PRIORITY 2

INFORMATION SOCIETY TECHNOLOGIES (IST)

REVIEW REPORT

51136 HYCON

Project full title: **HYbrid CONtrol: Taming Heterogeneity and Complexity of Networked Embedded Systems**

Review no. 4 covering project month 13 to 24

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1 EXECUTIVE SUMMARY

The HYCON project is a Network of Excellence (NoE), funded for a duration of four years starting on 15th of September 2004. The total EC contribution is 4.6 M€, with the second reporting period accounting for 1.3 M€.

The fourth review is contractual verification of the project achievements after two years have past. It is addressing the progress of work, the extent to which the recommendations have been followed as well as the negotiation of the up-date of the JPA for m25-m42. The topics include all work packages. The period under review covers months 13 to 24.

The overall objective of HYCON is to integrate European research in "hybrid" control (i.e., systems & models with discrete and continuous aspects). This objective is structured into scientific and technological **integration** (coordinating fragmented European research & developing a research infrastructure), achievement of a **durable integration** mechanism through the establishment of a sustainable European Institute of Hybrid Systems, and overall spreading of excellence.

Major achievements of this period are:

- Legal decisions taken on the EIHS (Re-branded the European Embedded Control Institute EECI) and implemented. EECI about to start operation.
- Major progress on tool repository, tool interoperability – ongoing (WP3)
- The increase of work in the application areas of WP4x
  * WP4a provided large amount of research results
  * WP4d has not sufficiently improved in focus, range of case studies too broad, however, individual research results of high quality
- The creation of a hybrid control taxonomy, annotated bibliography now online (WP5)
- Lund workshop to gather feedback on industrial interest.
- Dissemination activities continued to run extremely well.

The overall conclusions of the review meeting are summarized in the following:

- The project is progressing well at both a technical and integration level.
- A follow-up meeting has been agreed on for reviewing the project management report and the up-date of the JPA for m25-m42.
- From the technical point of view, the reviewers support the continuation of HYCON, assuming the project fulfils its contractual obligations and submits the up-dated JPA before December 15, 2006.

2 ORGANISATION AND LOGISTICS

The review was held at the premises of the ETH in Zurich. All partners required for this third review meeting were present.

The presentations were of good quality and enough time has been devoted to the achievements of each work package. The copy of the review slides have been distributed prior to the meeting. The main organisational issues to be raised are related to the fact that the management did not inform the experts about the status of the deliverables in time. Neither were deliverables sent nor were

the experts informed which deliverables were ready for download. For the next review meeting, this should be clearly communicated in time to the experts two weeks before the review meeting.

In addition, the project management report and the project progress report were not ready or incomplete which led to another meeting on 23 October 2006. Bearing in mind the recommendations of the last review, the key issue being focused on was how well *integration work* was progressing. The major part of the presentations has focused convincingly on this particular issue.

In the beginning of day 2, the main conclusions of the reviewers were presented for a brief discussion with the consortium. Hereafter, the proposed update of the JPA has been thoroughly discussed which led to major agreement on the proposed activities at the end of the meeting, all of which need to be implemented in the following draft of the JPA due for 10 days before the envisaged follow-up meeting.

3 PROJECT MANAGEMENT

The project management is carried out by Dr Francoise Lamnabhi-Lagarrigue from CNRS. As in previous review, project management is of demonstrably good quality. It has achieved an increasing level of communication and cooperation between the partners which seems a good basis to further implement the integration research expected from a NoE. A valuable and significant effort has been spent by the project management in the last year to establish the foundation of the EECI and set out the legal framework. The EECI that is largely supported by University of Aquila, CNRS, and SUPELEC is now operational at two sites, i.e. Paris and Aquila.

Some certain progress in cooperation and strengthening the link to industry has been achieved through the organisation of the Lund workshop 2006.

Some further important issues to mention are that

- Responsibility for the final delivery of the updated Description of Work lies with the project manager, and this issue has to be tackled with high priority.
- Student mobility and teaching activities have benefited, like in the first year, from synergies with the Marie-Curie programme.
- The Scientific Committee has been extended by John S. Baras, David J. Hill, Ravi Banavar, Daizhan Cheng, and Tielong Shen.
- The project manager has assumed the role of the EECI institute manager intended to promote the leading role of the EECI institute in the hybrid control community. In addition, the manager is responsible to preserve a vital link between the two sites in Paris and Aquila.

- The consortium has established a solid cooperation with some US universities (using recent NSF-IST collaboration meetings) and other European initiatives, such as ARTIST2. The link with Artemis, however, and the participation of HYCON partners in several ARTEMIS meetings is not documented. Despite this remarkable progress, the project management should continue to encourage the application domains to document the usage of the HYCON toolboxes and to strengthen the commitment of the industrial partners as members of the IAB in the HYCON network to increase visibility and awareness of the new institution (Rec.1; Rec.2).

From the previous reviews 2 & 3, the following list highlights the status of the recommendations.

- **Review 2 - Recommendation 2 – status ok and on-going**: Major (legal) decisions for the institute EECI have been taken and implemented. Defining the role, purpose, and the 'selling position' of the EECI beyond the HYCON project duration remains to be the challenge for the future. In particular, how to fill the separation between Paris and Aquila with life and turn it into a fruitful form of organization will have to be worked out by the consortium (Rec.1).
- **Review 2 Recommendation 5 – status ok and on-going:** The consortium has prepared a booklet in which the requested mapping of tools to case studies has been addressed in detail in a useful form of presentation. Monitoring of the portfolio of tools, the status and their application to case studies remains a continuous task (Rec.3).
- **Review 2 – Recommendation 8** – status ok and on-going: The documentation for the automotive workshop is useful and to be provided for the Lund workshop. This should, obviously, be continued for future workshops.
- **Review 2 - Recommendation 7 – status ok and on-going:** Milestones for the most part have been documented by short notes that are accessible via the web page. The consortium should make sure that the list is kept up-to date, complete, and in fact accessible (see Rec.7).
- **Review 2 - Recommendation 8 – status ok and on-going:** the clarification of the problem under review for WP4.d. was provided at the mid-term review. However, progress and focus in that part of work package 4 did not become clear during the review. Neither the integration issue between partners and activities has been properly addressed nor the cohesion between them had been improved. Also, the requested clarification on the integration with the other HYCON workpackages, studying and applying e.g. the application of hybrid tools to derive new solutions for the focused problems, remained outstanding. As a consequence, the work plan for WP4.d has been considerably restructured during the review and the updated status will be reviewed at the M36 review.
- **Review 2 – Recommendation 9** – status ok and on-going: The HYCON visibility has improved, but still seems to be focused on the “control” communities. At the current point in time, the status is acceptable; for the future, improvements still seem possible. Activities like the Hycon-NEWCOM collaboratively organized conference sessions are appreciated and highly encouraged (Rec.11)
- **Review 2 - Recommendation 11 – status ok** The consortium invested a significant effort in enlarging the scientific council with international recognized experts from U.S., India, Japan, Australia, China achieving greater global balance.
- **Review 2 - Recommendation 12 – status ok and on-going:** the level of tool integration and integration issue has been greatly addressed throughout the different work packages. The link of the case studies as analyzed in WP4x has been convincingly explained. The consortium is encouraged to progress after the first steps and put emphasis on issues and activities cross-cutting different work packages (Rec.13). Notwithstanding the positive progress, integration issues and the usage of different tools within vertical domains (i.e. within automotive, within network control, etc.) remain to be stressed in greater detail during the next review. For instance, to what extent will HYCON trigger other research activities, standardisation or commercialization of tools (Rec. 12).
- **Review 2 - Recommendation 13 – status ok:** the up-date of the JPA for m13-m24 has been approved in April 2006.
- **Review 3 - Recommendation 1 – status ok and on-going:** see comment on Rec.2.12

- **Review 3 - Recommendation 2 – status ok and on-going:** The EECI has been founded and is ready to start operation. The links between CNRS / SupElec / Uni Aquila appear to be clarified. The future position of the EECI, however, needs further profiling and promotion to largely increase visibility and usefulness (Rec. 1).
- **Review 3 - Recommendation 3 – status ok and on-going:** see Rec.2.7
- **Review 3 - Recommendation 4 – status ok and on-going:** As said, the tracking process will be implemented to monitor the maturity of the tools and whether the tools are actually used within one application area by up-dating the HYCON booklet regularly (see Rec.2.5)
- **Review 3 - Recommendation 5 – status ok and on-going: see Rec.2.8**
- **Review 3 - Recommendation 6 – status ok:** The budget planning has been revised which is reflected in the up-date of the JPA for m13-m24 that has been approved in April 2006.
- **Review 3 - Recommendation 7 – status ok:** the up-date of the JPA for m13-m24 has been approved in April 2006. The project has not been suspended.
- **Review 3 - Recommendation 8 – status ok:** The issues have been addressed in the review.

4 DELIVERABLES

All deliverables which were due during the period under review are listed below. The status of each deliverable is mentioned and the main findings including possible recommendations are described in this section. Overall, the deliverables produced by the project are occasionally somewhat unbalanced. Some are extremely (and overly) detailed, while others seem to lack crucial information. Also, it has been repeatedly notable that relevant information is only provided at the review meetings, not in the deliverables as such – the "case study booklet" is a prime example. It would considerably ease review work if all information were available in the deliverables in a concise, compact, and timely form (Rec. 22).

Progress report

The progress report is well structured and concise and its sections are clearly written. The progress report clearly highlights also an improvement in the integration activities of Hycon. However, the report arrived very late and information on resource allocation could not be reviewed in detail. Corresponding comments were made in the relevant work packages in Chp. 4.

The report is provisionally accepted with qualifications (see Chp.4).

Management report

The project management report which contains the justification of resources, the cost statements per partner as well as consolidated financial tables has not yet been submitted. It is due for the next meeting.

Deliverable 1.5.1 Ideal Profile of the Manager and Call for Applications

The deliverable presents an update of the intended manager profile. As the search did not succeed, the decision has been taken for the HYCON coordinator Dr Francoise Lamnabhi-Lagarrigue (CNRS) to also assume the duties of this manager. This may turn out to be a desirable solution; nevertheless, the consortium is encouraged to occasionally reconsider the question of whether a permanent, full-time manager will not serve the institute's needs better and whether it would be advisable to engage in another search for a manager. This will, evidently, depend on the development of the institute itself.

The deliverable is accepted.

Deliverable 1.6.1 Call for applications to EECI Resident Scientist position issued

The deliverable contains the text of the call itself. It is, however, not clear from the deliverable how, where, and with how much effort this call has been distributed (mailing lists? Web sites? Conferences? …?). This fact notwithstanding, it seems that Prof. Johansson (Lund?) will take up this position (details on timing not providing) and thus, the call for applications can be regarded as a success. However, for future such deliverables, some more details about the distribution of such calls is desirable.

The deliverable is accepted,

Deliverable 1.7.2 Joint CTS-HYCON Workshop on Nonlinear and Hybrid Control

The workshop appears to have been well organized, with an interesting and appropriate program. The number of attendees is commensurate with the nature of such a workshop. The deliverable documents the workshop well. Similar to the 1st HYCON summer school, however, an evaluation of some form of feedback of the workshop by the attendees would have been desirable (e.g., statistics about an evaluation form). This should be adopted as a common practice for future such events and there should be no need to reinforce this point again for future reviews.

The deliverable is, nevertheless, accepted in its current form, with the recommendation to improve on feedback collection in the future (see also Rec.6).

Deliverable 1.8.1 ICO rules for Admission, Enrolment, Dissertation, Defense

The guidelines laid down in this deliverable strict a good compromise between practicality issues and desirable control over the process by an international "board". The efforts and achievements with respect to the ICO are commendable. For the future, it will be interesting to track how many of these degrees (i.e., diploma supplements) will be granted.

The deliverable is accepted.

Deliverable 2.2.2 Documentation for Benchmark exercises M1 and I1

The deliverable gives a good summary of the benchmarking activities. It is concise and to the point; it looks useful for the work of the project itself.

The deliverable is accepted.

Deliverable 2.3.2 List of accepted experiments

The list of experiments and the selection out of the proposed experiments appears reasonable; the work on the "solar plant" experiment seems useful and concrete. The work in this respect is accepted. The idle speed control experiment, on the other hand, did not attract much interest; the consortium decided no longer to pursue this experiment. While this experiment is justifiable, it seems that it should not be dropped without a replacement; the current plans to take some other example from one of the "application" workpackages" WP4x is encouraged but the decision on this should not be put off for too long. Also, a clear plan on how to pursue this second experiment (e.g., is there already an actual site for this new experiment available?) should be described and documented in the DoW.

The deliverable as such is therefore accepted with qualifications; the point of experiments other than the solar plant should be considered by the consortium (Rec.15).

Deliverable 3.3.2 relation between Piecewise Affine Systems and Hybrid Automata

This deliverable ties together two different classes of models for hybrid systems. It even does so by providing a constructive equivalence proof, which renders this result QUITE USEFUL both for the project itself and for the control community at large. This deliverable is of value particularly because of the explicit nature of the hypotheses and the examples it contains; these indicate how useful a general theory of the equivalence of hybrid systems (in terms of structural or dynamical , etc, specifications) would be towards the objectives of this work package. (Suggestion: PEC)

The deliverable is accepted.

Deliverable 3.3.3 existing tools and methods for the identification of PWA systems

The deliverable compares four different identification strategies for PWA systems. It goes into some detail about these techniques and their performance for some examples. The work provided in the deliverable is of high technical quality; the conclusions are honest in the sense that the current state of the art is presented in a clear and unelaborated form, they reveal, however, that no general fundamental principles or methods are yet available. It might have been useful, however, if some clear recommendations were provided on when to use which technique; in its current form, a potential user of this set of techniques is still left somewhat to his own devices in deciding between them. Also, the fit into the overall WP3/HYCON picture at large might have been improved – but this is a smaller point.

The deliverable is accepted

Deliverable 3.4.3 Free Modelica library for fast simulation of DAE and multirate controllers

The deliverable is well written and reports on work of good technical quality. It is a bit weak, however, on the issue of how these results can be used in other parts of the project or outside of HYCON and show that such usage is actually going to take place (or, even better, has already

happened). A good example might have been to discuss how this library could be applied in the automotive application area.

The deliverable is accepted

Deliverable 3.6.1 Requirements for an interchange format

This deliverable recommends differential and algebraic equations as a basis for an interchange format between different hybrid control tools. It provides some details about how this basis can be worked out. Some further details were presented during the review meeting. While the work is of overall good quality, a reason for concern is that support for modularization and hierarchical model is, in the deliverable, at best limited. During the review meeting, a discussion of this point revealed that the consortium members are well aware of the issue and are working on it. Without a good support for modularity, an interchange format is likely to be of only limited interest (both academically and practically). Therefore, the consortium is strongly encouraged to work on this issue.

The deliverable is hence accepted with qualifications (Rec.16).

Deliverable 3.6.1' Addendum: Languages and tools for hybrid systems design

The deliverable is an extensive, detailed survey of languages and tools. It can act as an excellent basis of reference or as a tutorial.

As a side remark, it is interesting to see this deliverable mentioning a web site at http://wiki.grasp.upenn.edu/ graspdoc/hst/ the goal of which is to serve as a community repository for tools and software for hybrid systems. Is there a strategy how the Hycon activities should be aligned with such community activities ("join them" or "beat them") (Rec. 17) ?

The deliverable is accepted.

Deliverable 4a.3.1 Final report on modelling tools, benchmarks and control methods (new version)

In the reviewers' opinion, the final report on the extensive set of research programs in the modelling, simulation and power electronics areas represents an impressive and extremely thorough deployment of modern control theory and design methods in the identified set of challenging control engineering problems. The technical case studies are specified at a sufficiently detailed technical level that the indicated future directions of investigation will be strongly enabled by this work.

The deliverable is accepted.

Deliverable D4a.5.1 Report on the Assessment of Hybrid Control Methods for Electric Energy Management Problems

A set of paradigmatic case study control problems in the two overall areas of (i) power generation and transmission control, and (ii) power electronics control are thoroughly analysed in this deliverable. Essentially all of the relevant, leading current control design methods, together

with their extensions for the hybrid systems under consideration, are constructively applied and exhaustively evaluated on each problem. Good insights are gained from this exercise. Future developments are indicated.
The deliverable could have been improved by making it more concise (the level of detail might actually have been too high) and by providing a more high-level view; also, some ideas about the interaction with other workpackages (WP2 & 3, in particular) would be quite welcome in such deliverables (Rec.3).

The deliverable is **accepted**.

Deliverable 4b.1.3 Verification results for two of the case studies in the area safety-related discrete control

This deliverable presents a clear statement of purpose in the fuel cell and evaporation system safety verification case studies. The description of the system dynamics and safety verification problem in each case is sufficiently detailed that the reduction to discrete time piece-wise affine (PWA) systems and timed automata (TA) systems respectively to enable systematic safety verification is readily accessible. The degree of applicability of (i) the (linear algebra based) safety verification algorithms for PWA systems and (ii) the TA dependent verification algorithmic methods and their degree of success is straightforward. The next steps and challenges in this line of work concerning principally (i) modelling, (ii) complexity reduction , and (iii) algorithmic implementation issues are clearly presented.

The deliverable is accepted.

Deliverable D4b.2.4 Application results for three of the case studies in the area "large transitions"

This is a fully acceptable report consisting of a set of papers written by the affiliated consortium members; it represents the state of the art with respect to challenging hybrid control problems in the following case study areas: (i) a batch plant,(ii) chemical plant parallel production line, (iii) start up of an evaporation system, (iv) an industrial evaporator, (v) an exothermic heat exchanger, (vi) an application of model predictive control to a hybrid process control (sugar end section) problem.

The deliverable is accepted.

Deliverable 4c.1.4 Report on Case Study 1: Hybrid modelling engines
The final submission of the deliverable has been postponed.

Deliverable 4c.2.2 Preliminary report on Case study 2: Optimal and MPC in vehicle dynamics control

This is a preliminary report on the application of model predictive control methods to vehicle dynamics; it presents a useful exposition of the application of a new set of hybrid linear quadratic optimal control algorithms to PW linear models of the system dynamics (a motor vehicle in this

case). The consortium is encouraged to submit a final draft. Accepted with qualifications (Rec.18).

Deliverable 4c.3.2 Preliminary report on Case study 3: Platform-based design of an ECU

The report of this deliverable describes the development of platform based design methods for embedded control systems (ECUs) in the motor vehicle context. Randomized techniques are introduced and investigated. It is claimed that the hybrid control methods introduced are "of great usefulness" but this is a rather too general description of utility and should be made more precise. In particular the scale of the examples in terms of generality and complexity makes it difficult to clearly evaluate the value of the techniques which are applied. Clear criteria for the quality of performance obtained and for their comparison to other methods should be described and employed.

Accepted with qualifications (Rec.19).

Deliverable 4c.4.1 Proceedings of the First HYCON Workshop on Automotive Applications of Hybrid Systems (new version)

This report constitutes the proceedings of the HYCON Automotive Workshop; it gives a useful concentration of papers but the comments of the industrial participants are difficult to evaluate. The deliverable is lacking a consolidated description of the feedback or the expected and real outcome of the workshop.

Accepted with qualifications (Rec.5).

Deliverable 4c.4.2 Proc. of the HYCON & CEmACS Workshop on Automotive Systems and Control

This report constitutes the proceedings of the joint workshop between HYCON and CEMACS. In principle, similar comments on this report as above could be given. A one page describing the expected and real outcome and well as possible future activities would be valuable.

Accepted with qualifications (Rec.4).

Deliverable 4c.4.3 Projects on automotive applications

This is an additional deliverable which presents of collection of abstract on research papers in the domain. The considerable number of research problems derived from the several case studies clearly shows the potential needs of automotive companies for collaborations with research organizations to address actual challenges. As mentioned, besides the sequential presentation of the research work that is linked to several problems in the automotive domain, there is no section on guiding the reader through the document nor what is the added value of one or another research issue in the context of Hycon.

Accepted.

DELIVERABLE 4D.2.2 DEFINITION AND DESCRIPTION OF THE CASE STUDIES

This deliverable defines two families of case studies to be considered in the context of (i) controlling multi-robot systems and (ii) performing hybrid control, where measurements/control signals have to be transported over a (typically resource-constrained) wireless network. Unlike the situation in, for example, workpackage 4a, these two areas do not constitute a well-defined, clearly identified case study in the proper sense of the word – for example, the DC-DC down conversion problem is clearly defined and can be tackled by well defined tools and methods as well. The situation here is somewhat different in that each family contains, in turn, quite a vast number of detailed problems – 5 problems for the multi-robot case, 3 problems or the control-over-wireless case. That being said, the description of each of these problems appears to be concise enough to be of actual usefulness, but the range of problems still is very wide. It is also remarkable that different partners have contributed different case studies; while a detailed analysis of who contributed to what specific case study is not provided, there is a clear danger of "boxing in" the work of different groups. There is a clear danger of overstretching the integrating capabilities of the project by the wide range of problems considered here. Following the recommendations made in Chp.4, no revision of the deliverable is requested.

The deliverable is **accepted**.

DELIVERABLE 4D.3.1 HYBRID MODELLING AND CONTROL FOR THE CASE STUDIES

Given the nature of the previous deliverable 4D.2.2, an obvious expectation for this deliverable would have been to further refine the already presented case studies, give detailed hybrid models for them and propose hybrid control strategies, possibly (and desirably) applying tools and methods provided by WP3. This is partially included in this deliverable, along with other material.

The deliverable starts out by an executive summary. The fact that the number of partners in the workpackage has increased is somewhat surprising, in that this seems to have widened the scope even further. Conclusions of the technical results stay vague here ("have been investigated" without becoming more concrete). The used set of tools seems to have been started from scratch.

In addition to the "generic" test cases introduced in and considered by deliverable 4d.2.2, a "real-world" test case on a mining application is introduced in this deliverable. While clearly this test application in its entirety far outweighs the total effort that an NoE can render, it is attractive and reasonable to consider it since it can, potentially, bring about the necessary level of detail and concreteness, based on an actual, real-world application, that the generic test cases have so far left to be desired. From this perspective, the reviewers strongly support the consideration of this test case. In particular the work on control-over-wireless-links should be easily integretable here.

The following chapter 3 of D4d.3.1 concerns itself with the question of a software architecture amenable to control applications. While there is little wrong with the questions asked and answered in this chapter, it is puzzling to see this content in this context. It has, in fact, nothing at all to due with *hybrid* modelling but rather is a more or less straightforward structuring of a generic protocol stack in different layers (motivated from a sensor networks background). Thus, its level of innovation for hybrid control is essentially zero. On the other, if this approach is simply to be used by the workpackage, then this is entirely acceptable but then the room given to this issue in deliverables and presentations seems disproportionably large.

Chapter 4 then presents detailed results on both the multi-robot and the networked control case study families – this is the actual core of the deliverable. Individually, these results are mostly quite interesting. In some cases, however, the simplification assumed appear to take away crucial aspects of the problem – for example, when a wireless channel is assumed to suffer only from a bounded disturbance, but this disturbance can happen arbitrarily often, no probabilistic assumptions are made. Practically speaking, this means that the channel capacity is correspondingly reduced and a non-variable, non-wireless channel can be assumed.

The last chapter details how various tools were used for the work presented here. The description should be improved in terms of integration with other WPs, namely WP3 (. Integration issues have been addressed during the review, however, this work appears to be at an early stage.

Overall, this deliverable leaves a mixed impression. Chapter 2 seems promising for the future, the relevance of chapter 3 seems overestimated, Chapter 4 individually novel and interesting but not well connected, and Chapter 5 also interesting but also somewhat lacking connection to the remainder of the project. As laid down in Chp.4, the workpackage seems to have made a serious decision to concentrate on one specific problem that will allow it to achieve more coherent results in line with those obtained by the other WP4x. In summary, the range of problems addressed in the two case studies in deliverable D4d.3.1 is considered still too broad, different partners have contributed to different case studies while the conclusions of the technical results stay vague. Given the new focus of WP4d, deliverable D4d.3.1 needs to be refined and adopted to the new case study.

The deliverable is **accepted with qualifications** (Rec.9)..

DELIVERABLE 5.1.3 TAXONOMY AVAILABLE ON THE WEB

The taxonomy can be regarded as a "heroic" effort. What seems crucial for the future of this taxonomy is to find an efficient way of and incentives for contributions from the community for the further development of this taxonomy. It will also be important how the EECI will later on take charge of this taxonomy and ensure that it will remain a lively too. It will also be interesting, at later reviews, to learn about usage statistics. See also remark in D3.6.1 about http://wiki.grasp.upenn.edu/graspdoc/hst/ (Rec.17).

The deliverable is **accepted**.

DELIVERABLE 5.2.2 ANNOTATED BIBLIOGRAPHY AVAILABLE ON THE WEB

Similarly to D5.1.3, this seems like a very good effort, but it is mandatory that it is not seen as a stable, finished achievement but rather that a continuous update from the community is made possible. It must be, in some form, opened up to updates, corrections, commentary, etc. And again similar to the above, usage statistics are interesting.

The deliverable is **accepted**.

DELIVERABLE 5.4.5 PROCEEDINGS OF THE SPECIAL SESSION ON HYBRID SYSTEMS AT ECC-CDC

The deliverable is **accepted.**

DELIVERABLE 6.1.3 INDUSTRY AFFILIATION AND INDUSTRY INVOLVEMENT AT M24

The level of industry involvement to Hycon has improved and is now at a good level; the recommendations of previous reviews have been well implemented here. The role of some partners (e.g., the Swedish Defence Research Agency as an industry affiliation?) is, however, not fully clear.

The deliverable is **accepted.**

DELIVERABLE 6.2.2 INVENTORY OF PILOT PROJECTS - RELEASE 2

This deliverable presents in detail one pilot project of how hybrid control is used to solve a real-life automotive area control problem. The deliverable demonstrates that the solution obtained is simpler and offers better performances than in the absence of hybrid control. It is assumed that a similar deliverable will be provided for the other areas with pilot projects and not just for the automotive project and Magnetti Marelli.

The deliverable is **accepted.**

DELIVERABLE 6.3.1 PROGRAMME DEFINITION INCLUDING POTENTIAL LECTURERS AND OUTLINE OF THE LECTURE MATERIAL

The aims, structure, and content of the proposed teaching programme are sound. The candidate lecturers appear to be of high quality. The details of the execution of this programme, however, still seem a bit superficial. There are no decisions on location, date, intended audience, etc. visible – waiting for industrial requests for such courses without actively marketing them seems a rather optimistic approach. – At the next review, details about the execution of this programme should be reported.

The deliverable is thus **accepted with qualifications** (Rec.24)

DELIVERABLE 6.5.1 IPR POLICY FOR INDUSTRIAL PARTNERS

This deliverable has been postponed and has to be reconsidered at the next review (see also Rec.23).

DELIVERABLE 7.3.3 FINANCIAL REPORT OF Y2

The report was not available at the time of the review. A justification of major items of resource spending is pending and should be provided for the next meeting.

DELIVERABLE 8.1.2 REPORT ON DISSEMINATION ACTIVITIES AND RECOMMENDATIONS

The report was not available at the time of the review. Acceptance is pending.

DELIVERABLE 8.2.1 JPA WORK ANALYSIS OF DEVIATION TO ORIGINAL PLANS AND RECOMMENDATIONS

The report provided lists the analysis of current deviations. The report focuses on deviations prior to 14/3/2006 and does not contain the solutions (solutions are considered "part of review 3"). As review 3 is past, the report should have been updated with the current solutions and actual delays. (see also comments on D 8.4.2)

The deliverable is to be resubmitted with the addition, in the deliverable, of the proposed solution for the deviations (Rec.20).

DELIVERABLE 8.2.2 REPORT ON THE SCIENTIFIC AND TECHNICAL RISK AND RECOMMENDATIONS

The report provided the major risks of the project. The focus is on the EECI and the issue of sustainability. The risks are clearly listed; however they are addressed in a fairly generic way.

This deliverable is accepted, with a recommendation to revisit the risks prior to the next follow-up meeting in November (see Rec.21).

DELIVERABLE 8.3.1 PROGRESS OF THE GENDER ACTION PLAN

This report details the increase in the percentage of female participants to Hycon and highlights the creation of a mailing list that allows dedicated actions oriented towards women.

The deliverable is accepted.

DELIVERABLE 8.4.2 NEXT JPA UPDATE FOR M25-42

A draft version has been provided shortly before the review meeting which in fact is lacking information on resource allocation and planning. A revised version is due for the next meeting. The consortium is asked to complete the report and to revise the JPA following the recommendations given during the presentations of the review (Rec.25).

DELIVERABLE 8.5.2 REPORT ON SYNERGY ACTIONS WITH OTHER PROJECTS AT M24

The report clearly summarises the contacts between Hycon and other projects during the 2nd year of Hycon. Hycon links to other projects are relevant to its work – the experts recommend that such contacts be pursued and increased over the second part of Hycon.

This deliverable is accepted.

5 WORKPLAN AND RESOURCES

Overall, the workplan has been closely followed as described in the update of the JPA for m13-m30. Resource allocation during the period under review has preliminarily assessed given the late submission of the project progress report. This section:

- briefly describes the highlights of the work packages under review at this meeting
- details the main work packages and comments on resources allocated in the previous period.

5.1. Creation of the European Institute for Hybrid Systems renamed EECI

The creation and re-branding of the European Institute for Hybrid Systems into EECI is positive. The actual setting up of the Institute and the visibility that it has been given through local newspapers are also positive.

However, the fact that no dedicated manager has been found and the lack of communication oriented activities are worrying when analysing the potential sustainability.

Even though the current situation of having the project manager and the EECI manager be the same person can be positive in the short term- however, in the long term, the experts recommend that this situation evolves and that the communication needs of the EECI be carefully analysed and implemented. Without such activities, the consortium will not achieve to build the prestige and the necessary constituency for the EECI (see Rec.1).

5.2. Workpackage 2:

Two benchmarking exercises have been compared which provided the basis for an online control trial of a real problem. The task has been successfully completed for one benchmarking case, i.e. the solar plant. The call for benchmarks has generated considerable interest in topic "Solar Plant". 11 proposals have been submitted out of which 9 have been selected and scheduled for real-time, remote control tests whilst giving each proposal two time slots. About 50% of a first series of experiments were carried out so far.

On the other hand, the second benchmarking case, i.e. the Idle speed control, did not receive much interest which then led to postponing the real exercise. The consortium is planning for another call. At the same time, two more benchmarking exercises have been proposed and call for experiments are planned in the following 2 years. A decision on future benchmarking exercises is pending.

The work represents a genuine, novel approach to experiment with new control methods and tools in a real test environment in a remote manner. As understood by the experts, the real test involves quite a significant effort for preparation and surveillance during the experimental test slots. The experts encourage the consortium to implement another 2 benchmarking exercises which need to be chosen no later than month 30 (see Rec.15). In line with the last comment, the consortium should disseminate the successful completion of the first benchmarking exercise and promote the usefulness of that kind of activities. The resources allocated so far are commensurate with the work carried out.

5.3.Workpackage 3: Tool Integration

This work package gained a lot of momentum during the second year. The HYCON tool repository is now online with 11 tools included and documented in the database. In the long term it will be adapted and transferred to the EECI institute. The HYCON demonstrator site, which is intended for dissemination in industry and academia, represents a second important issue which gives access to potential users to experiment with the tools via the web. So far two tools that were widely used in WP4x have been deposited and documented. The experts consider this an important link to the WP4x in which test cases have been evaluated and documented using the tools aforementioned. Again the idea is nice and the result will be a major asset of the HYCON institute in order to attract industry and provide guidance for potential users.

Task 3.4 is aiming at developing interoperability of different simulation tools. Given the complexity of many tools, the consortium made an important decision not to aim at one uniform simulation platform, which has been well understood and supported by the expert team. As outlined during the review, the maturity of existing tools is still considered the major roadblock for wide-spread adoption in industrial domains. Consequently, the consortium concentrates on fastening integration of new methods and models into existing tools for comparing results and on fastening the verification process. Since for the most part models are developed in a Matlab environment the coupling via the S-functions interface received much attention. In particular, the coupling to a Modelica library has been an important step (although the realization of the Modelica interface is slightly delayed) which may directly link the HYCON tool development to a potentially commercial tool in short term.

The work package is running pretty well and well in line with the work proposed. During the second year, existing tools have been extended to piece-wise affine systems and new aspects of current research have been tackled including nondeterministic hybrid systems demonstrating that the consortium is working at the forefront of research.

Overall, the work is carried out in a most timely manner. Deliverables have been prepared in time, work progress is extremely well documented. All milestones due during the period of review have been reached and were well documented. The work package has gained a lot of momentum and it demonstrates tight cooperation with the partners involved.
The links to WP4x and WP6 have been established and became quite clear during the review; for instance, through the sketch shown which was considered extremely useful. However, those links need to be reinforced in the following years. A close monitoring of the toolbox assessment and usage in any application context would be highly beneficial for the successful integration of the excellent work carried out in this work package (see Rec. 3). Overall, the resource consumption in the seconds fairly reflects the work carried out and the objectives achieved.

5.4.Workpackage 4:

The consortium has prepared a small booklet that exhibits the usage and applicability of tools that are available in the consortium to many of the case studies defined. This activity directly follows the recommendation of the expert to establish a tracking process that would serve to monitor

whether and in which context the tools are actually used. The booklet will be continuously updated contributing to its benefits that of knowing a) who used the tools; b) for what was it used; c) maturity of the tool, and d) any feedback on the success/failure and general comments. It should also be pointed out that the availability of this booklet *before* the review would have been much appreciated by the reviewers and would have helped to answer a number of questions beforehand (see also Chp.4).

Workpackage 4a: Energy Management

The goal of WP4a is the investigation of hybrid control techniques and tools to problems related to the generation, transmission, and conversion of electric energy. The major progress of the work in the second year is related to the final modelling and verification of a first set of case studies which tackle simplified models of the real problem. The deliverable assesses in detail the simulation results which involved tools that are part of the HYCON tool repository. The strength of the WP4.a relies on the strong involvement of industrial partners like Bombardier and ABB. Especially the Lund workshop provided relevant feedback from the experimental verification and industrial relevance of the simulation results. An extensive personal exchange programme initiated during the last period, will largely contribute to an increased cooperation among the partners. The envisaged definition of a new benchmarking exercise, i.e. a DC-DC power converter, reflects the vital integration with WP2. Remarkable activities of the industrial partners in WP6 document that WP4a is well embedded. A common set of tools that are deposited in the HYCON toolbox also indicates significant commonalities with WP3. The experts conjecture that the industrial application and take up of the toolbox set up in WP3 could greatly benefit from an increased level of integration of WP3, promoting the added value of the combined usage of tools and the availability of the Hycon toolbox to the relevant industrial members – WP4a might serve as a valuable conduit for this purpose.

In summary, the work carried out in year 2 represents solid progress according to the work plan, all milestones were reached in time and the consortium is aiming at more ambitious test cases in the future (which is appreciated given the available resources).

Workpackage 4b: Industrial Control

During the reporting period, the consortium worked on numerous challenging case studies, all of which are derived from real-world industrial problems and which directly involve industrial partners. In a broader sense, all investigations ensuring a safe and timely optimized operation of industrial plants represent an activity which became quite prominent recently, e.g. the ARTEMIS SRA. The industrial involvement is well perceived as the strength of this application area which reflects dynamic work in this work package and which drive the progress.

Generally speaking, the several case studies seem to cover a broad range of problems from relatively simple one to very complex. Recently, another case study guided by Danfoss has been added which shows great enthusiasm of the participants. The objectives of this WP are ambitious and the work clearly shows tight interaction between the partners involved. The consortium has made a great job applying and integrating different tools which seem to be rather mature such as UPPAAL and gPROMS in this application context (WP3). Model exchange is considered

essential to allow fast introduction and application of new models and methods to different relevant problems. However, most tools seem to be rather specific to WP4b.
With respect to possible toolbox integration, the portfolio and complexity of tools seems widespread hindering large take up in other application domains and leading to minor contribution to the HYCON toolbox and HYCON demonstrator site. The experts encourage the consortium to identify tools which are sufficiently mature to be transferred and documented as part of the HYCON demonstrator site. In the future, the significant large number of case study represents an essential asset of WP4b all of which should be sufficiently documented and promoted by the HYCON institute EECI.

Summarizing the main achievements this WP is well on track and seems to run very smoothly – resource consumption in the last period is well justified. Reviewing the future plans, it was noticed that the envisaged number of objectives and case studies seem not be ambitious given the reduced number of resources planned. Although this is considered positive showing the commitment of the stakeholders, the experts raised the issue to balance out resource planning in each WP4x work package taking into account the scale and ambition of the objectives.

Workpackage 4c: Automotive Control

The WP involves a significant number of partners of the consortium and proofs to generate most robust industrial input. During the period under review, the consortium followed the expert's advice to concentrate on three main case studies which were largely backed by industrial collaboration out of which one led to the definition of a benchmarking exercise, i.e. the 'Idle speed control'. Surprisingly, less interest has been created so far. In addition to numerous publications including a special issue of the Intl. J. of Control on Advanced Design Methodologies in Automotive Control, other achievements within this workpackage are related to the definition of an industrial pilot with Magneti Marvelli that triggered an action in WP6. Contributions to WP5 have led to a specific automotive taxonomy. The work progresses well showing more intense and fruitful collaboration between the participants.

As a striking new results, PWA models for case study 1 have been introduced and studies leading to tight interaction with WP3. If they progress further in the future, current activities in case study 3 related to randomized algorithms and stochastic methods may directly influence on-going tool development in WP3. It was noticed that WP4c seems well embedded in the HYCON project; the degree of industrial interest is significant and is viewed very positively. The link to WP6 is well presented and very solid. The uptake of several tools of the hybrid toolbox has been demonstrated and likewise the recommendation in WP4b that tools that are more mature, such as the MPC-range of tools, are recommended to be transferred to the HYCON tool demonstrator site in the short-term.

The consortium should continue its efforts in promoting the Hycon toolbox and the demonstrators as the main bridging activity to their industrial partners. Links with the Artemis platform have not materialized so far, and the approach to monitor and to link to standardization activities like AUTOSAR remained unclear. As a general comment (which is on-going) the consortium is asked to better document the feedback obtained and possible impact of the numerous workshops, e.g. the Lund workshop and/or the HYCON/CEMACS workshop (see Rec.12).

Overall, the numerous issues detailed in the 3 case studies seem to demonstrate the tackling of a significant set of problems which are very relevant for autmomotive control. The activities are widespread and industrial interest is clearly reasonably high. The HYCON projects seem to have identified an increasing number of research issues in the domain all of which are highly relevant to industrial usage and up-take paving the way to establish hybrid methods and tools in this domain. As there seems to be ever increasing interest also from the industrial partners, the WP maintained the high momentum of activities although the definition of tasks and milestones for the future activities should be more specific showing a measurable success of HYCON activities. Integration efforts were appreciated and should be maintained. Resource allocation largely reflects the enormous amount of modelling results obtained and published.

Workpackage 4d: Networked Control

The workpackage 4d has concentrated on two larger families of case studies: multi-robot control and control over a wireless channel; the former concentrating more on actual control aspects in such an environment, the second aiming at solving the problems that occur when control signals (either measurements or commands) have to be communicated over a non-ideal wireless channel.

In this workpackage, an interesting situation has occurred. Initially, the spread of topics considered in it had been extremely wide. Over time, the work has started to focus on these two families of cases studies, which both still encompass a wide range of individual problems. For various of these individual problems, interesting, novel, and good scientific results have been achieved (for example, the performance bounds in multi-agent systems). In some cases, however, the chosen assumptions appear to be somewhat oversimplistic (e.g., wireless channel assumptions as having an arbitrarily occurring, bounded loss of quality).

On the other hand, the work package struggled to find a coherent perspective on such control-over-networks scenarios and find a "common language" between partners from different backgrounds. As a possible solution, an existing platform concept ("platform based design") has been invoked to serve as a common ground. While this might proof to work out and to actually be practical in the future work of the workpackage, the reviewers would hesitate to see a need to actually invest effort in the development of this platform concept *as such* as it is not specifically geared towards hybrid control systems. Nonetheless, some such platform concept might be practical for the everyday work of the project.

Given the recommendations of the last review, the activities were still widespread, and not specific to hybrid tools. For several sub-problem tackled in this WP, there still is no clear perspective apparent why and how the HYCON approach, ideas, methods, tools/toolsets could or should be applied to these problems and how any *synergies* could be envisaged from solving these problems. On technical level, the results presented are not coherent. The targeted development of hybrid tools is still in an early stage and tools still need to be specified, developed and experimentally verified. No significant progress on tool integration has been noticed either, links to WP3 were not substantiated. Overall, progress in this WP appears to be rather small compared to the other application-specific work packages WP4x.
Clarification with respect to questions and recommendations as outlined in the third review report were not convincingly provided. The claimed increase in resource allocation was not substantiated by the work progress as presented. Resource allocation for the reporting period therefore should be limited to the level of the previous year.

For the future work, the consortium is asked to solely focus its effort on one industrial test case that has been introduced through a cooperation with ABB and that can provide a sufficient level of detail on which to anchor the formulation of control problems and to which the already developed results can be applied. This should give the workpackage the level of concreteness and detail that it has, in comparison with the other WP4x, so far lacked.

Although the results presented are in fact striking and valuable in nature, a coherent vision of synergetic use and a realistic path for tool integration was not convincingly presented. The interaction about tools with WP3 is envisaged for the following reporting period, albeit it remains to be seen whether the tool integration work done in WP3 will actually proof to be needed or beneficial for this workpackage WP4d. The test case of ABB, when fully developed, might become a candidate for a WP2 scenario as well (see Rec.10). The integration and dissemination outside of HYCON has improved as well; activities like the joint workshop with NEWCOM are useful and are explicitly encouraged (see also Rec.11).

Resources do not fully commensurate with the work progress achieved; resource allocation should be limited to 20 PMs (at funding level) (Rec.8).

5.5. Workpackage 5:

Overall, the workpackage 5 has already delivered valuable and useful work in the form of the online taxonomy and bibliography. It will be crucial, for the lasting success of this workpackage, to ensure that these database are opened for general updating while making sure the quality and integrity of the material is maintained. (Possibly approaches like Wikipedia are worthwhile to consider?) – Rec.14.

Workpackage 5 should make sure that other, similar activities are at least observed and, ideally, a joint strategy is developed. Also, it seems necessary to develop a strategy how this taxonomy and bibliography can be made open to public scrutiny, comment, and updating; especially once it has been passed on to the EEIC. In addition, the workpackage should take final decisions on whether at all and how to go forward with a "textbook" produced by HYCON. The number and content of the relevant milestones that are reported should be verified (e.g. M5.3.1).

Resource consumption is well in line with the work plan and commensurate with the results obtained.

5.6. Workpackage 6:

This work package has progressed well:

- The IAB has been restructured to map to the different activities classified under WP4a, b, c, and d. There are four IAB subsections and one IAB council with one representative per area.
- On-going investigation of "super test cases", i.e. hard industrial applications from industries available to provide feedback. Current status: Magneti Marelli available with an injection engine control problem which has been confirmed as pilot. Possibly the "mining site" test

case supported by ABB – if successfully analysed could be come a supported pilot in the future.

- Research and training activities: Hycon is currently looking into the process of forming a coherent set of workshops and courses particularly targeted at industrial seminars. Dates, target audience and speakers to be decided (Rec.24).

6 USE AND DISSEMINATION

Exploitable knowledge and its use

The project has started to generate a substantial amount of exploitable knowledge. While IPR issues will remain to be difficult for this type of project (especially due to the co-funding from other projects and the large number of partners), the project is encouraged to exploit this knowledge. An important point is going to be whether and how such knowledge/IPR is going to be handed over to the EEIC and the possible remunerations to be made. Access to knowledge and making use of IPR, however, is considered essential for the success of the EECI (Rec.23).

Dissemination of knowledge

The dissemination of knowledge has been vastly improved. Especially events like the workshop in Lund or the joint workshop with the NEWCOM project or the summer schools are good examples. The project is encouraged to maintain this momentum (see also Rec.11).

7 FUTURE WORK

Specific Comments on the new Description of Work are postponed pending the submission of the updated JPA. The consortium has a clear and concise view on the future planning and activities most of which pretty much along the line of continuing on-going research and integration work. Major issues such as the re-shaping of WP4d have been thoroughly discussed and the findings were much in line with the experts' views. More detailed comments will be provided after receipt of the revised JPA (Rec.25).

8 ASSESSMENT OF OBJECTIVES

The objectives of the NoE HYCON are relevant. Both the actual research work objectives – in principle, assessing tools for hybrid control systems in different application areas – as well as the integration work – ensuring that different tools are compared against each other and that, in general, the state of awareness of hybrid systems is raised in a wider audience – are relevant to the field and to industrial practice.

With the evolution of Hycon, the second objective “integration” did materialize in the WP3 tool integration which gained a lot of momentum. Comparing the different application areas in Wp4x, cross-cutting activities and the links to other work packages became more visible and clear after the review although the level of tool development and application is not balanced across the four domains. The integration objectives, therefore, will become more evident for the most 'established' applications such as automotive and energy.

9 RECOMMENDATIONS

While detailed recommendations have been made in the previous sections already, an overview of recommendations is listed below (all relevant from previous reviews are collected here under a uniform numbering).

- **Recommendation 1 (former Rev.2 Rec. 2 & Rev. 3 Rec. 2):** The "business model" for the EECI will have to be further defined and proven in practice. The lasting integration of European research in hybrid control will be one of its major tasks and a critical metric for its success. Indeed, the position of the EECI manager needs to evolve and communication needs of the EECI are to be carefully analysed and implemented. Also, the separation between Paris and Aquila will have to be filled with life and it will have to be shown in the future that this separation is indeed an efficient form of organization.

- **Recommendation 2:** The project management should continue to encourage the application domains to document the usage of the HYCON toolboxes and to strengthen the commitment of the industrial partners as members of the IAB in the HYCON network.

- **Recommendation 3 (former Rev. 2 Rec. 5 & Rev. 3 Rec. 4):** While the current description of the mapping between tools and case studies is useful, this mapping needs to be monitored in the future to ensure that neither tools are developed in which nobody is interested nor case studies proceed within leveraging the tools already developed/integrated by other parts of Hycon and needlessly repeating work. The synergies between the different parts of the project have to be demonstrated here.

- **Recommendation 4:** A conclusive part describing the expected and real outcome as well as possible future collaborative activities should be added to deliverable D4c.4.2.

- **Recommendation 5:** A consolidated description of the feedback or the expected and real outcome of the workshop is requested for deliverable D4c.4.1.

- **Recommendation 6 (former Rev. 2 Rec. 8):** Future workshops, especially with industry participation, should be evaluated and the results documented.

- **Recommendation 7 (former Rev. 2 Rec. 7 & Rev. 3 Rec. 3):** Continue to document milestones and ensure that their description is easily and early on available before a review meeting. Make reviewers explicitly aware of such availability of both milestones and deliverables.

- **Recommendation 8:** The increase in resource allocation in WP4d from year 1 to year 2 was not substantiated by the work progress as presented. Resource allocation for the reporting period therefore should be limited to 20 PMs.

• **Recommendation 9:** Given the new focus of WP4d, deliverable D4d.3.1 needs to be refined and adopted to the new case study.

• **Recommendation 10 (former Rev. 2 Rec. 8 & Rev. 3 Rev. 5):** The reviewers support the decision in WP4d to pursue one industrial-scale test case (the "mining" application) which should provide concrete challenges and constraints to the control research. In how far this has lead to relevant research and integration results will be a critical issue for the next review meeting.

• **Recommendation 11 (former Rev. 2 Rec. 9):** Hycon visibility outside the control communities is starting to grow but, obviously, can never be big enough. Activities to spread awareness in other communities (automotive, energy, networking, …) will be considered at the next review meeting.

• **Recommendation 12 (former Rev. 2 Rec. 12 & Rev. 3 Rec. 1):** One goal of an NoE is to ensure that activities outside of itself are triggered as well – other research activities, standardization, or commercialization of tools developed within or aided by the NoE. Links with the Artemis platform have not materialized so far, and the approach to monitor and to link to standardization activities need to be clarified. The project is encouraged to pursue and document such options.
This is related to recommendation 2 as well.

• **Recommendation 13:** An overall recommendation is to strengthen the "cross-cutting" activities between different workpackages to foster the "integration" aspect of the Network of Excellence. For example, work in the individual WP4x is, currently, still isolated from each other and at best linked via other workpackages. While it will be difficult to change that due to the quite different nature of these application areas, it might be worthwhile to consider whether some joint activities between different WP4x can turn out to be fruitful for the area at large.

• **Recommendation 14:** WP5 should make sure that other, similar activities are at least observed and, ideally, a joint strategy is developed. Also, it seems necessary to develop a strategy how this taxonomy and bibliography can be made open to public scrutiny, comment, and updating; especially once it has been passed on to the EEIC.

• **Recommendation 15:** In WP2, the selection of a further possible two benchmarks should proceed quickly and with care, notably a decision is expected before month 30.

• **Recommendation 16:** An interchange format (WP3) should, to be practical useful, have mechanisms for modularity and reuse of individual modules. The project is strongly encouraged to take this issue into account; the issue of modularization/hierarchies and the achieved results should be revisited at a later review meeting.

•**Recommendation 17:** In deliverable D3.6.1.Addendum, a web site is mentioned to at http://wiki.grasp.upenn.edu/ graspdoc/hst/ the goal of which is to serve as a community repository for tools and software for hybrid systems. The consortium should consider the added value of an additional community repository for promoting HYCON tools and control software.

• **Recommendation 18:** The consortium is encouraged to submit a final draft of deliverable D4c.2.2.

• **Recommendation 19:** For the final report of deliverable D4c.3.2, clear criteria for the performance obtained from hybrid control methods and for their comparison to other methods should be described.

• **Recommendation 20:** The deliverable D8.2.1 is to be resubmitted with the addition, in the deliverable, of the proposed solution for the deviations.

• **Recommendation 21:** Risk expressed in the deliverable D8.2.2 need to be revisited prior to the next meeting in October/November 2006.

• **Recommendation 22:** Overall, the deliverables produced by the project are occasionally somewhat unbalanced. Some are extremely (and overly) detailed, while others seem to lack crucial information. Also, it would considerably ease review work if all information were available in the deliverables in a concise, compact, and timely form before the review.

• **Recommendation 23:** The consortium should give priority to set the mechanisms and rules for hand-over of knowledge/tools/IPR to the EEIC**.**

• **Recommendation 24:** Details about concrete plans to run an industrial lecturers programme that defines location, date and speakers should be provided.

• **Recommendation 25:** A revised version of the JPA for m25- m42 should provided for the follow up review meeting taking into account the recommendations given during the review meeting.

10 REVIEW CONCLUSION

The project has progressed well on administrative and on technical level. The consortium has reacted well to the recommendations given by the experts. With the evolution of Hycon, the second objective "integration" did materialize in the WP3 tool integration which gained a lot of momentum. Comparing the different application areas in Wp4x, cross-cutting activities and the links to other work packages became more visible and clear after the review. The project revealed satisfactory performance during the second year and should continue.

Outcome of the review:

	Continue	Modify	Stop
Technical Progress:	**X**		
Management and Consortium	**X**		
Dissemination + Exploitation:	**X**		
Future Plans:	**X**		
Overall Status of Project	**X**		

The outcome of the review is

- the project has progressed well, even if two areas remain critical: (1) EECI and its integration in the community (even in the project) (2) As part of WP4d Networked Control, the formalization and solution of the hybrid control problem for a specific case study and tool development and integration.
- the finalisation of the updated DoW is of utmost urgency.
- The project management report has to be sent as soon as possible
- Follow-up review meeting has been decided to take place on 27 November 2006.

11 NEXT REVIEW MEETING

The next technical and financial review, which will formally review the period from M25 to M36, will take place in about one year from now (2 DAYS to be defined).

Reviewers' signatures:

Peter Caines Holger Karl Véronique Pevtschin

12 APPENDICES

12.1 List of pariticipants

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12.3 Agenda

IST-2003-511368
Fourth Review Meeting

Agenda

Date: 26/27 September, 2006

Venue: ETH Zurich, CH
Laboratory of the ETHZ

Tuesday, 26 September 2006

From	To	Topic	Speaker
09:45	10:15		Reviewers closed session
10:15	10:45	Project overview including the implementation of the previous review recommendation	F. Lamnabhi-Lagarrigue
10:45	11:05	WP4a achievements and milestones M13-M24	M. Morari
11:05	11:20		Coffee Break
11:20	11:40	WP4b achievements and milestones M13-M24	S. Engell
11:40	12:00	WP4c achievements and milestones M13-M24	A. Balluchi
12:00	12:20	WP4d achievements and milestones M13-M24	M. Di Benedetto / K.H. Johansson / F. Santucci
12:20	14:00		Lunch
14:00	14:40	WP4x conclusions and consolidation WP6 achievements and milestones M13-M24	M. Morari & A. Balluchi
14:40	15:10	WP3 achievements and milestones M13-M24	S. Engell
15:10	15:40	WP2 achievements and milestones M13-M24	E. Camacho
15:40	16:00		Coffee Break
16:00	16:30	WP5 achievements and milestones M13-M24	J. Lunze
16:30	16:50	WP1 & EECI achievements and milestones	A. Bemporad / F. Lamnabhi-Lagarrigue
16:50	17:50		Reviewers closed session

Wednesday, 27 September 2006

From	To	Topic	Speaker
09:00	09.30	Discussion on EC administrative procedures	R. Riemenschneider
09:30	09:50	Dissemination / Links with other projects	F. Lamnabhi-Lagarrigue / Karl Henrik Johansson
09:50	10:20	Conclusions and feedback of Day 1	Commission / Experts
10:20	10:40	Coffee break	
10:40	11:15	Objectives, Challenges, Milestones for the second part of HYCON	F. Lamnabhi-Lagarrigue
11:15	11:30	WP3 planning & negotiation of M25-M42	S. Engell
11:30	11:45	WP2 planning & negotiation of M25-M42	E. Camacho
11:45	12:00	WP5 planning & negotiation of M25-M42	J. Lunze
12:00	12:15	WP4a planning & negotiation of M25-M42	M. Morari
12:15	12:30	WP4b planning & negotiation M25-M42	S. Engell
14:00	14:15	WP4c planning & negotiation of M25-M42	A. Balluchi
14:15	14:30	WP4d planning & negotiation of M25-M42	M. Di Benedetto / K.H. Johansson / F. Santucci
14:30	14:45	WP6 planning & negotiation of M25-M42	M. Morari & A. Balluchi
14 :45	15:00	WP1 & EECI future activities	A. Bemporad / F. Lamnabhi-Lagarrigue
15:00	15:45	Reviewers closed session	
15:45	16:15	Conclusions and feedback	Commission / Experts