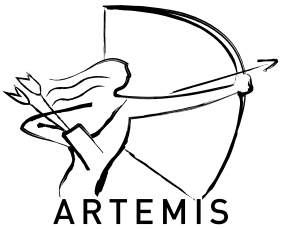
ARTEMIS Industry Association

WORKING GROUP

Metrics and success criteria for ARTEMIS



ARTEMIS Industry Association
WORKING GROUP
METRICS AND SUCCESS CRITERIA
FOR ARTEMIS

A BOTTOM-UP STUDY ON SUCCESS CRITERIA OF ARTEMIS PROJECTS

REPORT OF RESULTS

FROM THE 2010 QUESTIONNAIRE

FEBRUARY 2011

Editors :

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OPENING WORDS

To define metrics and success criteria for an R&D programme is not an easy job. This is certainly the case when the metrics and criteria are intended to predict as leading indicators impact in society and the market, which might not occur until many years after a programme's completion.

The Working Group has, as a first step, taken a pragmatic approach by surveying a representative number of projects of the first call of the ARTEMIS Joint Undertaking. This report presents the results of this survey and reveals some interesting insights and observations. However, a lot of work remains to be done.

We would like to thank the Working Group for all their efforts and we look forward for the next studies and deliverables it has in store.

Jan Lohstroh,
Secretary General ARTEMIS Industry Association

INTRODUCTION

The working group (WG) 'Metrics and Success Criteria for ARTEMIS' was created to **define and monitor the achievements of the ARTEMIS JU Programme**[1] **with the aim to generate a bottom-up report** suitable to support some higher-level evaluation initiatives[2]. The WG is a group of industrial and university people with an excellent mix of technical, economic and social science backgrounds along with multi-disciplinary expertise in embedded systems technology. In addition, the task was supported by the invaluable contributions of two experts, one from the ARTEMIS JU and the other from the ARTEMIS-IA Office, who followed up on progress and supported the process to ensure alignment of criteria with key documents and an effective data collection process from a selected population of project partners. Also the European Commission has been informed and kept updated from the initial thoughts on the initiative up to the launch of the questionnaires to the consortia, in order for it to endorse the process and ensure added value to the Interim Evaluation it has been setting up[3].

The goal of the initiative is twofold:

1. To define a set of metrics and criteria to measure the success of the ARTEMIS JU programme and test these in practice in this first inquiry.
2. To provide input to ARTEMIS Industry Association on **'Priority Setting'** and possibly **'Refocusing the ARTEMIS JU Programme'**.

Two key differences in these initiatives are, on one hand, the **methodological approach 'bottom-up', which brings data on perceived success directly from the organisations involved in the projects selected,** and, on the other hand, **the strategic approach**, gathering the information to generate a, programme-level report on its success from an industrial point of view.

[1] *Members of the WG can be found on page 69.*
[2] *Such as the 'First Interim Evaluation of the ARTEMIS and ENIAC Joint Technology Initiatives' by the European Commission on 30 July 2010*
[3] *Contact persons at the European Commission were Martin Ubelhor & Tom Clausen.*

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METHODOLOGY

The document uses a mixture of **quantitative and qualitative** methods to identify and measure success criteria. A **multiple choice questionnaire with open-ended questions** was sent out to a selected subset of ARTEMIS Call 1 project consortia. Only Call 1 projects[4] were selected because they can already demonstrate intermediate results and have a more concrete view on their end-of-project expected results.

A mix of large and small projects was selected:

CESAR	Type 1 - Large & Wide Scope
SOFIA	Type 1 - Large & Wide Scope
eDIANA	Type 1 - Large & Wide Scope
SCALOPES	Type 1 - Large & Wide Scope
INDEXYS	Type 2 - Small/Medium & Focused
EMMON	Type 2 - Small/Medium & Focused
SYSMODEL	Type 2 - Small/Medium & Focused

Table 1. Call 1 projects selected for the 1st ARTEMIS survey of success criteria.

The rationale for this mix was to cover the SRA matrix on application areas versus research domains and to ensure coverage of all ASP's. The message to the consortia was clear: this questionnaire is intended purely for the assessment of the overall ARTEMIS **programme**. It has nothing to do with the project evaluation: "We need your input to improve the instrument". The questionnaire covered June 2010 till October 2010. Replies to the questionnaire were managed only by the WG 'Success Criteria and Metrics', securing the necessary confidentiality and making sure all reports were anonymous.

The survey's questions related to three main subthemes, as generated from the ARTEMIS Strategic Research Agenda (SRA):

Theme 1 : Focusing on common R&D agendas more effectively

> Realise the seamless interoperability between the 'Ambient Intelligent Environments' envisaged for the European citizen (at home, travelling - in various modes, at work, in public spaces, ...).

> There will be twice as many European SMEs within the aegis of ARTEMIS engaged in the Embedded Systems supply chain, from concept through design and manufacture, delivery and support, as there are today.

4 *Start date first half of 2009.*

> There will be an integrated chain of European sourced tools, based on ARTEMIS results, to support development of Embedded Systems from user requirements, through system design, to system-on-chip production.

Theme 2 : Providing significant economic & social benefits

> 50% of Embedded Systems deployed throughout the world will be based on ARTEMIS
> ARTEMIS will have generated at least 5 'radical innovations' of a similar paradigm-breaking nature to the microprocessor, digital signal processing and software radio.

Theme 3 : Successful results in the market

> Major educational programmes and technology acquisition programmes will be able to deliver new skills in less than 2 years.
> The number of relevant patents granted per annum to European companies engaged in ARTEMIS will have doubled.
> To close the design productivity gap between potential and capability, ARTEMIS will:
  - Reduce the cost of the system design by 50%.
  - Enable a much higher degree of strategic reuse of all artefacts through matured product family technologies while permitting predictable assembly of Embedded Systems through component technology .
  - Achieve 50% reduction in development cycles.
  - Aim to reach through design excellence the goal of "right first time, every time" by 2016, including validation, verification and certification (to the same standards as today and higher).
  - Manage a complexity increase of 100% with 20% effort reduction.
  - Manage uncertainty in the design process and maintain independent hardware and software upgradability all along the life cycle, which is seen as crucial.
  - Reduce by 50% the effort and time required for re-validation and recertification after change, so that they are linearly related to the changes in functionality.
  - Achieve cross-sectoral reusability of Embedded Systems devices (for example, interoperable components, hardware and software, for automotive, aerospace and manufacturing) that will be developed using the ARTEMIS results.

For each theme, and for a specific number of criteria, questions were defined and added to the questionnaire, which can be found in Annex 1.

Some criteria discussed during the questionnaire design process were not included for the following reasons:

> Raising programme efficiency : overhead costs for operating the programme
  - **REASON :** ARTEMIS is in a start-up phase (hence more investments) and it is unclear how to measure the different components (ARTEMIS-IA Office, ARTEMIS JU, EC, PA's,…) asking questions to the association members.
> Reduction of development costs
  - **REASON :** Hard to measure what the 'real' impact is of the ARTEMIS project itself versus other programmes in which the company takes part.

Some other criteria were not measured because they are actually quantified by other bodies (like ARTEMIS JU, ARTEMIS-IA Office, European Commission):

> Leveraging resources & integrating national efforts
  - Number of countries that commit funding to JTI
  - Commitments & payments (time interval from 'project selection' to 'first payment')
  - National funding committed and spent on projects selected by JTI
  - Resources invested by industry in R&D work on selected projects
> Raising programme efficiency
  - Time interval between proposal submission and project selection
  - Number of organisations, including SMEs participating in call for proposals.

LIMITATIONS

It is worth pointing out that this essential methodology for the future performance of the ARTEMIS instrument may contain ambiguous interpretations. Below, the known issues are identified to help the reader to better understand the results obtained, and put them into perspective.

First and foremost, the current study is the first of its kind to be designed and conducted, and as such, there is room for further improvement. The process of definition has taken over a year, and the actual data gathering has been done using completed excel spreadsheets and largely manual analysis.

Second, the sample involves only projects and beneficiaries participating in call 1 (2008). Involving partners of subsequent calls at this point in time was not relevant for the purposes of the study, since the projects in the second call were in their start-up phase.

Furthermore, not all consortia were invited. Although the success rate of replies was high, some consortia answered as a consortium and some selected a number of partners from the consortium to answer the questionnaire.

Third, the type of organisations that provided the answers are not exclusively industrial partners, as originally intended. A third of the respondents are academic organisations (26 % of total respondents).

Fourth, the questions themselves presented problems. When answering the questionnaire, a number of participants expressed their inability to answer some of the questions because they were either unclear or too wide in scope in order to provide a proper answer. Also, some participants focused mainly on answering only the technology-oriented questions and left unanswered those questions with an economic and social orientation.

Fifth, the amount of work was severely underestimated as were the resources needed to design and conduct the survey. This work was done only on a voluntary basis by the WG members.

Finally, the WG hopes that this report provides an interesting read and if you have any queries relating to it, please direct these to the office of ARTEMIS Industry Association: communications@artemis-ia.eu.

EXECUTIVE SUMMARY

This report is based on the input received by the participants of 6 projects funded under the 1st ARTEMIS call. In particular the questionnaire was filled in by 25 industrial partners, 9 university partners and 1 consortium as a whole. The report is divided into three sections, covering the following themes:

1. **Focusing on common R&D agendas more effectively**
2. **Providing significant economic & social benefits**
3. **Successful results in the market.**

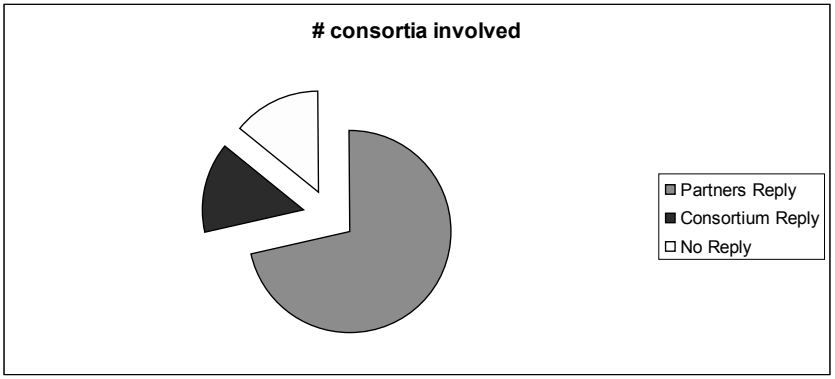
1. Regarding the **partnerships** formed within those projects the main points are that 75% of the partners had partnerships before setting up a project consortium, whereas 65% of the partners claimed that they also formed new partnerships in ARTEMIS projects ; 33% of the new partnerships involve at least one SME whereas 40% of the partners are keen on further cooperating with the SME's participating in the project. In terms of new initiatives it is very important that - even though all the projects are in an early state still - one spin-off company has already been established, whereas two more are planned to be established soon. An **'ARTEMIS CoIE'** could be an excellent instrument to pave the way towards **'Innovation Eco-Systems'**, but at this point in time almost none of the participating partners is aware yet of what an 'ARTEMIS CoIE' exactly is. This can be explained by the fact that this is quite a new concept in the ARTEMIS community. The main reasons that the partners selected ARTEMIS instead of other funding programmes, were that ARTEMIS follows an **industry driven cross-domain approach with an adequate type and size of partner alliances**. The main issue of the ARTEMIS programme is unanimously agreed to be the **administrative burden** associated with realising an initial payment after project approval.

2. Moving to the economic and societal benefits of the projects, the key **market impact** is expected to be through applications that will be commercially introduced within a period of 2-5 years after project completion. Key effects on the applications are **reduced development costs and less power consumption** of future products. In terms of the contributions to the **ARTEMIS AWP-targets**, the vast majority of the partners believe that their project contributes to almost all of them, whereas in terms of the quantification of the project results most of the partners could not answer because either the application and demonstration activities of the projects they are involved have not yet been started or the integration work was not yet finalized. It will require further attention for the future ARTEMIS programme definition on how the technologies developed specifically contribute to the quantitative data. Moreover, as the projects are only running for 2 years, no **radical innovations** are obtained yet, although the term 'radical innovation' needs to be defined in more detail, before robust conclusions can be drawn. For almost all participants **in-house innovation & development** remains key, and a large majority (90%) indicates that the amount of in-house innovation has increased by participating in the ARTEMIS programme. In general, 'Embedded Systems' is perceived by the respondents as **a truly enabling technology across a variety of applications/markets**. The current respondents are focussing mainly on 'Energy Efficiency' and 'Mobility of people and objects' in terms of societal challenges.

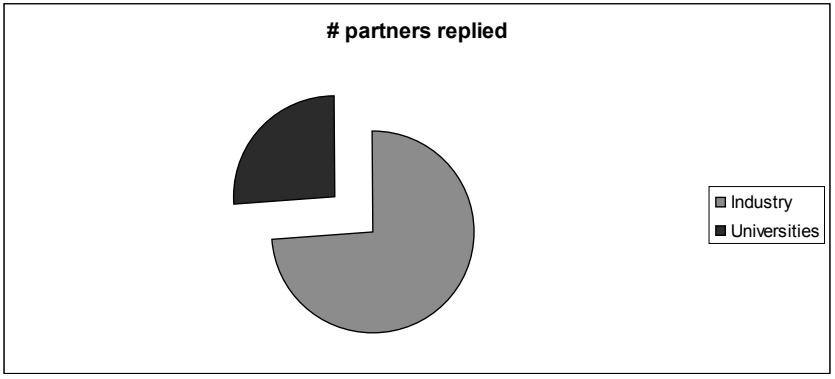
3. Finally, regarding the successful results introduced in the market, we have to emphasize that, since all the projects are in early stages, the answers were diverse and not complete. However, **demonstrators** – varying widely in scope, size & complexity - are considered by a majority as a key driver for future Embedded System developments. 67% of the respondents indicate that they actively participate in **standardisation** activities. The development of **new methodologies and tools** is also considered an important asset in the ARTEMIS programme. 12 tools have already been developed and 31 tools are planned in the near future. In order to exploit the full potential of these tools in a broader industrial context, it is recommended to further investigate the strategy (e.g. with respect to interoperability) on tool developments & exploitation within the ARTEMIS programme. With respect to **'Open Source Communities'**, responses are polarised : on one hand there is evidence that there is a contribution, but on the other hand some partners explicitly mention not contributing to it.

SURVEY RESULTS

The questionnaire was sent to 7 project consortia who participated in the 1st ARTEMIS call (2008). Six replied (86% of the project sample). 1 consortium answered as a whole. The other 5 answered on a participant-per-participant basis. A total of 34 organisations answered the questionnaire.



The participants were divided as follows : 25 industrial organisations (10 large enterprises, 15 SMEs) ,9 university institutions).



RESULTS FOR SUBTHEME 1
Focusing on common R&D agendas more effectively

TOPIC 1: Partnerships

This topic reflects the joint analysis of the answers to the following questions:

Did partnerships exist between the consortium partners before the ARTEMIS project was proposed?
If yes, please sum up all the partnerships that already existed
Have new partnerships been created or planned, between the consortium partners?
If yes, please sum up & give some short explanation of content / duration / …
Please sum up new SME partnerships resulting from participation in the project

Partnerships within the ARTEMIS programme are characterised by a strong percentage of previous collaborations. **In Call 1, 75 % of participants had cooperation in place before setting up a project consortium: 25 % did not.**

Most of the project consortia were built from existing partnerships between the participants. In total 25 participants confirmed that partnerships with other members of the consortium already existed while 8 participants indicated that they joined the project without having any partnerships beforehand. These partnerships originated mainly from other cooperation programmes like national clusters/districts, ITEA2, FP7. Some also indicated Medea+ and national programmes.

This 25% of new partners might be indicative of the degree of risk that the projects' core groups are willing to take to complement their ideas and strengthen the quality of the proposed solution. It might be interesting also to magnify the results in order to understand the role different ARTEMIS events contribute to finding those partners or if the strong national tendency of the instrument structure makes national coordinators take the risks at a national level.

The results of this collaboration in Call 1 reveal a high percentage of brand new partnerships. A total of 20 participants **(65 % of the respondents)** confirmed that cooperation in the project resulted in new partnerships while 11 participants indicated that no new partnerships were created. So, 2 in 3 participants set up new initiatives based on cooperation in the project.
Regarding the number of new partnerships created, while 39 were mentioned by the participants, this number is probably higher in reality as some participants did not give an absolute number, but indicated 'several'. For the purpose of analysis 'several' is taken as "1". So 39 is a conservative figure and means that for every participant, at least 2 new cooperative initiatives have been set up.

SME participation in those new partnerships is 33 %. A total of 12 new partnerships have already been formed in which SMEs have been involved, implying that around 1 in 3 new partnerships involves an SME.
A word of caution, on the question of new partnerships, some participants did not answer. Some indicated that there is potential but a reply would only be possible after conclusion of the project.

11 partnerships involved new or renewed collaboration with universities and research institutes.

CONCLUSION:

- Collaboration under the ARTEMIS umbrella has been very successful in creating brand new partnerships (65%), with the significant involvement of European SMEs (33%).
- ARTEMIS consortia are characterised by being strongly rooted in established collaboration relationships that take advantage of new partners to bring specific expertise to the project. Furthermore, 40% of participants are determined to continue to cooperate in future with the SME partners in their ARTEMIS consortiums.

TOPIC 2: Innovation Ecosystems

This topic reflects the analysis of the of the answers to the following questions:

Is there any ambition or plan to create such an ARTEMIS CoIE from the consortium or the project?
If yes, please explain
Is there any plan or intention to create a new company (either a spin-off or a new start-up), based on the project results?
If yes, please explain:
Is there any plan or intention to invite other SMEs to cooperate in the future based on experiences in the project ?
If yes, Please explain

The questions formulated around the topic Innovation Ecosystems, while being extremely important in terms of focusing R&D agendas more effectively, were posed to the Call 1 projects too early to expect concrete outcomes.

Regarding potential plans to create a CoIE (Centre of Innovation Excellence), it is not clear to all participants what is meant by an 'ARTEMIS CoIE'. Answers support this statement: one participant mentioned setting up something for community building via internet whereas another indicated setting up a local CoIE with local companies and research institutes. Only one participant had a clear vision of setting up a CoIE in the domain of 'Embedded Systems for Eco-Efficiency Applications'. It is intended to make the first steps that have been taken more tangible before the end of 2010.

Intentions to create new companies based on project results exist, but it is too early for most consortia to provide realistic data on this particular point. One of the projects is investigating a path to exploit project results via a spin-off company. Another is currently in discussions to set up a company for providing system-level modelling services to SMEs that lack the required skills. One new company was already formed on 2 March 2010, based on intermediate project results (TedeSys, www.tedesys.com).

Continuity of collaboration with the SMEs with which participants are linked within Call 1 consortia is a positive outcome of the ARTEMIS instrument. 14 (40%) of the 35 participants indicated that they wanted to continue the cooperation established with SMEs in the current project. Their intention is to focus on R&D activities in the area of ES. One participant indicated specifically to have extended cooperation to manufacturing level.

CONCLUSION:

> It is too early to evaluate the extent to which the ARTEMIS instrument contributes to the creation of Innovation Ecosystems, although some initiatives are emerging.
  - One new CoIE – Centre of Innovation Excellence on Embedded Systems for Eco-Efficiency Applications plans to start work in 2011.
  - One spin-off and 2 potential new spin-offs are being considered and could eventually support the establishment of an Innovation Eco-system.

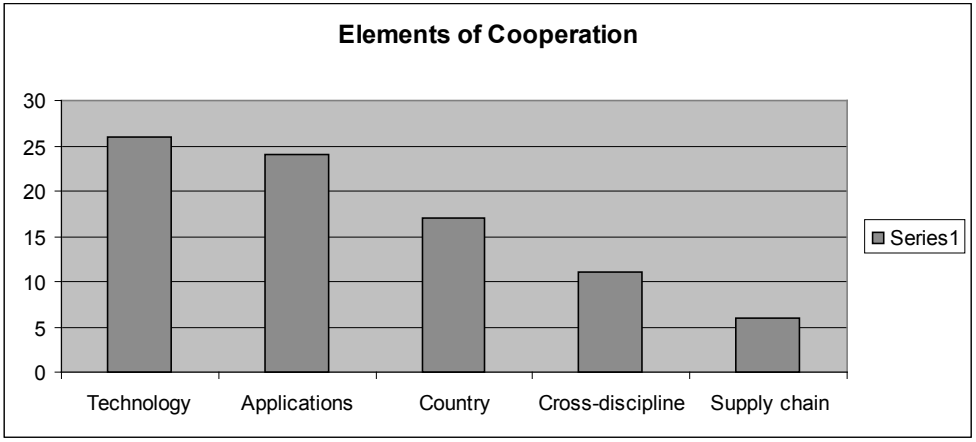
> CoIE could be an excellent instrument to pave the way towards Innovation Eco-systems. However the survey shows that there is no clear understanding of the added value of creating a CoIE at this point in time.

TOPIC 3: Drivers for Cooperation

This topic reflects the joint analysis of the of the answers to the following questions:

Along which axis is the cooperation in the project being organised?
Country-level
Technology-level
Cross-discipline
Application-based
Supply-chain based
Has this evolved over time since the project proposal phase?

On the question along which axis the cooperation in the project was organised, 60% of the answers point towards technology (26) and applications (24) as key drivers for collaboration. Others were country (17), cross-discipline (11) and supply-chain based (6). Most of the participants indicated th at this cooperation was a combination of different factors, e.g. clusters of national cooperation working together with other participants in other countries because of technology and/or applications. A few participants indicated that SME cooperation and support was mainly arranged at country level.



CONCLUSION:

> Reasons to participate in the ARTEMIS programme are based on a combination of multiple drivers. The two key drivers are 'Embedded System Technology Research' and 'Industrial Application Developments'.

TOPIC 4 : Alignment

This topic reflects the joint analysis of the answers to the following questions:

How is the project aligned with other national or other european programmes in terms of R&D topics covered?
Is there any unintended influence of the project on the internal R&D agenda of the partners in the project?
What is this influence of the project?

The topics covered by Call 1 ARTEMIS projects are aligned with other projects running under the ITEA2 and FP7 instruments. Some projects mention that they have taken their research further under national initiatives. Strong interaction does, in effect, exist in France and Germany between ARTEMIS and national clusters.

Regarding FP7, specific reference was made to ICT, and to the PPPs Future Internet and Energy Efficient Buildings initiatives. One project mentioned CATRENE as a programme to which it is aligned.

The question on potential **"influence on the internal R&D agenda of the participants"** was not clear to everyone. Answers were very different in scope and nature. Some of the aspects covered, were:

> Tool evaluation & use of prototype tools
> New business opportunities
> Discussion about future projects
> Increase focus on the Research dimension
> Increase of knowledge and experience
> Acquisition of series production projects (e.g. Airbus A380 Cabin Pressure Control System).

CONCLUSION:

> **ITEA2, FP7, CATRENE are programmes that Call 1 ARTEMIS projects see as close in terms of R&D topics covered. But participation in an ARTEMIS projects seems to broaden perspectives and develop their knowledge base.**

TOPIC 5 : Why ARTEMIS ?

This topic reflects the joint analysis of the answers to the following questions:

Why did you select ARTEMIS as a programme to submit the project?
Have you been looking at alternative programmes to submit?
If yes, which alternative programmes did you consider?
What are strengths of participating in the ARTEMIS programme from a project perspective?
What are weaknesses of participating in the ARTEMIS programme from a project perspective?

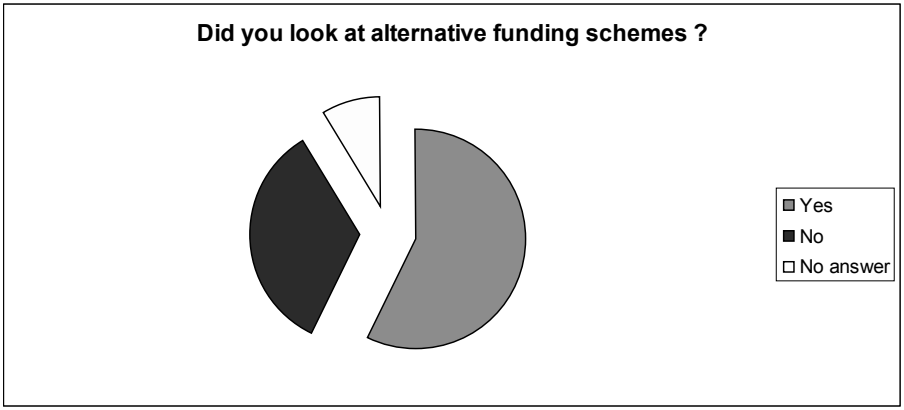
In order to explore the motivation and the impressions of participants in the Call 1, these questions were left open-ended, so answers are very diverse. A qualitative analysis and subsequent grouping of answers by themes throws a very interesting light on why ARTEMIS was chosen as an instrument to enable specific ES research visions.

ARTEMIS was the preferred choice over other programmes for three main reasons: first, for its industry-driven approach (8 answers); second, for its particular technology challenges (6 answers); and, third, due to its good blend of industrial and university participants (3 answers).

Other arguments were mentioned only once or twice, but still reflect the variety and complexity of the decision-making process surrounding participation in the ARTEMIS programme[5].

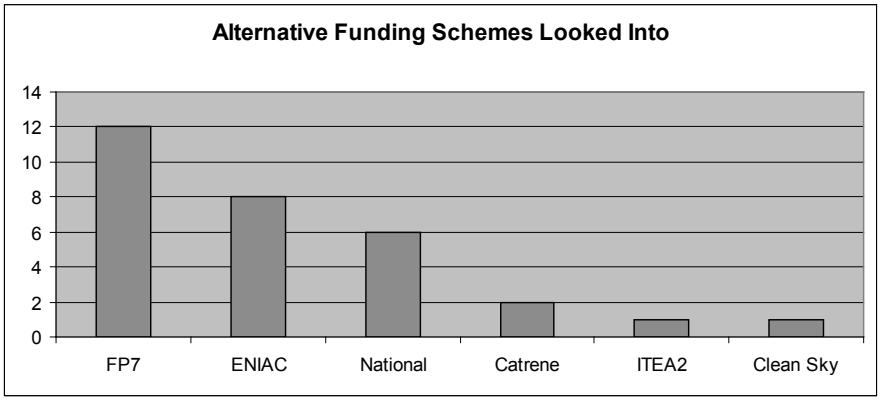
Alternative programmes?

Interestingly enough, more than half of the respondents had considered alternative funding schemes and just over a quarter had not.



[5] *- Considerable momentum*
- Influence on engineering & tools for embedded systems
- Synergy application developers & technology providers
- Manage cost complexity & convergence in global markets
- Allows good blend of industrial & university participants
- Large projects that anticipate real market impact
- Fits & supports huge challenge of system integration
- Public Value
- ARTEMIS is suitable scheme for our envisioned cooperation
- Meeting SME requirements
- Good fit with research agenda of industrial participants & complementarity with ITEA2 & FP7
- Correct level of technology readiness level for developments in the projects
- Mixed funding level
- Support for generating proposals
- Probability for success ~ trade-off between proposal writing investment & success rate (SME answer)

Alternative programmes and their relevance is expressed in percentages in the Figure below. Results that complement those presented in Topic 4: Alignment suggest there are similarities between programmes as well as a risk of innovative ideas going over to other funding frameworks if the perceived interest and benefits of ARTEMIS decrease.



An analysis of strengths and weaknesses explicitly mentioned by participants presents the following picture:

Three key **strengths were identified** (answered more than 5 times):

> **Partner Alliances / Consortium**
> **Cross-domain approach**
> **Industry drive & industry relevance**

Other, less significant arguments mentioned are:

> Combination of scientific & industrial views
> Visibility, support, dissemination & exposure of ARTEMIS-IA and ARTEMIS JU
> Close to market / mature technology
> Short decision time & simplified application process
> Both national & European support
> Success rate

Regarding weaknesses, all the arguments provided were mentioned many times:

> Long delay before first financial grant / administrative burden (13 times)
> Excessive number of participants (8 times)
> Low level of financial contribution (5 times)
> Large synchronisation overhead (thus reducing work efficiency) (5 times)

One participant complained explicitly about the high investment to participate in all ARTEMIS events, which sometimes have positive results (e.g. brokerage event), but which are sometimes too internally oriented.

It is risky to analyse such results without further data, but it seems that the question here is: if we put these results in a balance, what would carry more weight from the point of view of the participants in ARTEMIS Call 1? We venture to suggest that the strengths are far more attractive to industry and research organisations than the weaknesses and, furthermore, the weaknesses can potentially be solved but the strengths are unique to the programme.

Additional remark (issue):

The intention of ARTEMIS to start a project as soon as a label has been granted (no negotiations any more with local authorities) has not been reached.

CONCLUSION:

> **The key differentiator for ARTEMIS compared to other programmes (as e.g. ITEA2, FP7, CATRENE) is the industry-driven, cross-domain approach and the type and size of the partner alliances.**
> **The administrative burden associated with realising an initial payment after project approval is considered a key weakness of the ARTEMIS programme.**

CONCLUSIONS FOR SUBTHEME 1
Focusing on common R&D agendas more effectively

Key findings

Partnerships

> Collaboration under the ARTEMIS umbrella has been very successful in creating brand new partnerships (65%), with the significant involvement of European SMEs (33%).

> ARTEMIS consortia are characterised by being strongly rooted in established collaboration relationships that take advantage of new partners to bring specific expertise to the project. Furthermore, 40% of participants are determined to continue to cooperate in future with the SME partners in their ARTEMIS consortiums.

Innovation Ecosystems

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  - One new CoIE – Centre of Innovation Excellence on Embedded Systems for Eco-Efficiency Applications plans to start work in 2011.
  - One spin-off and 2 potential new spin-offs are being considered and could eventually support the establishment of an Innovation Eco-system.

> CoIE could be an excellent instrument to pave the way towards Innovation Eco-systems. However the survey shows that there is no clear understanding of the added value of creating a CoIE at this point in time.

Drivers for Cooperation

> Reasons to participate in the ARTEMIS programme are based on a combination of multiple drivers. The two key drivers are 'Embedded System Technology Research' and 'Industrial Application Developments'.

Alignment

> ITEA2, FP7, CATRENE are programmes that Call 1 ARTEMIS projects see as close in terms of R&D topics covered. But participation in an ARTEMIS projects seems to broaden perspectives and develop their knowledge base.

Why ARTEMIS ?

> The key differentiator for ARTEMIS compared to other programmes (as e.g. ITEA2, FP7, CATRENE) is the industry-driven, cross-domain approach and the type and size of the partner alliances.

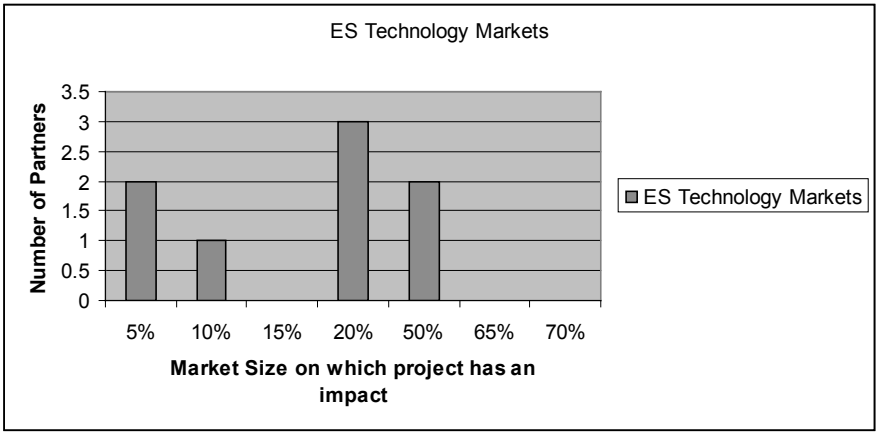
RESULTS FOR SUBTHEME 2
Providing significant economic & societal benefits

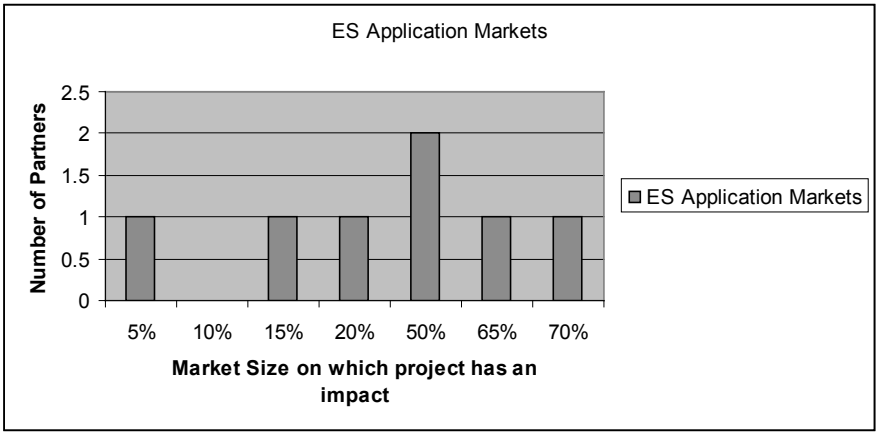
TOPIC 1: Market impact

This topic reflects the joint analysis of the answers to the following questions:

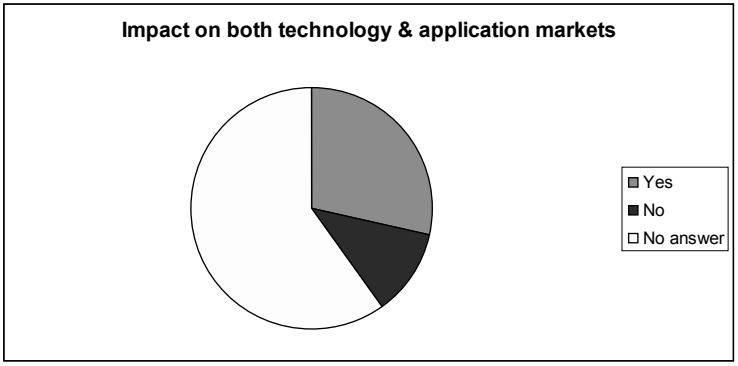
What market is your project focusing on?
ES Technology Markets
ES Application Markets
Both
When will the project be considered successful in terms of market impact (now and in the future)?

The charts below, one for the ES Technology Market and one for the ES Application Market, give an overview of the number of participants and the market size on which they estimate their project will have an impact. As is evident, the expected impact is higher on the ES application market where ARTEMIS projects have the highest degree of innovation.





A number of participants indicated an expectation that their project would have an impact on both technology and application markets, at between 25 and 50% (see chart below).



On the question of the project's market impact, most of the participants indicated a period of 2-5 years after project completion to see a real impact. For SW tools, the outcome is expected in a shorter time; for applications the time horizon is slightly longer.

One project consortium defined success as when a certain percentage of participants make further use of and develop the technology after project's completion and by at least 3 non-project participants. It is estimated this will still take 3 years after project completion by which time estimated productivity gains are expected to be 20%.

For large-scale Wireless Sensor Networks, the technology is expected to be proved upon completion of the project. It will be considered successful if at the same time it can be proven that scaling up is feasible and realistic within in a short time frame. Real success will measured by a first customer signing up to deploy a large-scale network in a real-world environment.
Approximately 10 participants indicated that success is measured when part or all of the project results can be used for the design of a new product with a clear and measurable ROI in terms of cost, development time and power dissipation.

CONCLUSION:

> **The key market impact will be through applications that will be commercially introduced within a period of 2-5 years after project completion.**

TOPIC 2: Impact on application target market

This topic reflects the joint analysis of the answers to the following questions:

Do you expect that the project will influence the specific application target market?
If yes, please explain how:
What type of impact do you plan to realise on the current specific application target market?
What is the current status?
What is the time frame in which the impact has to be realised?
What kind of effort is still required after the project to realise the impact?

Some of the impacts are generic, but some impacts are market-specific.
Some generic impacts mentioned are:

> higher degree of hardware re-usability
> early performance, power & thermal analysis (mentioned by more than 5 participants)
> new opportunities for small players
> increase the number of applications and size of the market by offering more cost effective and more reliable embedded systems.

For the aeronautics market, cost and time-to-market are expected to be reduced by:

> creating a tools interoperability standard capability to conduct trade-offs
> collaborative work based on multi-views modelling
> dependability improvement of components

For participants in space-related developments, major impact is expected in the development of unmanned systems.

The type of impact for the different players is answered as follows (in order of the total number of times they were mentioned):

> Development cost reduction: 20%
> Right first time – need to rework reduced by 20-30%
> Lead time reduction: 20%
> Time to market reduction: 10%
> Framework configuration and deployment reduction: 30%
> Increase in reuse of HW/SW components: 20%
> Reduced time & cost to carry out testing, validation & certification activities (no % mentioned)
> Reduced maintenance activities (no % mentioned)

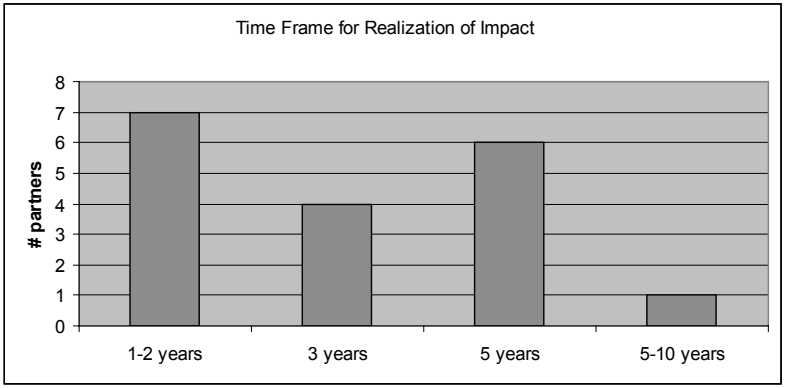
One participant mentioned the 'capitalisation of models' as a new means which will impact the way applications are being developed.

For Wireless Sensor Networks the common denominator was the extension from 'lab-scale' proof-of-concepts to 'large area monitoring' in a real world.

In the area of smart buildings, a 20% saving in energy consumption is expected to be possible by 2020 and to enable future buildings to become at least energy neutral.

For more than 10 participants, power optimisation of embedded systems will be one of the key results of the projects in which they are involved.

In terms of the time frame in which the impact realisation is planned, most participants give an estimate of 3-5 years after project completion (11). 7 participants indicate they will already see impact shortly after the project completion (1-2 years). One participant indicated 5-10 years before impact can be measured.



The bar chart above is interesting as it shows that the impact can really be achieved in the short term.

The kind of effort required after project completion is to:

> industrialise
> deploy the technical solution
> train the final users in a transnational way within the supply chain

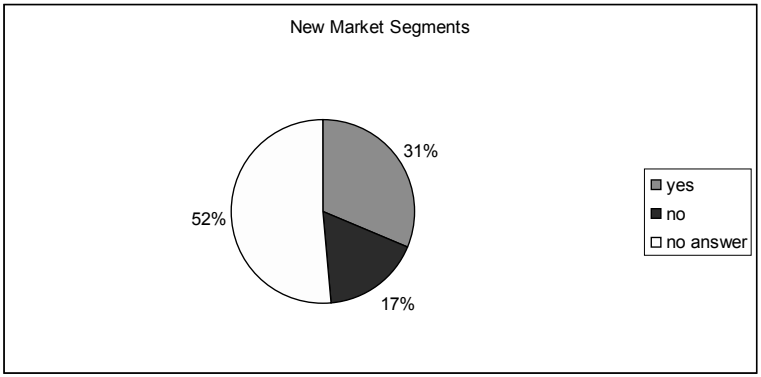
CONCLUSION:

> Key effects on applications are reduced development costs and less power consumption of future products.

TOPIC 3: New market segments

This topic reflects the analysis of the answers to the following questions:
Do you expect that the project will create any new segments in the embedded systems market or in the application market as targeted?

The question whether new market segments are being envisioned prompted the following answers as shown in the pie chart below:



There is, however, no strong explanation of what new market segments are envisioned – sharing such information is not relevant at this point in time.

Some more generic elements provided are:

> Facilitate the development of tools for critical real-time embedded systems in europe, permitting an extension of European technology providers & SMEs
> Focus more on enhancing existing segments instead of full new segments
> The possible integration of appliances in buildings resulting in better energy-efficient solutions.

CONCLUSION:

> **Although 30% is looking to new market segments, no concrete conclusions can be drawn yet, as this needs to become more specific (e.g. in a subsequent questionnaire).**

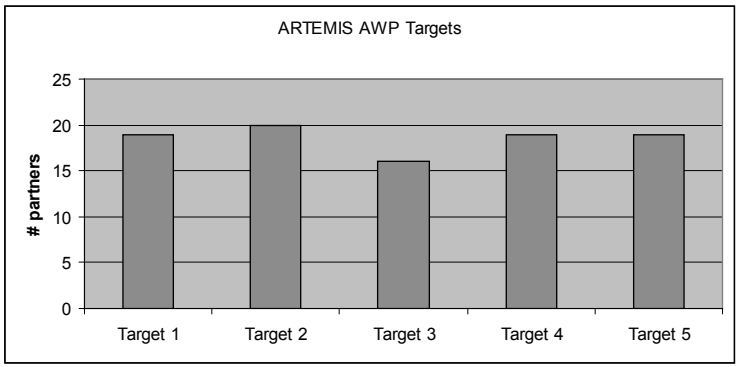
TOPIC 4: Contribution to ARTEMIS AWP targets

This topic reflects the analysis of the answers to the following questions:

Please indicate the ARTEMIS AWP target to which your project contributes. More choices are possible.
Reduce cost of system design by 15% by 2013 (compared to 2005 levels).
Achieve 15% reduction in development cycles (esp. in sectors requiring qualification/certification).
Manage complexity increase of 25% with 10% reduction in effort by 2013, compared to 2005.
Reduce by 15% the effort and time required for re-validation and re-certification of systems after making changes by 2013, compared with 2005.
Achieve cross-sectoral reusability of ES devices (e.g. interoperable components for different sectors/applications).

The ARTEMIS AWP targets are to:

1. Reduce cost of system design by 15% by 2013 (compared to 2005 levels)
2. Achieve 15% reduction in development cycles (esp. in sectors requiring qualification/certification)
3. Manage complexity increase of 25% with 10% reduction in effort by 2013 (compared to 2005)
4. Reduce by 15% the effort and time required for re-validation and re-certification of systems after making changes by 2013 (compared to 2005).
5. Achieve cross-sectoral reusability of ES devices (e.g. interoperable components for different sectors / applications)



This chart shows that all targets have been addressed.

The following arguments were used for the different targets.

1. Reduce cost of system design by 15% by 2013 (compared to 2005 levels)
   - Provide architecture trade-offs, reuse / product line capabilities
   - Create reuse dynamics by prequalified components and architecture
   - Component based design
   - Integrated tool chain
   - Open source high level modelling tools and methodologies
   - Reducing power consumption will reduce thermal effects, then cooling systems, then weight, size & cost
   - Architectural mapping & software optimisation
   - Composable, modular firmware development with re-use of existing models
   - Re-use of basic performing hardware platform with added specialised blocks (e.g. hardware accelerators)
   - Variability in terms of quality
   - Formal approach to capture user requirements and forward these into a test sequence for automating the validation and verification of both functional and non-functional properties
   - Standards
   - Increasing the effectiveness of existing error propagation analysis and online fault management

2. Achieve 15% reduction in development cycles (especially in sectors requiring qualification/certification)
   - Pre-certified components, pre-validated components, formal verification, requirement formalisation
   - Automated testing should even result in higher reduction levels
   - Optimisation of requirements in the V-cycle
   - Use of (more) formal methods and tool qualification
   - Model-based approach in order to create smoother path to product qualification / certification
   - Moving the complexity at system level
   - Methodology and tools to give architects the possibility to evaluate the validity of the specifications and system architecture solutions
   - Improved design & simulation platforms will allow acceleration (up to 30%) of virtual prototype implementation
   - New methods & tools for power/thermal characterisation of industrial platforms
   - Faster architectural mapping and software optimisation
   - Common meta models
   - Tools to detect problems earlier in the development lifecycle, improving software quality and certification processes by developing tool-aided process and product control and system/software integrated development environments to avoid design flow gaps

3. Manage complexity increase of 25% with 10% reduction in effort by 2013 (compared to 2005)
   - Provide multi-views and multi-criteria analysis capabilities and formalisation of requirements
   - Multi-criteria management of models
   - More efficient handling of product variants

- Modelling approaches to better deal with the product complexity (better comprehensibility, more automation)
- Fault tolerant radio communication techniques and reliability in general
- Reflective Python-based modelling and simulation
- Reduction in complexity of thermal estimations
- Architectural mapping & software optimisation
- Applying techniques from other domains & providing results for cross-fertilisation
- Make standard components available to system developers
- Reduce the resource complexity of fault-handling mechanisms

4. Reduce by 15% the effort and time required for re-validation and re-certification of systems after making changes by 2013 (compared to 2005).
   - Pre-certified components, pre-validated components
   - Very fast validation of changes in design
   - Higher abstraction level models
   - Reliability assessment tools
   - Composability, dependability & predictability aspects
   - Efficient Resource Management Layer
   - Possibility for easy & rapid re-validation of performance & power figures
   - Meta-models and profiles to enhance current tool-chains
   - Re-use of low-level software elements
   - Simplifying and modularising the existing error propagation and fault-handling middleware mechanisms

5. Achieve cross-sectoral reusability of ES devices (e.g. interoperable components for different sectors / applications)
   - Shared components libraries, configurator of framework based on common tools & techniques
   - Common tools baseline and interoperability if tools are different
   - Common standards which are valid for different application domains – base for cross-sectoral re-usability
   - Fault-tree analysis meta-model and proprietary tool format translators
   - Combination of different technologies to achieve a new application
   - Efficient simulation of models described at higher levels of abstraction
   - System modelling capabilities
   - Context aware innovations in the domain of middleware technologies
   - Many participants mention that the cross-sectoral proof will be done within the project itself

CONCLUSION:

> **All ARTEMIS AWP targets have been addressed with no real differentiator. Although technologies that contribute to these targets have been mentioned, the link between how these technologies contribute to the specific quantitative data is not always clearly explained. This requires further attention.**

TOPIC 5: Quantification of current & future results

This topic reflects the analysis of the answers to the following questions:

Please quantify the results of the project till now.
Please quantify the expected future improvement
If you do not have quantitative data available, please explain in a qualitative way what your contribution will be (and/or make some estimates).

For many participants no information could be given at this stage because the application and demonstration activities had not yet been started or the integration work was not yet finalised.

Some participants indicated energy savings while keeping the performance on a cross-domain multi-core platform. The following figures have been given by different participants working in this field : 7%, 30%, 45%, 50% and 55%. One participant managed to reduce power consumption of a video application up to 20% on a mono-processor platform for the same application and same level of performance by using the new resource management techniques developed in the project, and up to 40% on a multi-processor platform.

One participant indicated that multi-core application test benches had been implemented in different hybrid programming models. Current results were that message-relay implementations were 10-20% more efficient than shared memory and transaction memory implementations.

Other quantitative data provided :

> 10-15% savings of computing resources
> 50% die area reduction
> 20% productivity gain
> 25% performance improvement
> 20% shorter thermal estimation time vs. off-the-shelf flows
> 1.8x, 2.5x and 3x performance speed-up when software is running on 2, 3 or 4 processors on a new platform.
> 10x in performance/power analysis speed-up with a loss of accuracy below 10%.

One consortium indicated that a major refurbishment, in terms of energy, will occur in 5% of the buildings in the following 5 years (9.2 million buildings) thanks to the application of new embedded systems. The consortium plans to sell its platform directly to 1% of the refurbished buildings (92,000 buildings), representing a turnover increase of 25,000 euros each, meaning a total income of 2.3 billion euros and an estimated revenue of 750 million euros. Selling through other distribution networks and technology transfer is expected to happen for 2% of the buildings, representing a turnover of 6,000 euros each, meaning a total of 1.1 billion euros and an estimated revenue of 250 million euros.

CONCLUSION:

> The respondents have given an overview of current and planned results with quantitative data, which potentially have a large impact in a wide variety of applications & markets.

> While a number of planned technical quantification results has been reported, more information is required. It can be considered as an important step forward that different ARTEMIS partners are making such quantitative objectives more and more visible and specific. There is a gap, though, between what organisations say their results are and understanding how they arrive at those quantifications, an issue that will have to be tackled in the next survey.

TOPIC 6: Radical innovation

This topic reflects the analysis of the answers to the following questions:

Has radical innovation been obtained (e.g. uproc., SW defined radio, …) ?
If yes, what? And what is the business potential?
Is there the prospect of gaining radical innovation in future (e.g. uproc., SW defined radio..)
If yes, what? And what is the business potential?
Is there the prospect of realising a scientific innovation breakthrough beyond the state of the art?
If yes, what?

As the projects have only been running for 2 years, no radical innovations have yet been obtained.

One participant considered the fact that evaluating software for a target architecture by only modelling the input/output behaviour leads to a radical innovation.

Another participant considers the combination of existing methods in specific domains to make them accessible and available for cross-domain use as an important achievement for European industry towards cost reduction for the development of new products.

A number of participants indicate that they are focusing more on an evolutionary improvement approach than a radical innovation.

Some participants indicate the following expected results as major achievements, which can be called 'radical innovations'compared to the current state of the art :

> Tool interoperability standard
> Availability of pre-certified components
> Composable platforms
> More technology providers and European SMEs
> Innovative Reference Technology Platform
> Wireless Sensor Networks moving to large-scale deployment
> Better products in terms of autonomy, thermal dissipation and size
> Innovative thermal characterisation strategy without the need for technology information, but from on-line monitoring, integrated in current operating systems
> New tool for performance and power analysis
> Cost-effective real-time pricing to manage energy consumption
> Real-time power consumption sensor and embedded energy controller for the urban or domestic area

No quantification of potential business impact could be given at this stage, although there is an overall consensus that the large-scale Wireless Sensor Networks do have considerable business potential.

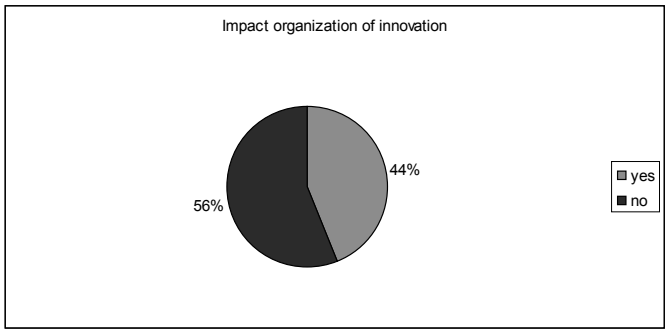
CONCLUSION:

> 'Radical Innovation' can be interpreted in different ways. If one considers such an innovation at the same level as the invention of the micro-processor by Intel, for example, then such an invention in the ARTEMIS context should be considered as extremely successful. If it is interpreted more broadly, then more results can be considered. Therefore, it is important to define what exactly is meant with 'Radical Innovation' in order to make the question more clear.

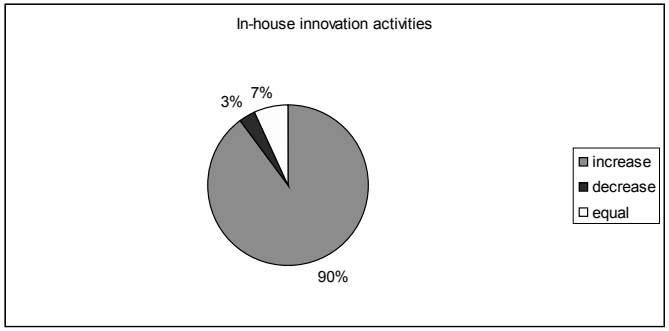
TOPIC 7: The way innovation is organised inside the company

This topic reflects the analysis of the answers to the following questions:

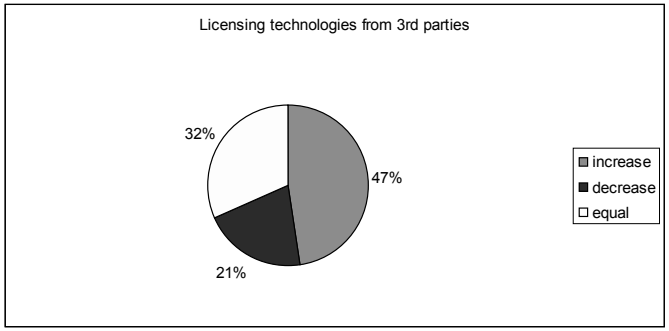
Does the project impact the way you organise innovation within your company?
Do you increase/ decrease your in-house innovation?
Do you increase/ decrease licensing technologies from 3rd parties?
Do you increase/ decrease outsourcing of innovative activities to project partners, to external non-project partners, to universities, etc?
Does the project have any impact on the total R&D expenditure of your company?



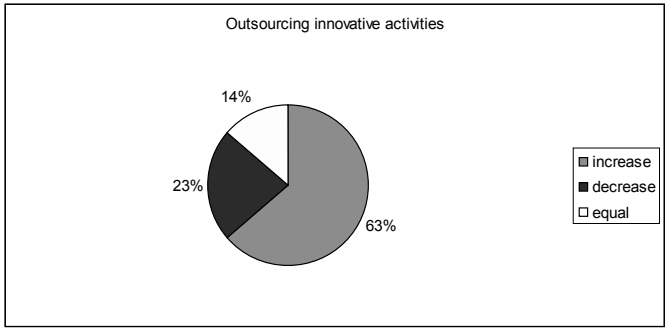
The projects do have an impact on the way innovation is organised in the company for 44% of the respondents. The main impact is in the way and methodology used on how to develop and test embedded systems. Others emphasise an increasing evolution towards a cooperative model instead of doing everything in-house themselves. Some indicated they have evolved from short-term oriented R&D towards mid-term oriented R&D.



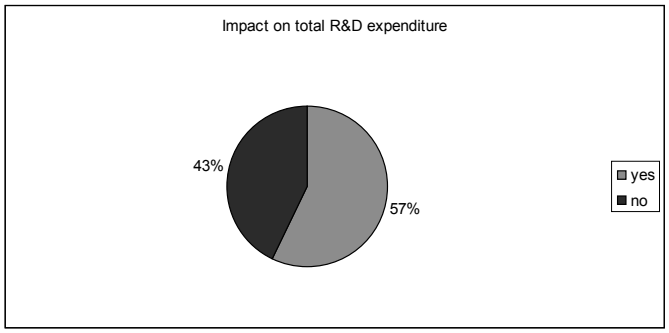
For almost all participants the amount of in-house innovation has increased by participating in the ARTEMIS programme (90%).



Regarding licensing from third parties, no clear conclusions can be drawn. One third remains unchanged (no impact). A majority indicates a growth in the amount of licensing and a larger number is witnessing less licensing.



On the other hand, almost two-thirds of the participants indicate they will outsource a larger chunk of future work to third parties. This is often a result of projects whereby the cooperation leads to further innovative joint projects or to bilateral agreements on further partnership.



For a majority of participants (57%) taking part of an ARTEMIS project has an impact on the total R&D expenditure of their organisation. This can range from reducing product development costs to increased expenditure thanks to the subsidies received, especially under financial crisis. This was especially recognised by SMEs that consider project contributions as a stimulus for sustaining R&D budgets in future initiatives.

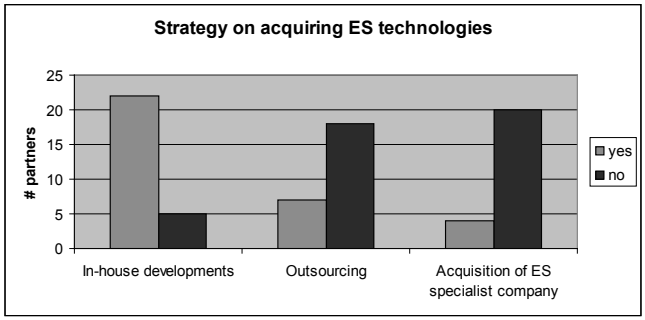
CONCLUSION:

> In-house innovation and development remain key for the participants in the ARTEMIS programme.
> A large majority (90%) indicated that in-house innovation increased while 56% stated that the way the innovation is organised is not affected by participating in the ARTEMIS programme.
> Overall, there is also an impact on the amount of licensing, outsourcing and R&D expenditure. Participating in a programme like ARTEMIS demonstrates a clear impact on the size of the R&D teams and the interaction with outside teams.

TOPIC 8: Strategy on acquiring Embedded Systems technologies

This topic reflects the analysis of the answers to the following questions:

What is the overall strategy on acquiring ES technologies
In-house
Outsourcing
Acquisition of a ES specialist company



A majority of the participants prefer an in-house development strategy for acquired Embedded Systems technologies. Outsourcing is another, much less preferred option. A large number of participants deliberately opt not to outsource developments of this type. A few participants indicated that they are also looking for the acquisition of high-tech companies in the near future.

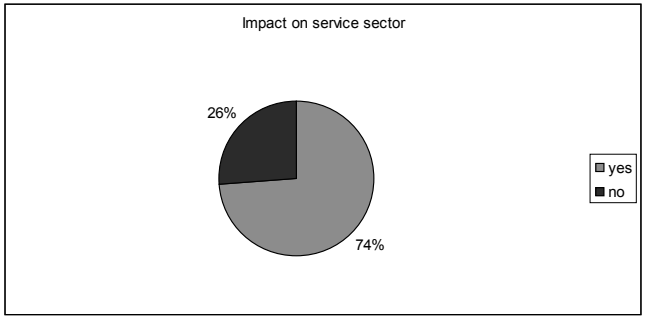
CONCLUSION:

> As already stated above, in-house development remains key for the ARTEMIS project partners and remains more important than outsourcing & acquisition. However, this requires more in-depth investigation in a subsequent questionnaire.

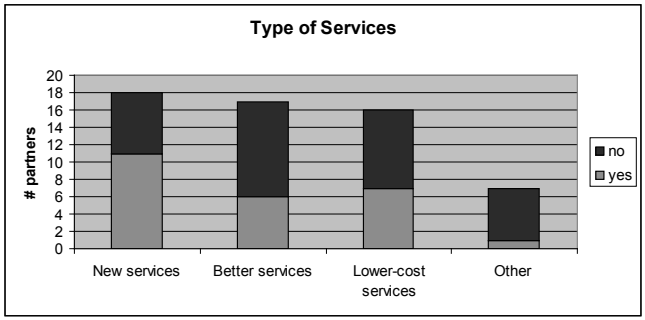
TOPIC 9: Impact on service sector

This topic reflects the analysis of the answers to the following questions:

Is any impact expected on the service sector?
If yes, what impact?
New services
Better services
Lower-cost services
Something else:



Almost 75 % of the participants indicated that the results of the project are expected to have an impact on the services market.



In terms of types of service, most achievements will result in the commercial introduction of new services. Some indicated lower-cost services, but the general consensus was that for this type of services, one never evolves to lower costs because of the high and increased quality offered. It is strange, however, that "better services" score so low.

CONCLUSION:

> First data on the impact on the services market has become available, but more details are needed in order to make any concrete conclusions.

TOPIC 10: Societal Challenges

This topic reflects the analysis of the answers to the following questions:

Have green initiatives been started or planned from the project?
What is the (potential) contribution to societal challenges?
Green car:
Electrical car:
Mobility:
Energy efficiency in buildings and other applications:

Future factory:
CO_2 emission:
Health and Well-being:
Support of ageing society:

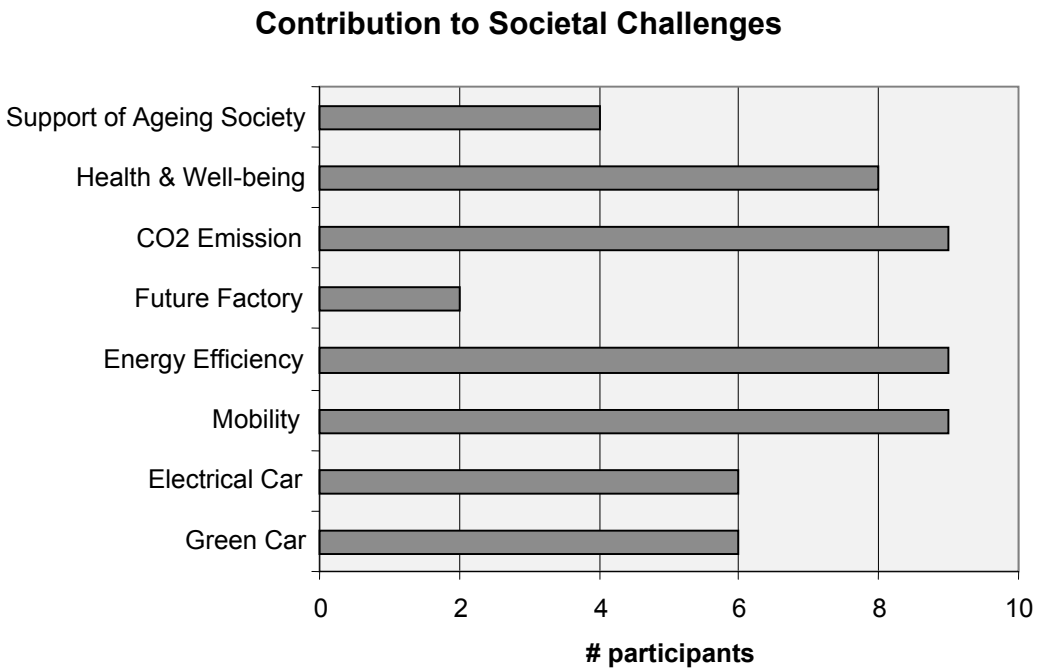
20 of the 34 respondents replied to the question whether or not they had or had planned 'Green Initiatives' within the scope of their projects. 5 of them (25%) explicitly mentioned that they had whereas 15 (75%) mentioned that they had not directly planned for it.

It is interesting that most of the participants indicated that they work on specific embedded control devices (both hardware & software) that respond to a number of societal challenges in a direct or indirect way. Participants perceive Embedded Systems as an enabling technology across a variety of applications/markets.

Regarding the societal challenges listed for the question[6], participants see their projects contributing less to the category 'Future Factory' while 'Energy Efficiency' related topics (incl. CO_2 emission) are identified as the area where their work within ARTEMIS contributes the most. Some participants explicitly mentioned the target of a 20% reduction of CO_2 emissions for 2020, compared to 1990 levels. One consortium indicated that its project was aiming at an average reduction of energy consumption for intelligent buildings in the 27 European Member States of 26.05%, an equivalent of 726 million tonnes of oil.

The topic 'Mobility' is a special case since it was understood by different participants in different ways. Some interpreted this term as 'being mobile everywhere all the time', while others interpreted it as 'mobility of transport'. See table below:

[6] *It is important to mention that a lot of answers were 'empty'.*



CONCLUSION:

> Embedded Systems technology is perceived by the respondents as a truly enabling technology across a variety of applications/ markets.

> The ARTEMIS respondents are focusing mainly on 'Energy Efficiency' and 'Mobility of people and objects'.

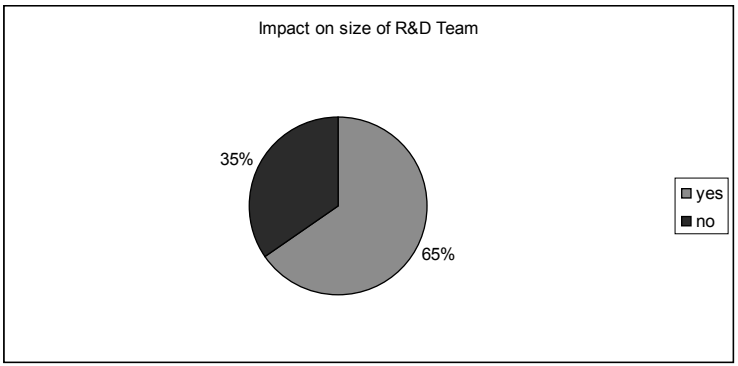
> Embedded Systems contributions to societal challenges should evolve through time and next surveys may provide new insights on how the ARTEMIS community tackles them.

TOPIC 11: Size of R&D teams

This topic reflects the joint analysis of the answers to the following questions:

Is there any impact of ARTEMIS projects on the size of R&D teams in Europe in the company?
If so, can you please elaborate?
Please also indicate if there is any partnership with universities & research institutes related to this:

Regarding the impact in relation to the size of the R&D teams, two-thirds of the participants indicate that the cooperation within ARTEMIS has indeed has an impact of the size of those teams in the organisation.



The participants used the following arguments to assess the impact:

> Transnational teams under a unique project management even if the national companies are the official participants of the project
> Increase the R&D partnerships with other industrial domains (cross-domains)
> Extend collaboration with European labs
> More & better results through collaboration instead of going it alone
> Larger teams thanks to additional funding
> Possibility to have (more) PhD students working on the project

Some unique quotes from industrial organisations :

> "Our team is expanding"
> "The project team did not exist before the project was conceived"
> "Being a small enterprise, ARTEMIS projects allow us to build and keep a sizeable R&D team with mid-term stable objectives"
> "Direct impact of this project to the company's R&D size is 4 people"

CONCLUSION:

> **Participating in a programme as ARTEMIS does demonstrate a clear impact on the size of the R&D teams and the interaction with outside teams.**
> **The way of thinking becomes much more transnational and open-minded.**
> **However, the current survey has not captured the difference of the impact of participation within ARTEMIS on research and industrial organisations' R&D teams. This is an aspect to study in the next survey.**

TOPIC 12: Sustainability

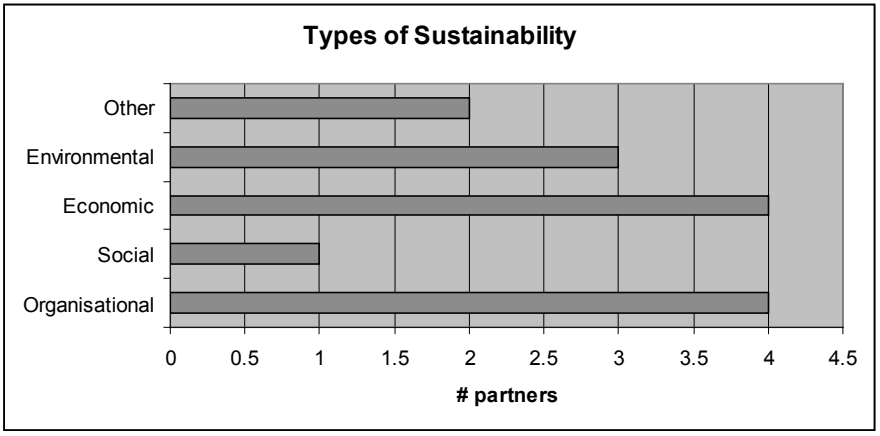
This topic reflects the analysis of the answers to the following questions:

What type of sustainability is envisioned: organisational, social, economic, environmental, all of them?
Is it a direct or indirect contribution?
Please give quantitative variables if possible:

Merely 16 participants out of 34 replied to the question whether their project was contributing to a 'sustainability strategy'. Half replied yes and half no. Answers group mainly around the categories Organisational, Economic and Environmental (see chart below)[7].

Only 4 of those 16 indicated whether the contribution was direct or indirect, with 1 organisation indicating that the project contribution towards sustainability of some sort was 'direct'. This was related to organisational aspects, more in particular new types of collaboration that had been established as a consequence of participation in an ARTEMIS project. 3 answered that the contribution was 'indirect' with no further explanation.

[7] *Please note that not all 16 participants replied to this question.*



CONCLUSION:

> Sustainability does not seem to factor as a contribution in Call 1 ARTEMIS projects as a main concern. The number of answers gathered is too low and thus too unrepresentative of the whole ARTEMIS programme to draw any real conclusion(s). The WG suspects that the concept and the question were not understood properly by the respondents.

CONCLUSIONS SUBTHEME 2
Providing significant economic & societal benefits

Key findings

Market Impact

> The key market impact will be through applications that will be commercially introduced within a period of 2-5 years after project completion.
> Impact on Application Target Market
> Key effects on applications are reduced development costs and less power consumption of future products.

New market segments

> Although 30% is looking to new market segments, no concrete conclusions can be drawn yet, as this needs to become more specific (e.g. in a subsequent questionnaire).

Contribution to ARTEMIS AWP targets

> ARTEMIS AWP targets have been addressed with no real differentiator. Although technologies that contribute to these targets have been mentioned, the link between how these technologies contribute to the specific quantitative data is not always clearly explained. This requires further attention for the future ARTEMIS programme definition.

Quantification of current & future results

> The respondents have given an overview of current and planned results with quantitative data, which potentially have a large impact in a wide variety of applications & markets.
> While there has been a number of planned technical quantification results, more penetration is required. It can be considered as an important step forward that different ARTEMIS partners are making such quantitative objectives more and more visible and specific. There is a gap, though, between what organisations say their results are and understanding how they arrive at those quantifications, an issue that will have to be tackled in the next survey.

Radical Innovation

> 'Radical Innovation' can be interpreted in different ways. If one considers such an innovation at the same level as the invention of the micro-processor by Intel, for example, then such an invention in the ARTEMIS context can be considered as extremely successful. If it is interpreted more broadly, then more results can be made visible. Therefore, it is important to define what exactly is meant with 'Radical Innovation' in order to make the question more clear.

The way innovation is organised inside the company

> In-house innovation and development remain key for the participants in the ARTEMIS programme. A large majority (90%) indicated that in-house innovation increased . Overall, there is also an impact on the amount of licensing, outsourcing and R&D expenditure. Participating in a programme like ARTEMIS demonstrates a clear impact on the size of the R&D teams and the interaction with outside teams.

Impact on Service Sector

> First data on the impact on the services market has become available, but more details are needed in order to make any concrete conclusions. This needs to be worked out in more detail in the ARTEMIS programme and the next questionnaire.

Societal Challenges

> Embedded Systems is perceived by the respondents as a truly an enabling technology across a variety of applications/markets.
> The ARTEMIS respondents are focusing mainly on 'Energy Efficiency' and 'Mobility of people and objects'. Embedded Systems contributions to societal challenges should evolve through time and next surveys will provide new insights on how the ARTEMIS community tackles them.

RESULTS FOR SUBTHEME 3
Successful results in the market

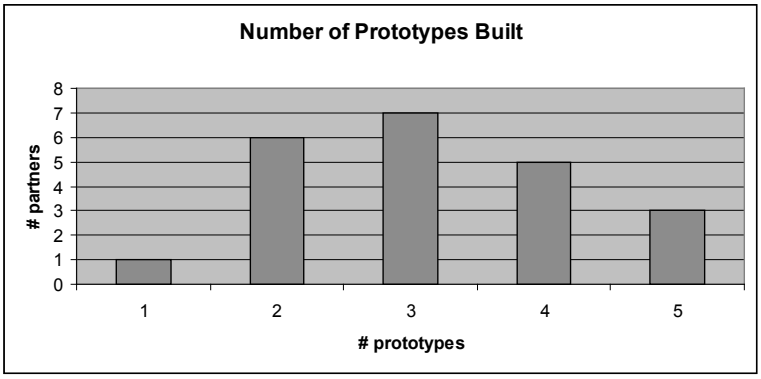
TOPIC 1: Application Prototypes

This topic reflects the analysis of the answers to the following questions:
How many application prototypes have been built or are planned to be built?

This question was answered by 25 of the 34 partners. The others indicated that there were no plans or decisions on this as yet. For all the partners who answered, typically 1 demonstrator for a specific application was being built in the scope of the project and the other demonstrator(s) in that same application domain would be built after the project finished. That means that *50-75% of the work on demonstrators is post-project.*

Regarding the type of prototypes that will be built, the answers were very diverse, e.g. cabin mock-ups, airbus devices, astrium satellite modules, railway signalling on-board units, audio devices, etc. One consortium mentions that 2 demo-labs will be built and 4 real-scale demonstrators in 4 different buildings. Although the question was explicitly on application prototypes, 2 participants mentioned that prototype software tools were being developed.

On the number of demonstrators, the overall view is given in the chart below revealing that 7 partners indicated that they planned to build 3 prototypes in their project, 6 would build 2 prototypes , 5 partners would build 4 prototypes, and 3 would build up to 5 prototypes within the project. One partner indicated that it would only 1 prototype in its project.



CONCLUSION:

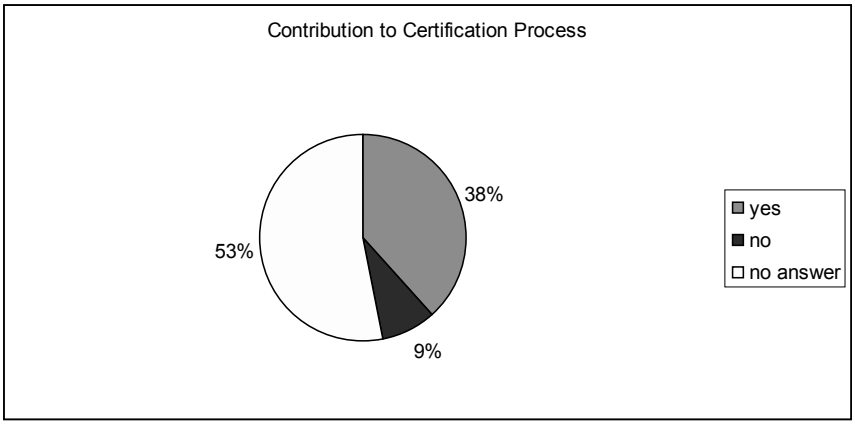
> Demonstrators are a key element in Call 1 ARTEMIS projects.
> Whereas they vary widely in scope, size and complexity, they are considered by all partners a key driver for future ES developments.

TOPIC 2: Certification Process

This topic reflects the analysis of the answers to the following questions:

Does the project contribute to improving the certification processes of products?

Almost 40% of all respondents replied that they would contribute to the certification process in one or another way. If we take away the "no answers", this means that 80% will contribute and 20% will not.



The following contributions were mentioned multiple times:

> Standardised environment in which the tools can be plugged and a configurator enabling the development framework to be tuned to industrial needs (Reference Technology Platform).
> Tool interoperability
> Easing the certification process by increasing the composability, dependability and predictability of processing system-on-chip components, leading to an 'incremental certification'.

CONCLUSION:

> In terms of certification, the contributions identified are the following : standardisation, certification for interoperability of tools & devices, and simplification of the process.

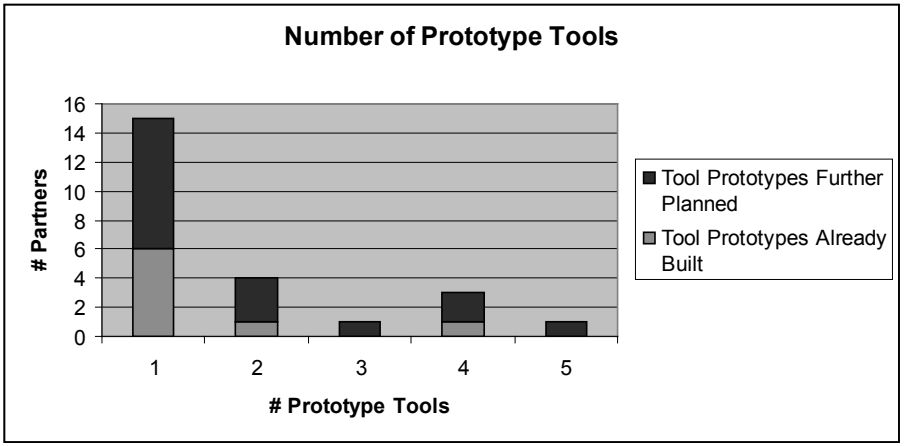
TOPIC 3: Methodologies, Tools & Tool Platforms

This topic reflects the analysis of the answers to the following questions:

How many prototypes of tools are planned to be built?
How many tool prototypes have already been built?
If no new platform is created, which ARTEMIS Tool Platform is being used by the project?
How is the method / tool usage?
Who is using what methods /tools?
How many of the partners in the project contribute to the Tool Platform?
What is the expected re-use of methods / tools by each company?
Please give some examples of improved methods / tools - more integrated / coherent

A number of prototype tools have already been built in the first 2 years of the ARTEMIS programme. Some further prototype tools are planned to be developed in the remaining part of the projects. Most of the participants work on 1 prototype tool but some of them will develop 4 or 5 during the project. It is also important to mention that some consortia explicitly mention that they focus on new applications with existing tools, and as such do not work on any prototype tools at all.

An overview of the number of participants working on specific prototype tools is given in the chart below, showing that 6 partners have already developed one prototype tool and 9 partners plan to develop a prototype tool in the remainder of the project. One partner has already developed 2 prototype tools and 3 more partners expect to develop 2 prototype tools during the remainder of the project.



On the question related to tool usage and re-use of tools, no relevant data is available for any conclusions to be drawn. Either the questions were not clear enough or it is too early in the project lifecycle to provide any relevant statistics.

In the area of improvements of methods and tools, the following projected achievements were given (in order of number of times mentioned):

> Requirements engineering, such as (semi-formal & formal) requirements specification language
> Seamless modelling of the product in the different development phases
> Coherent interfaces in central tools / tool platform
> (Near) real-time visualisation
> Run-time fault handling
> Reduction in development time & improvement in reliability due to the absence of design faults in architectural services ('proven set of services' results in direct usage without extra design work)
> New user interface interactive methods for Wireless Sensor Networks

CONCLUSION:

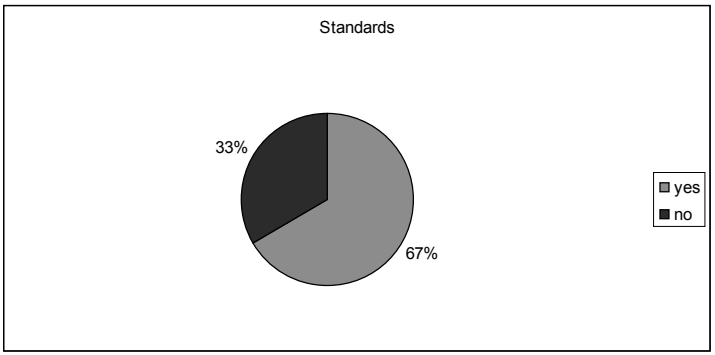
> The development of new methodologies and tools is an important asset in the ARTEMIS programme.
> 12 tools have already been developed and 31 tools are planned in the near future.
> In order to exploit the full potential of these tools in a broader industrial context, it is recommended to further investigate the strategy (e.g. with respect to interoperability) on tool developments & exploitation within the ARTEMIS programme.

TOPIC 4: Standards

This topic reflects the joint analysis of the answers to the following questions:

Is there any specific contribution to standards? Please explain
Have any new standards been set up?
Is there a specific contribution / extension to existing standards?

On the question of whether participants were actively participating to standardisation (either in existing organisations or in new standards developments), 67% answered positively (see chart below).



Most contributions were devoted to interoperability standards between different tools. One participant explicitly mentioned participation in a new standard development, but did not reveal any details.

Some important contributions to existing standardisation groups, were the following :

> Multicore Associations Multicore Resource Management API MRAPI
> Zigbee Alliance
> ISO 26262
> Services Standard to Genesys Platform

Because the projects have only been running for 2 years, it is too early to make a real in-depth analysis of the final results in this domain.

CONCLUSION:

> 67% of the respondents indicate that they actively participate in standardisation activities.

TOPIC 5: Novel Business Models & Open Source Communities

This topic reflects the analysis of the answers to the following questions:

How many novel 'business models' have been undertaken (e.g. open-source, new distribution mechanisms, etc….)?
How many open-source communities have been established? Give examples:
What results have been submitted to open-source communities? Give examples:

On the question related to 'Novel Business Models', there were many 'no' answers (no answer at all or 'not applicable', 'not known', 'no answer', 'empty') and many indicating that it is too early to analyse this. A 2-3 year running project is to be considered as a starting point and real impact in terms of business & business models can only be expected within a time frame of 5-10 years after the project is finalised.

However, 3 participants explicitly mentioned that for the use of and contribution to 'Open-source Software' distribution was a new concept not worked with so far. Some have even opened new Open Source Communities such as:

> - 'wiki on Open Source System Design',
> - a 'Supervised Open Source Versioning System',
> - an 'open Zigbee net community' (open-source toolset for IEEE 802.15.4 Zigbee)
> - Par4All – a platform dedicated to technologies for automated parallelisation of software
> - GStream Open Source Community.

Five large industrial partners made very explicit no contribution to any Open Source Community. One of them indicated that this is considered not the goal of the industry in the domain they are working in.

Here also the total amount of data is too limited to draw real conclusions but, at least, the growing importance of 'Open Source Communities' in today's Embedded System developments cannot be underestimated.

Concerning the new business models, two other new approaches have been mentioned as future aims :

> provision of modelling services to SMEs
> provision of *consecution??* of energy efficient buildings as a service

CONCLUSION:

> In general 'novel business models' within ARTEMIS is still an area in its infancy.
> With respect to 'Open Source Communities', responses are polarised: on one hand, there is evidence that there is a contribution to Open Source Communities and, on the other hand, some partners explicitly mentioned not contributing to it.
> Longer time frames are needed to observe progress in these areas.

TOPIC 6: Patents

This topic reflects the analysis of the answers to the following questions:

How many patents have been filed?
Where are/were they filed?
Is there an increase in patents filed originating from Europe and based on the project (planned) results?

On the question of new or intended patents, the main result was also that it is too early to provide detailed data on this. Only 10 of the 34 participants replied.

7 answered that they were not envisioning any patent submission at all, which is a quite high figure while 2 indicated that new patents were under study. One participant indicated that it had already submitted a patent in the first two years of the project.

CONCLUSION:

> Regarding patent filing, the time frame of 2 years is too short to draw any conclusions.

TOPIC 7: Public trials

This topic reflects the analysis of the answers to the following questions:

How many public trials have been set up or are planned?
What is the size of this pilot?
What is the number of users involved?
Will the results be made available to third parties?

A large number of organisations did not reply to this question. Some of these indicated that they are working in a B2B-type project, and hence 'Public trials' are not planned. These are only realistic when project results are embedded in final products after completion of the project.

However, some participants / consortia do envision public trials. Three participants mention that they plan 1 public trial. Of these three, two are still in the definition stage while one is already defined and envisioned as an 'unmanned system', with the following stakeholders involved : industry, service providers and civil protection representatives.

One consortium targets 2 public trials, one with 300 and one with 10,000 motes and 9 different participants involved.

Finally, one project will do 4 public trials in residential and office buildings, with more than 100 users each time. An initial trial is planned in an office building in Madrid, encompassing 150 users.

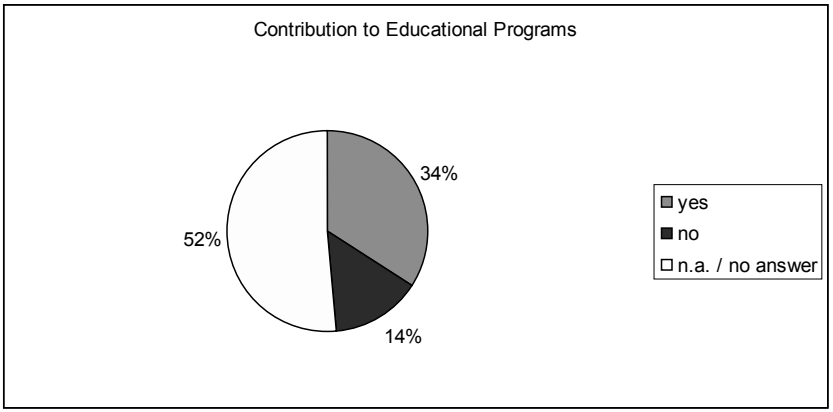
CONCLUSION:

> **Public trials are envisioned where relevant in the project – these tend to be large-scale.**

TOPIC 8: Contribution to educational programmes

This topic reflects the analysis of the answers to the following questions:
Is there any contribution to educational programmes?

Several participants indicate that the project findings will be integrated in courses and lectures, both at university level and at post-Master of post-PhD level (e.g. courses to industry & users), although the relevance of the statistical data of the answers given below can be questioned as this is a task mainly of universities & research institutes rather than industrial participants. A limited number of participants also indicated that the tools developed will be used for teaching as well as research purposes at universities.



CONCLUSION:

> Within the framework of ARTEMIS, and as in any other EU-oriented programme, universities do play a key role in the contribution to educational programmes.

TOPIC 9: Dissemination

This topic reflects the joint analysis of the answers to the following questions:

Please provide figures on dissemination actions
Number of books published:
Number of papers published:
Number of brochures:
Number of press releases:
Press coverage:
Number of seminars & workshops
Number of presentations with project results at conferences & workshops
How many attendants?

As the projects are only running for 2 years, the data needs to be handled with care. Typically in the first year of the project there are fewer activities related to dissemination than near the end of the project or after project completion.

Below are the answers to the different questions with an overview of partners that replied 'yes', explicitly stated 'no' (meaning they do not contribute to it), and have not (yet) answered or left the box empty.

	yes	no	no answer
Books	2	6	27
Papers	15	3	17
Brochures	6	5	24
Press releases	3	4	28
Seminars / Workshop	24	2	9

Some data can already be extracted, but is not complete as a number of participants did not answer the questions related to this topic in the table above (so the data is a real minimum):

> One consortium already contributed to 5 books
> Two consortia mentioned that they are planning to work on 6 books in total towards the end of the project
> One new professorship has been created in Germany on 'Model Based System Engineering', based on current project results.
> 30 papers have been published
> 30 brochures for dissemination have been made
> 3 press releases have been written on intermediate results, each with around 20 press citations
> 43 presentations given at workshops and conferences were attended by 40 to 500 people. The following workshops / conferences were explicitly mentioned :
  - ERTS
  - Embedded World
  - DATE
  - VIF
  - ARTEMIS Co-Summit
  - ARTEMIS Summer School Budapest

CONCLUSION:

> **Standard dissemination channels are well covered by all participants.**

CONCLUSIONS FOR SUBTHEME 3
Successful results in the market

Key findings

Application Prototypes and Standards

> Demonstrators are a key element in ARTEMIS Call 1 projects. Whereas they vary widely in scope, size and complexity, they are considered by all partners a key driver for future Embedded System developments.

Certification Process

> In terms of certification, the contributions identified are the following : standardisation, certification for interoperability of tools & devices, and simplification of the process. Remarkably, 67% of the respondents indicate that they actively participate in standardisation activities.

Methodologies, Tools & Tool Platforms

> The development of new methodologies and tools is an important asset in the ARTEMIS programme. 12 tools have already been developed and 31 tools are planned in the near future. In order to exploit the full potential of these tools in a broader industrial context, it is recommended to further investigate the strategy (e.g. with respect to interoperability) on tool developments & exploitation within the ARTEMIS programme.

Novel Business Models & Open Source Communities

> In general 'novel business models' within ARTEMIS is still an area in its infancy. With respect to 'Open Source Communities', responses are polarised: on one hand, there is evidence that there is a contribution to Open Source Communities and, on the other hand, some partners explicitly mentioned not contributing to it. Longer time frames are needed to see the evolution in these areas.

Patents

> Regarding patent filing, the time frame of 2 years is too short to draw any conclusions.

Public Trials

> Public trials are envisioned where relevant in the project – these tend to be large-scale.

Contribution to Educational Programmes

> Within the framework of ARTEMIS, and as in any other EU-oriented programme, universities do play a key role in the contribution to educational programmes.

Dissemination

> Standard dissemination channels are well covered by all participants.

FINAL CONCLUSIONS

STRATEGIC CONCLUSIONS: IMPROVING THE FUTURE PERFORMANCE OF ARTEMIS PROJECTS

> The analysis of the survey results shows that the future performance of this ARTEMIS measurement instrument needs to be improved. But as stated before, this first inquiry was a learning tool. Nevertheless, some very interesting results have been obtained, the most important being:
> Common R&D Agenda: collaboration under the ARTEMIS umbrella has been enormously successful in creating brand new partnerships (65%), with a significant involvement of European SMEs (33%).
> Common R&D Agenda: CoIE (Center of Innovation Excellence) could be an excellent instrument to pave the way towards Innovation Eco-systems. However the survey shows that there is no clear understanding of the added value of creating a CoIE at this point in time.
> Common R&D Agenda: the key differentiator for ARTEMIS compared to other programmes, is the industry-driven cross-domain approach and the type and size of the partner alliances.
> Common R&D Agenda: the administrative burden associated with realising an initial payment after project approval is still considered a key weakness of the ARTEMIS programme.
> Impact: the key market impact will be through applications that will be commercially introduced within a period of 2-5 years after project completion.
> Impact: the key effects on applications are reduced development costs and less power consumption of future products.
> Impact: all ARTEMIS AWP targets have been addressed with no real differentiator. Although technologies that contribute to these targets have been mentioned, the link between how these technologies contribute to the specific quantitative data is not always clearly explained.
> Impact: in-house innovation and development remain key for the participants in the ARTEMIS programme ; a large majority (90%) indicates that in-house innovation increased.
> Impact: Embedded Systems technology is perceived by the respondents as a truly enabling technology across a variety of applications/ markets.
> Market: demonstrators are a key element in ARTEMIS Call 1 projects. Whereas they vary widely in scope, size and complexity, they are considered by all partners a key driver for future Embedded System developments.
> Market: 67% of the respondents indicate that they actively participate in standardisation activities.
> Market: the development of new methodologies and tools is an important asset in the ARTEMIS programme. 12 tools have already been developed and 31 tools are planned in the near future..
> Market: with respect to 'Open Source Communities', responses are polarised: on one hand, there is evidence that there is a contribution to Open Source Communities and, on the other hand, some partners explicitly mentioned not contributing to it.

Of course, for some topics and trends, it is too early to draw conclusions, because at the time of the inquiry the programme had been running for 1.5 years only. So a subsequent questionnaire round will reveal much more detailed information, leading to better underpinned conclusions.

METHODOLOGICAL CONCLUSIONS
Improving the questionnaire tool

The Working Group Metrics and Success Criteria is very aware that this exercise has been a learning process and it is crucial to consider the limitations identified at the beginning of the report in order to improve the metrics and offer a more objective and realistic evaluation in the next round[8].

The next survey will build on the lessons learned from this first exercise. It will be fully automated via a web tool and the analysis of the results will be easier and faster to process, providing the necessary feedback for the different stakeholder organisations (ARTEMIS-IA Office, ARTEMIS JU, EC and others) in a shorter period of time. Furthermore, it will also be combined with statistical data based on projects' output.

The questionnaire automation will also ease the work related to conducting the survey, which is expected to remain a voluntary contribution.

The sample of participants involved will include previously surveyed consortia, for the purpose of correlation as well as new projects in subsequent calls. Also, answer rates are expected to be higher thanks to the automation of the questionnaire and its further simplification.

Next rounds of surveys will aim to differentiate between ´industrial partners´ answers and ´research organisations´ answers to better understand the performance of each type of entity within the ARTEMIS programme. Both are essential to the future success of the instrument.

[8] *A second round of questionnaires by September 2012 will be based on an improved version.*

RECOMMENDATIONS FOR THE NEXT SURVEY

> To revise the questionnaire :
  i. More multiple-choice questions
  ii. Fewer open-ended questions
  iii. Refine the questions where answers were not clear
  iv. To remove ambiguity in some of the questions

> To conduct the next survey with (minimum) financial support in order to:
  i. Automate the survey and data processing
  ii. Encourage contributions from the WG participants
  iii. Broaden the sample of respondents

> To complement the statistical survey:
  i. with statistical data from project outputs
  ii. with qualitative assessment of particular success metrics through interviews with selected industrial partners

> Separate the perspective of research organisations and SMEs from that of large enterprises.

> Conduct the survey at participant level and not at consortium level.

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