cycles
- Cost reduction of around 30% due to re-use of existing modular equipment when setting-up production systems for new product variants
- Renovation of outdated plants and structures. Safe production sites

Synergies and benefits of clustering

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- Projects in this cluster are involve in two FoF cluster initiatives (CSAs):

Cross-cutting issue	*Cluster initiative*
Smart components in manufacturing	Co – FACTOR X Smart Components for tomorrow's industry | FoF projects for Factor X multiplication
Production systems maintenance	FOCUS www.focusonfof.eu

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Synergies and benefits of clustering

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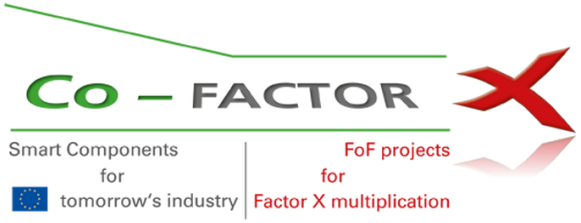

Objectives:

- Leverage individual FoF projects through
  - cross-project **collaboration**
  - alignment of certain activities (technical, promotional)
  - further steps towards industrial up-take of results
- **Exploitation push**: individual results & routes towards results up-take by the community
- Provide more **visibility** as a cluster/community
- Create a large, interdisciplinary, yet thematically focussed network through the "**smart components community**"
- Contribute to shaping future **technology roadmaps**

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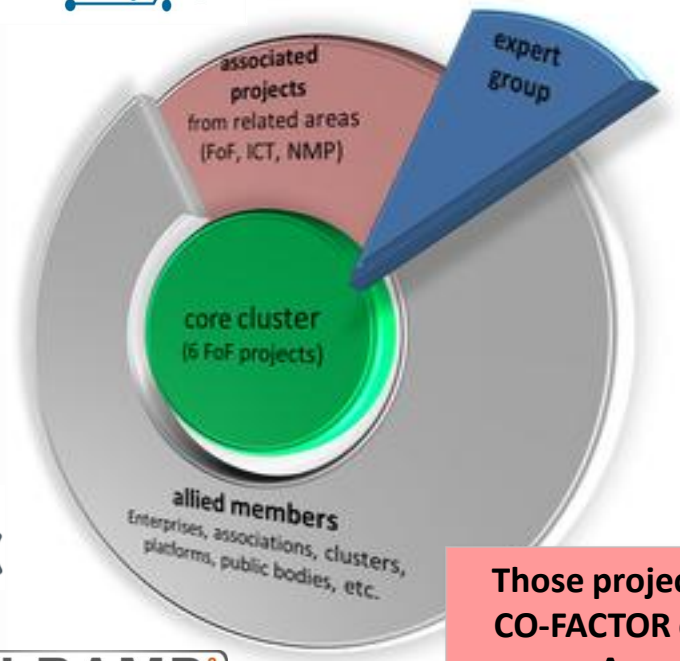
Co – FACTOR
Smart Components for tomorrow's industry | FoF projects for Factor X multiplication

The players:

- Power-OM
- reBorn Innovative Reuse
- T-REX
- SelSus Manufacturing Systems
- iNTEFIX
- I-RAMP³ Intelligent Network Devices for fast Ramp-up



All players are an integral part of the **community**

- Core cluster acts as point of adherence for the community
- Core takes the smart component perspective to observe the FoF field
- no hard borderline between the levels
- Interested players welcome at all levels.

Those projects in this cluster are CO-FACTOR core or support it as Associated Project

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Synergies and benefits of clustering

Factories of the Future
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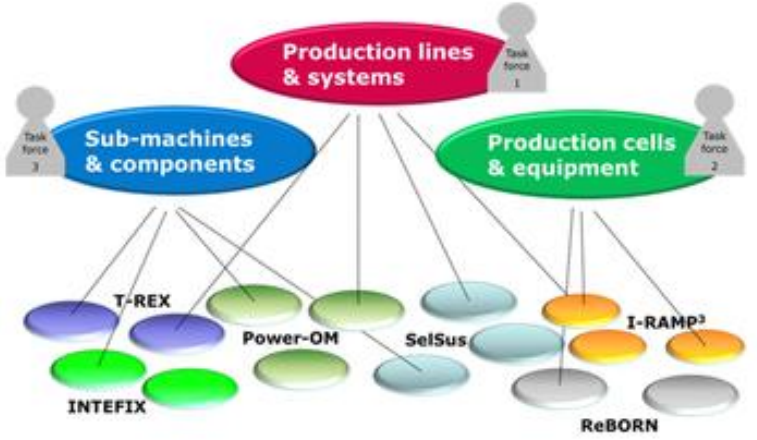
Co – FACTOR
Smart Components for tomorrow's industry | FoF projects for Factor X multiplication

Already done:

- Cluster-building started – interested contributors are being included and approached
- Website on line and first set of publishable material
- Communication started
- 3 Task force running focusing at technical, cross-cutting issues from the projects

- 3 defined application areas
- "Task forces" with strong and concrete thematic focus
- Comprised of professionals coming from the six core group projects
- Main objective: Work as specifically as possible on technological level



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Objectives:

In five existing FoF Clusters we will:

- Provide pro-active support to disseminate the projects' tangible outcomes to support industrial exploitation and take-up within the clusters
- Review the state of the art and formulate future FoF priorities

Building upon these five existing FoF Clusters we will:

- Deliver a model and associated methodology for effective cluster creation, execution and monitoring in future FoF PPP clusters
- Deliver a model and associated methodology for industrial exploitation and take-up of future FoF PPP projects

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The players:

Five existing FoF Clusters with 21 projects

Zero Defect Manufacturing:	Clean Factory:	Robotics:	High Precision Manufacturing:	Maintenance & Support:
IFaCOM	AREUS	UNIPD	Hi-MICRO	iMain
MIDEMMA	EMC2	MIROR	3D-HipMAS	SUPREME
MODPROD	ENEPLAN	CABLEBOT	HiPr	Power-OM
MEGAFIT	REFORM	MAINBOT	SMART-LAM	
		COMET		
		AUTORECN		

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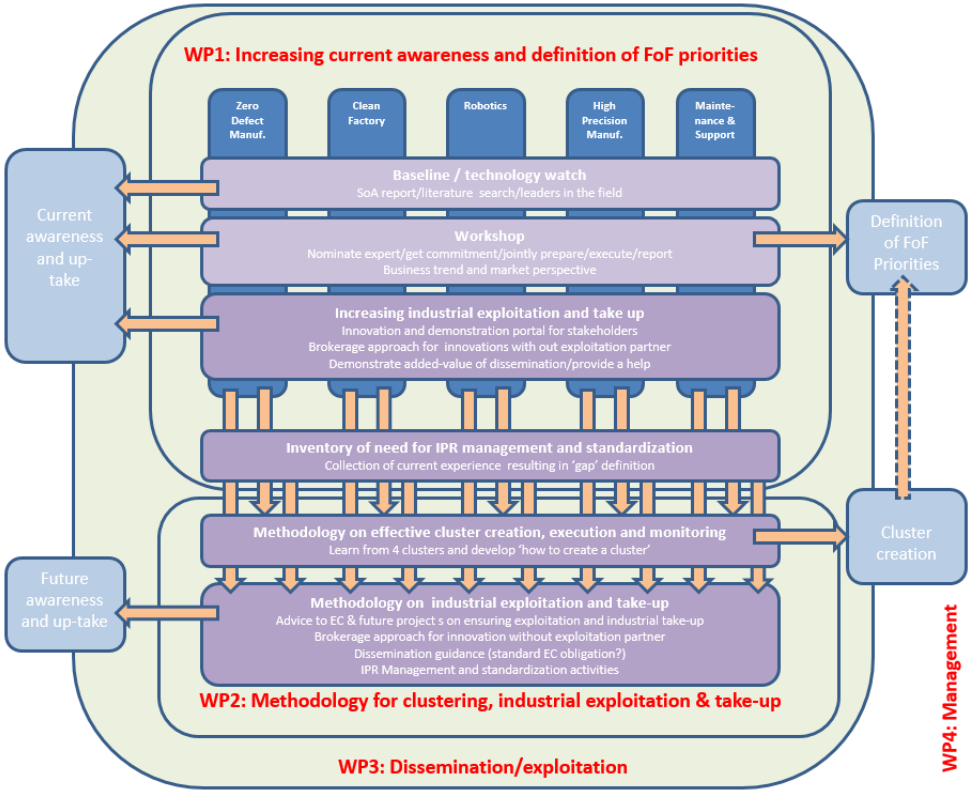
Already done:

- Cluster-building started
- Website and first set of publishable material online
- First quarterly Newsletter published
- Presentation at Hannover Messe



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Technical cross-cutting issues

- What technical cross-cutting issues should be addressed in cooperation with other projects in order to increase the overall impact?

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Smart Components

	Embedded inteligence-CbM	M2M, eMaintenance cloud, Remote services	Communication, interoperability
iMAIN	"Virtual sensor"; Fatigue hypotheses, failure accumulation (frames) CbM (bearings, guidings); production planning (PP)	Cloud data storage and load history; monitoring and prediction services; also mobiles; cloud is also open to third parties	OSA-CbM, OPC-UA
Power-OM	CbM (current consumption, CNC signals) applied to: Machines, LiftTrucks, Robots	Reliability, Operation, Maintenance	OSA-CbM, OPC-UA
EASE-R3	CbM (current consumption, CNC signals) applied to Machine-Tools	Selection the best maintenance strategy and policy (renovation, repair or re-use). Augmented Reality (AR) and Virtual Reality (VR) for maintenance	Component's interfaces
T-REX	CbM (current consumption, CNC signals) applied to: Machines, LiftTrucks, Robots	Equipments connected to the cloud, O&M, Re-novation	OSA-CbM, OPC-UA
SelSus	Distributed diagnostic and predictive repair and renovation models, embedded into smart devices incl degradation model	Synergetic relationship with operators and maintenance personnel based on pro-active communication, Augmented Reality (AR), Sensor Cloud	OPC-UA
eFBorn	Condition monitoring, device self-description, optimization model	-	Component's interfaces
white'R	Included in every P&P module integrated in the white'R island	Monitoring software for: -Robot reliability and accuracy -Module re-use over time -Maintenance -Quality of service of modules -Module lifecycle tracking	Component's interfaces
SUPREME	CbM (current consumption, vibration analysis, acoustic emission)	-	Component's interfaces ISO/TC 108/SC5 «Condition monitoring and diagnostics of machines»

Patents – IPR

- One patent under consideration (there could be a conflict with an existing one):
  - (Power-OM) Machine Tool fingerprint concept and its application for health assesment.

Standardisation aspects

- Cooperation with CEN TC 319 “TC Maintenance”

  Chair: Mr. Franchesco Santini Secretary: Mr. Roberto Ravaglia

  T-REX has sign a “Liaison agreement” in October 2014

  Participation in three meetings:

  1. Meeting of the Convenors and Secretaries of CEN/TC 319 Working Groups. Milano, 16th June, 2014
  2. Plenary Meeting of CEN/TC 319. Lugano, 20th October, 2014
  3. Meeting Working Group 13 - Maintenance process. Eppelheim, 9-10th March, 2015

CEN/TC 319/WG 3	**Maintenance agreements**
CEN/TC 319/WG 8	**Maintenance management**
CEN/TC 319/WG 10	**Maintenance within physical asset management**
CEN/TC 319/WG 11	**Condition assessment methodologies**
CEN/TC 319/WG 13	**Maintenance process**

Standardisation aspects

- CWA (CEN/CENELEC Workshop Agreement):
  - EASE-R3 is working in the preparation of the required documents for a CWA in “Reliability of machine tools based on life data analysis”. Next: CEN Workshop open to any interested party.
  - DIN involved in this process, as participant in EASE-R3.

    (contact Christine Fuss: Christine.Fuss@din.de)

- ReBorn: Interoperability issues with existing standards OPC-UA; planned approach on standardization from smart components perspective as planned in Co-FACTOR; observing of IEC/SG 8 „Industry 4.0 – Smart Manufacturing“