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Comprehensive Modelling for Advanced Systems of Systems

C O M P A S S

COMPASS Interest Group Challenge Problem Workshop

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Abstract

This deliverable provides a summary of the COMPASS Interest Group Challenge Problem workshop, which took place in London, UK on 16 September 2014. The deliverable includes a summary of presentations, points raised in discussion and future plans for the Interest Group.

The workshop focussed on reporting the outcome of work on the two COMPASS Challenge Problems. These problems are the Smart Grid Energy Management case study, proposed by COMPASS Interest Group (CIG) member Grid Manager, and the Traffic Management case study, proposed by CIG member West Consulting.

In addition, the workshop provided an opportunity for CIG members to provide feedback on the COMPASS Roadmapping activity, and to see a short summary of the latest developments in the Symphony tool suite. Finally, attendees were given an opportunity to provide feedback on their experience with the CIG and to show expression of interest in following post-COMPASS activities with the proposed new COMPASS Advisory Board (or “COMPASS Club”).

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1 Introduction

This deliverable summarises the COMPASS “Challenge Problem” workshop, which took place in London, UK on 16 September 2014. The workshop focussed on reporting the outcome of work on the two COMPASS Challenge Problems, as well as the providing an opportunity for CIG members to provide feedback on the COMPASS Roadmapping activity, and to see a short summary of the latest developments in the Symphony tool suite. Attendees were also given an opportunity to feed back on their experience with the COMPASS Interest Group and to show expression of interest in following post-COMPASS activities with the COMPASS Advisory Board.

Currently there are 22 members of the COMPASS Interest Group (CIG), consisting of 11 from the United Kingdom, 7 from mainland Europe and others from Japan, US and Brazil. Previous CIG meetings have been held in Bristol, UK and Schiphol, Amsterdam, The Netherlands. London was selected for the location of the final CIG workshop, to make it most accessible to UK and European attendees. The COMPASS Summer School, which is reported in D51.8, was held in the same location on two days immediately following the CIG workshop.

The CIG workshop was attended by representatives of Altran, University of Warwick Manufacturing Group, Airbus Space and Defence, Jaguar Land Rover, West Consulting, Rolls Royce and Test and Verification Solutions Limited. The majority of attendees stayed on for the COMPASS Summer School.

At the request of some CIG members who were not able to attend, talks at the CIG workshop were recorded to be made available to CIG members following the event. All attendees also received a USB pen drive with copies of presentations, videos and the most recent release of the Symphony tools.

The document is structured as follows. Section 2 gives a summary of the content of talks presented at the workshop and discussion points which were raised. Section 3 concludes the report. The full list of attendees is presented in Appendix A.

2 Workshop content

The following is a summary of the talks presented at the Workshop.

- Welcome and Introductions – Steve Riddle, Newcastle University

This talk presented a general introduction to the Challenge Problems and the process that was used to select them (as reported in Deliverable D43.1).

- COMPASS Roadmapping – Claire Ingram, Newcastle University

Claire presented a summary of Deliverable D11.4, *Roadmap for Research in Model-Based SoS Engineering*. The summary included the result of the roadmapping activity, presenting the major product features recommended for future research:

- Verification of emergent behaviour
- Accessible formal analysis
- Cross disciplinary analysis
- Architectural guidelines
- Fault tolerance and dependability
- Dynamic reconfiguration
- Process mobility
- Security
- Performance Optimisation
- Stochastic modelling
- Evolution

For each product, the relevant enabling technologies were reviewed and presented. Discussion points and feedback included the role of non-functional requirements and relation to model-based software engineering.

- Challenge Problems (1): Energy Management – Peter Gorm Larsen, Aarhus University

Peter Gorm Larsen presented the challenges of Energy Management: the need to provide energy production at a higher level than energy consumption, and to cope with fluctuations in both supply and demand. A Smart Grid is intended to address this using a flexible, self-healing network of servers, gateways, agents and meters. A top-level CML model for the topology was presented, together with a model of the

Grid manager process and actions for agents, gateway, meters, server and devices.

Experience drawn from the modelling process included a number of idioms such as use of invariants to represent contracts, having no shared state, and using timeouts to synchronise time. Ongoing work includes making a pure functional model and conduct model-checking, using FDR, after translating the model to CSP-M.

Discussion points for this talk included choice of language and tools - for example, the need to use CML rather than Simulink (which would not be able to model collaborative development between owners of Constituent Systems) - and the need to select appropriate technology (when to use a theorem prover, and when to use a model-checker).

- Challenge Problems (2): Traffic Management – Claire Ingram, Newcastle University

Claire Ingram summarised the Traffic Management Challenge problem, proposed by West Consulting. The main aspect of traffic management being modelled is a Ramp Meter System (RMS), which controls access to major routes to reduce congestion, by varying its behaviour based on traffic loads. A key challenge in the modelling was to analyse faults which could be introduced by constituent systems but require a recovery process at the SoS level. The Fault Modelling Architectural Framework (FMAF) was reviewed here, and illustrated using some scenarios from the case study. Integration of new constituent systems was also analysed using the COMPASS Integration Framework (CIF).

Discussion following this talk raised questions about the code generation status (SysML to CML), the modelling of faults, errors and failures in CML and the potential future development of contracts to explicitly model fault tolerance.

- Technology and Processes – Peter Gorm Larsen (Aarhus University), Jan Peleska (University of Bremen)

The presentations for the afternoon were concluded with a review of the Symphony tool and video demonstrations of distributed simulation and model-based testing with Symphony, RT-Tester and Artisan Studio. This was complemented by a presentation and demonstration of how co-simulation was used for the Home Automation case study by Klaus Kristensen, Bang & Olufsen.

- Final discussion

The day concluded with an introduction to the proposed COMPASS Advisory Board, and CIG members were invited to express interest in joining it. A general discussion about future directions and ways to manage and mature the research and tools included the following points:

- CML comes across as complex for industrial use - could it be simplified to make it more suitable? Rather than limit the language, users should be guided to use those parts that are applicable to their domain, through the use of domain specific profiles.
- Who will take CML and Symphony tools forward? Since the tool is built on Overture, which has a language board to control its development, Symphony and CML can potentially be included in this framework. Academic partners will continue to apply for research funding to develop the approach further, but companies are also welcome to contribute funding to propose developments for specific application areas.
- Standardisation of the CML language. While the project partners are, for the present time, not seeking to standardise the language, it can be a useful process in future as the language matures in order to help to grow the community.
- The role of the COMPASS Advisory Board (or “COMPASS Club” as proposed by one CIG member) would include regular meetings to develop a strategy for funding further research development, as directed by the roadmapping activity presented earlier. Interactions with INCOSE (both in UK and internationally through the SoS Working Group) should continue, and links with the MBSA (Model Based Safety Assessment) community developed.

3 Conclusion

The Challenge Problem Workshop succeeded in its main goal of presenting the results from the two Challenge Problems analysed in COMPASS. With good attendance from a range of CIG members the workshop also succeeded in presenting the state of the art in SoS methods and tools and receiving feedback on the roadmapping activity and future directions for maturing the Symphony tool suite and the CML language.

Following the close of the meeting, a two-day Summer School was held. This Summer School is summarised in deliverable D51.8.

A List of attendees

Table 1 lists the attendees at the workshop.

| Name | Company | CIG member |
|-------------------|---|-------------------|
| Robert Hooper | Altran | CIG |
| Vijay Pasupuleti | University of Warwick Manufacturing Group | CIG |
| Gunwant Dhadyalla | University of Warwick Manufacturing Group | CIG |
| Robert Sharples | Airbus Space and Defence | CIG |
| Gireesh Krishnan | Jaguar Land Rover | CIG |
| Nico Plat | West Consulting | CIG |
| Dave Banham | Rolls Royce | CIG |
| David Blore | Airbus Space and Defence | CIG |
| Jim Thomas | Test and Verification Solutions | CIG |
| John Fitzgerald | Newcastle University | |
| Maria Arias | Newcastle University | |
| Steve Riddle | Newcastle University | |
| Mark Jackson | Newcastle University | |
| Martin Mansfield | Newcastle University | |
| Claire Ingram | Newcastle University | |
| Peter Gorm Larsen | Aarhus University | |
| Jan Peleska | University of Bremen | |
| Uwe Schulze | University of Bremen | |
| Weng-ling Huang | University of Bremen | |
| Samuel Canham | University of York | |
| Adrian Larkham | Atego | |
| Klaus Kristensen | Bang & Olufsen | |

Table 1: CIG Workshop Attendees