ECHORD++

The European Coordination Hub for Open Robotics Development

4rth Review Meeting – WP3
Experiments Outcome and Exploitation

Yannick Morel, TUM

Luxembourg – 2018-02-21

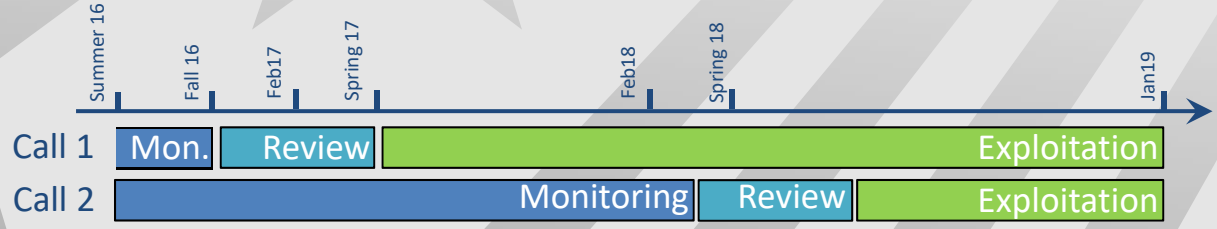
Bristol Robotics Laboratory

RUROBOTS
Cognitive Science at Work

Timing and Schedule WP3

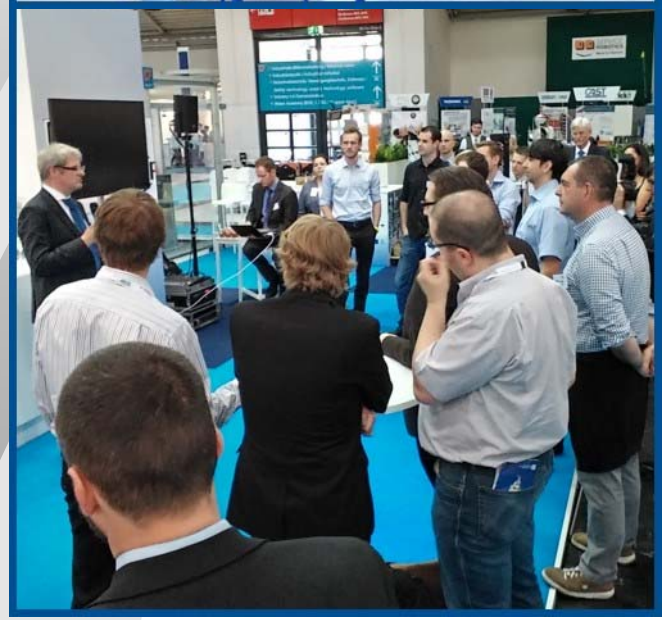
Timing of respective calls

- **Call 1** ended at around the end of RP3, reviews conducted from Summer 2016 to Spring 2017,
- **Call 2** began June16/Sept16, expected to end Nov17/Feb18,
- Significant number of **extensions** in Call 2 (10 requests as of today),
- **Call 2** Experiments to **conclude** by this June18.



Current situation

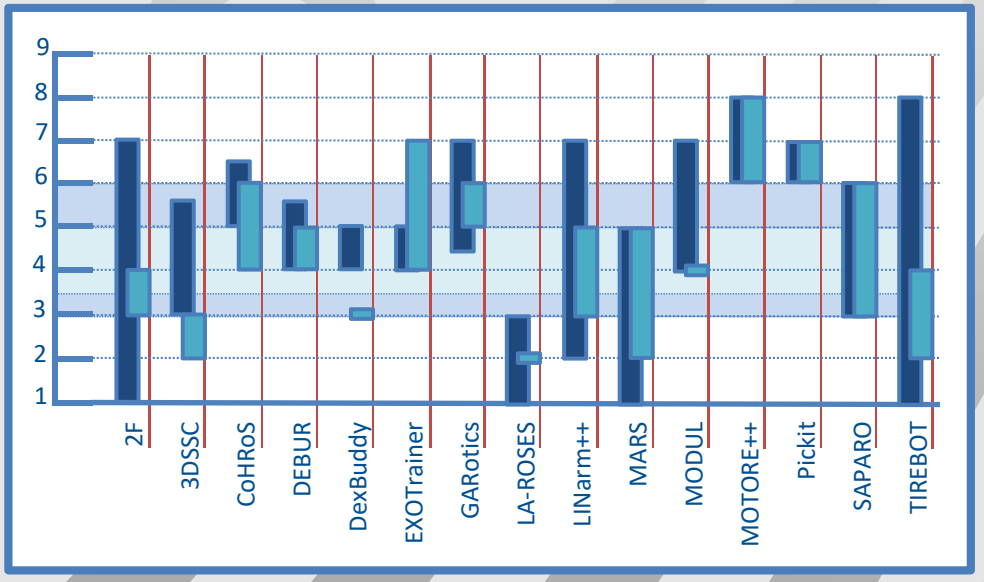
- **Call 2** Experiments finishing, first reviews happening,
- **Call 1** has been concluded for about a year.



Increase in Technology Maturity

TRL Evaluation

- **Call 1 self-evaluation**, intended to be only indicative of what Experimenters felt, not actual estimate,
- **TRL Workshop**, recruited a group of three experts in robotics, including Call 1 reviewers and one expert from contemporary TT Project: ROBOTTT-NET.
- **Outcome / evaluation**:



Technische Universität München · Lehrstuhl für Robotik und Echtzeitsysteme
Boltzmannstr. 3, 85748 Garching

Fakultät für Informatik
Lehrstuhl für Robotik und Echtzeitsysteme

ECHORD++ Call 1 Experiments Technology Readiness Level (TRL)
Evaluation result summary

Room 1.A.01
Volkswagen Data:Lab
Urgererstr. 69, 80805 München

30/01/2018

Experiment	Start TRL	End TRL	Comments
2F	3	4	
3DSSC	2	3	
CoHRoS	4	6	
DEBUR	4	5	
DexBuddy	3	3	
EXOTrainer	4	7	
GARotics	5	6	
LA-ROSES	2	2	
LINarm++	3	5	
MARS	2	5	
MODUL	4	4	
MOTORE++	6	8	
Pickit	6	7	
SAPARO	3	6	
TIREBOT	2	4	

The undersigned certify that the TRLs reported above reflect the consensus reached on the day between the contracted externa evaluators.

A. Müller – External Expert

P. van der Smagt – External Expert

M.-L. Nietz – Project Manager

T. Zimmermann – External Expert

Y. Morel – Project Manager

Call 1 Outcome

From Lab to Market

- **Product sales:** Over **€1mil** over 2017 for Call 1, rather top-heavy,
- **Sales vs Investment**: €4.5Mil of budget for Call 1, but only a fraction of total investments,
- **Expectation of growth**: Existing turnover to develop, additional Experiments reaching market.

Of the Nature of Success

- **Complicated situation:** No two Experiments alike,
- **Being in business:** Clearest metric of success is sales, six Experiments on the market by end of 2018.
- **Technology transfer:** Outcome of RTD work incorporated within the industrial partner products/processes,
- **Follow-up support:** Securing additional funding to build upon achievements in E++.

Experiments Instrument Outcome

MODUL: TT to Start-up, Focused Product

- **What:** Call 1 Experiment, developed new version of quadruped robot and actuators,
- **Impact:**
  - Created spin-off **ANYbotics** in Sept. 2016,
  - Currently **16 jobs**,
  - Selling Series Elastic Actuators (SEAs, **ANYdrive**) and quadrupeds (**ANYmal**),
  - **€1Mil** turnover in 2017.
- **Upcoming:** Work on product qualification supported by E++ Booster.

"The ECHORD++ project was the starting point for our business".

Experiments Instrument Outcome

MARS: TT to Big Business, on the Market in 2018

- **What:** Call 1 Experiment, developed unmanned ground vehicles for precision agriculture,
- **Impact:**
  - Industrial partner, **Fendt-AGCO**, took over Technological development
  - Project developed internally, **3 full-time positions**,
  - In-the-field **pilot testing** in Spring 2018 with potential customers,
  - **Industrialisation** later in the year.
- **Perspective:** Scalability allows wide target audience, from large industrial exploitations to small farms.

Experiments Instrument Outcome

EXOTrainer: Reaching Market (in HC) is Challenging

- **What:** Call 1 Experiment, developed new prototype of exoskeleton **Atlas 2020/2030** for SMA patients,
- **Impact:**
  - Performed **clinical trials** for acceptability during the Experiment‘s run-time,
  - Secured H2020 **SME Instrument** Phase 2,
  - First exoskeleton delivered to Sant Joan de Déu Childens Hospital (Barcelona), 29/11/2017.
  - Targeting **market introduction** in Germany, Sweden, Denmark.
- **Upcoming:** Receiving support for penetration of German market from the E++ Booster.

Experiments Instrument Outcome

MOTORE++: On the Market since 2017

Call 1 Experiment, **physical rehabilitation** device for upper limbs,

- **Clinical trials** and **CE marking** achieved within the Experiment's run-time,
- Device being **commercialized** by SME partner,
- **€220K** turnover in 2017.

TIREBOT: Successful TT, Difficult to Track

Call 1 Experiment, mobile robot assisting tire-change operations,

- Industrial partner **Corghi** transferred technology to **HPA**,
- System prototyped in the Experiment in use in **automotive factory**,

"Our starting point was the work done in ECHORD++"

Experiments Instrument Outcome

HyQ-REAL: Consolidating Collaborations

- **What**: Call 2, **quadruped robot**, hydraulic Intelligent Servo Actuator (**ISA**),
- **Impact:**
  - Validating the **Moog-IIT partnership** in mobile robotics,
  - Providing **structure** framing RTD process,
  - Selling Intelligent Servo Actuator (**ISA**, Moog), quadrupeds (**HyQ-MAX**),
  - Secure **follow-up** support on strength of work conducted in E++.
- **Upcoming:** Two nationally funded ressearch projects building upon achievements in E++.

"ECHORD++ motivated a decisive step forward in our RTD process".

Experiments Instrument Outcome

SAGA: Focused Product, Making Sales

Call 2 Experiment, **drones** for **precision agriculture**, computation and sensing platform for mobile robotics.

- **Successful TT**, academia to Avular (SME),
- Development of **Curiosity** platform,
- **Booster**: Redefinition of **business plan**, support for customer engagement,

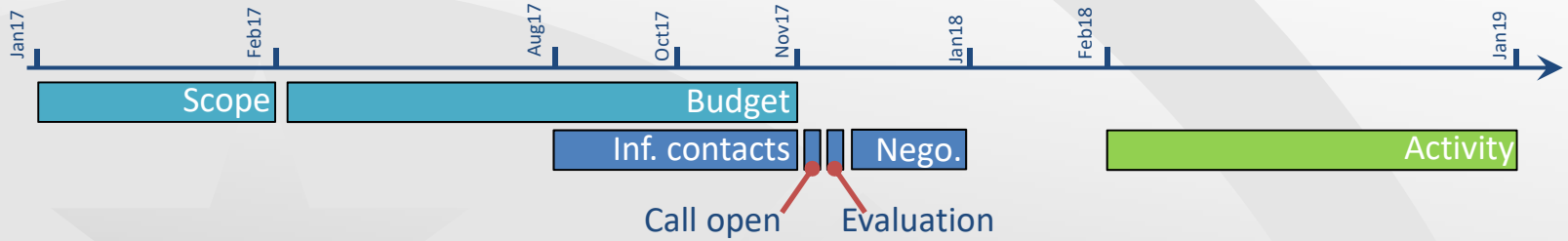
SAFERUN: Focused Ambition, Successful TT

Call 2 Experiment, software (**velocity planner**) for Laser Guided Vehicles (LGVs),

- The **right scope**, measured technical ambition, great E++ fit,
- **Successful TT,** software included within the product of the industrial partner (Elettric80),
- Direct and positive **impact on processes** of the industrial partner.

Booster Programme

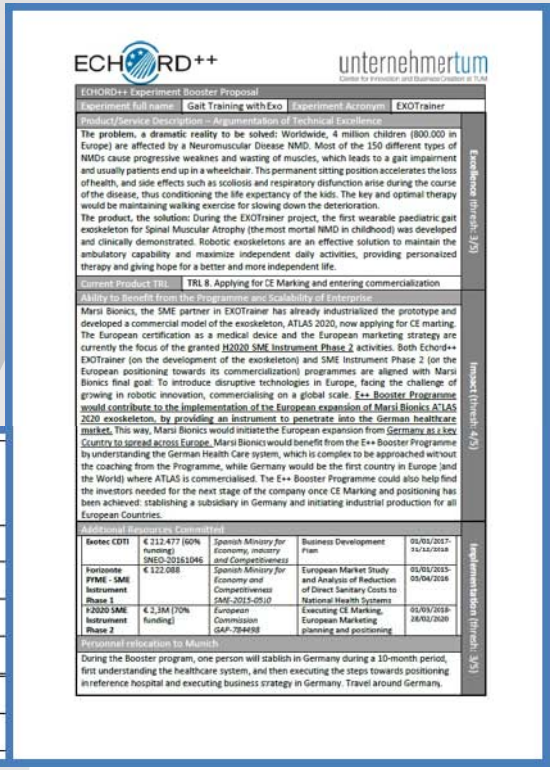
Timing & Process



- **Jan-Nov17:** Scope definition and solving of implementation-related issues,
- **Summer:** Informal communication with Experiments, expression of interest from five Exps,
- **7-15 Nov17**: Call open,
- **17 Nov17**: Results communciated to applicants.

Evaluation

Experiment	Partner	Call	Evaluation			Avg.	Location
			Excellence	Impact	Implem.		
EXOTrainer	Marsi Bionics	1	4.25	4	5	**4.4**	Munich
MODUL	ETH	1	4.25	4.25	4.5	**4.3**	Zurich
SAGA	Avular	2	4	4.25	4	**4.1**	Eindhoven
LINarm++	CNR	1	3	4	3.75	**3.6**	Munich
3DSSC	FRS	1	3.5	3	2.25	**2.9**	Heverlee
HOMEREHAB	UMH	2	3	2.75	2	**2.6**	Elche


ECHORD++ unternehmertum

ECHORD++ Experiment Booster Proposal

Experiment full name: Gait Training with Exo | Experiment Acronym: EXOTrainer

Project Concept Description - Argumentation of Technical Excellence

The problem, a dramatic reality to be solved: Worldwide, 4 million children (800.000 in Europe) are affected by a Neuromuscular Disease NMD. Most of the 150 different types of NMDs cause progressive weaknes and wasting of muscles, which leads to a gait impairment and usually patients end up in a wheelchair. This permanent sitting position accelerates the loss of health, and side effects such as scoliosis and respiratory disfunction arise during the course of the disease, thus conditioning the life expectancy of the kids. The key and optimal therapy would be maintaining walking exercise for slowing down the deterioration.

The product, the solution: During the EXOTrainer project, the first wearable paediatric gait exoskeleton for Spinal Muscular Atrophy (the most mortal NMD in childhood) was developed and clinically demonstrated. Robotic exoskeletons are an effective solution to maintain the ambulatory capability and maximize independent daily activities, providing personalized therapy and giving hope for a better and more independent life.

Current Product TRL: TRL 8. Applying for CE Marking and entering commercialization

Ability to Benefit from the Programme and Scalability of Enterprise

Marsi Bionics, the SME partner in EXOTrainer has already industrialized the prototype and developed a commercial model of the exoskeleton, ATLAS 2020, now applying for CE marting. The European certification as a medical device and the European marketing strategy are currently the focus of the granted H2020 SME Instrument Phase 2 activities. Both Echord++ EXOTrainer (on the development of the exoskeleton) and SME Instrument Phase 2 (on the European positioning towards its commercialization) programmes are aligned with Marsi Bionics final goal: To introduce disruptive technologies in Europe, facing the challenge of growing in robotic innovation, commercialising on a global scale. E++ Booster Programme would contribute to the implementation of the European expansion of Marsi Bionics ATLAS 2020 exoskeleton, by providing an instrument to penetrate into the German healthcare market. This way, Marsi Bionics would initiate the European expansion from Germany as a key Country to spread across Europe. Marsi Bionics would benefit from the E++ Booster Programme by understanding the German Health Care system, which is complex to be approached without the coaching from the Programme, while Germany would be the first country in Europe (and the World) where ATLAS is commercialised. The E++ Booster Programme could also help find the investors needed for the next stage of the company once CE Marking and positioning has been achieved: stablishing a subsidiary in Germany and initiating industrial production for all European Countries.

Additional Resources Committed

Exotec CDTI	€ 212.477 (60% funding) SNEO-20161046	Spanish Ministry for Economy, Industry and Competitiveness	Business Development Plan	01/01/2017-31/12/2018
Horizonte PYME - SME Instrument Phase 1	€ 122.088	Spanish Ministry for Economy and Competitiveness SME-2015-0510	European Market Study and Analysis of Reduction of Direct Sanitary Costs to National Health Systems	01/01/2015-05/04/2016
H2020 SME Instrument Phase 2	€ 2.3M (70% funding)	European Commission GAP-784988	Executing CE Marking, European Marketing planning and positioning	01/03/2018-28/02/2020

Personnel relocation to Munich

During the Booster program, one person will stablish in Germany during a 10-month period, first understanding the healthcare system, and then executing the steps towards positioning in reference hospital and executing business strategy in Germany. Travel around Germany.

Excellence (thresh: 3/5) Impact (thresh: 4/5) Implementation (thresh: 3/5)

Booster Programme

EXOTrainer – Marsi Bionics

One person, 10 months in Munich, **penetration of German healthcare market**, suported by UnternehmerTUM (UTUM).

MODUL - ETH

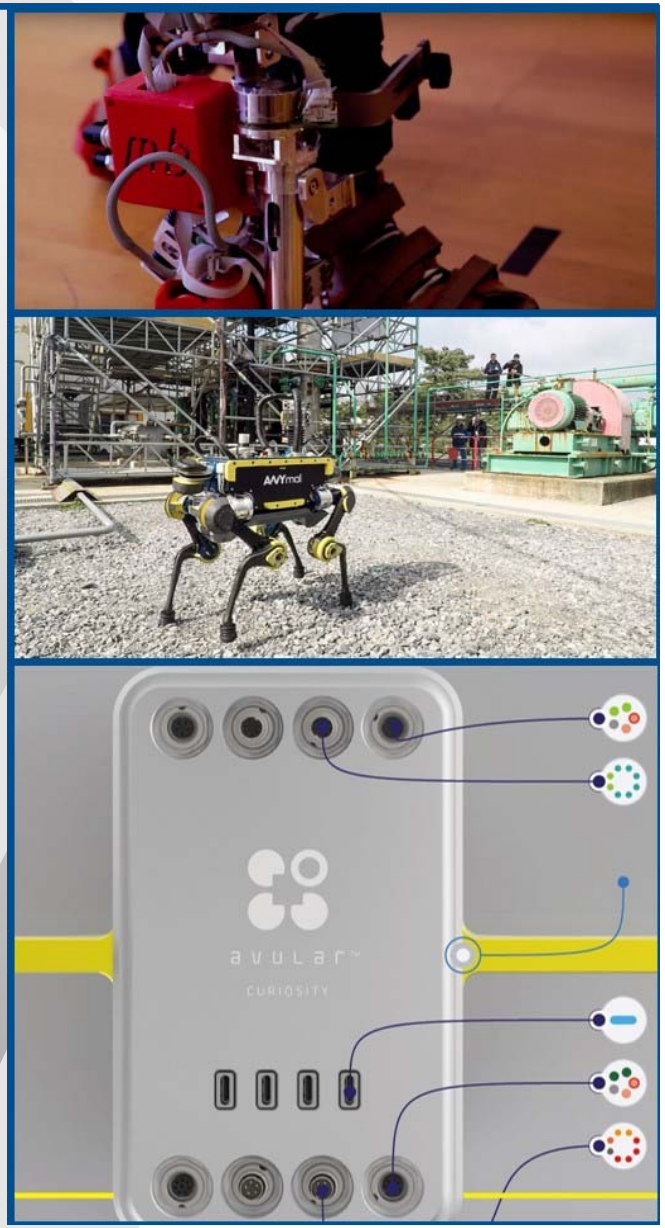
Pre-industrialisation, documentation, **qualification** of SEA (TRL7 to TRL8), in Zurich.

LINarm++ - CNR

Change of course, from rehabilitation robotics to VSA, **XPRENEUR** programme (UTUM), coaching and mentoring (5 months in Munich).

SAGA - Avular

Change of course, from drones to computing/navigation units, re-definition of **business plan** (Eindhoven), engagement of potential customers.



Concluding Remarks

From Call 1, six out of fifteen Experiments will have reached market by the end of 2018 (40%).

Remains an evolving picture, materialization of impact takes time, yet products already coming out of Call 2.

The ECHORD Plus Plus Consortium acknowledges support by the European Commission under FP7 contract 601116.

Technology Maturity

Insights from TRL Evaluation

- **FSTP expectations:** Increase in Maturity Level of about 1.5 over 18 month, 300K€,
- **Maturity Level going in**: Over half the selected Experiments started at TRL 3 or lower,
- **Outcome**: 3 Experiments at end-TRL 7 and above.

A Matter of Perspective

- **TRL scale:** The least bad tool to measure progress, requires context (ambition level, application area),
- **Target product:** The evaluation was performed for the declared Experiment‘s product,
- **TRL training:** Perspective of developing educational workshop on TRL assessment.