

Joint European submicron silicon initiative

JESSI-0029

1995

Assessment of JESSI programme


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Assessment of JESSI PROGRAMME
European Report
Final report

Coordination Group

31 May 1995

Assessment of the JESSI Programme

Executive Summary

JESSI - a success

JESSI is a success. European semiconductor companies have effectively caught up in terms of technology. JESSI has successfully catalysed the cooperation of companies and institutes in a whole range of microelectronics projects which have achieved, or are set to achieve, most of their technical goals in the areas of chipsets, design techniques, semiconductor technology and new equipment. The stage is now set to capitalise on the work of JESSI, adapting in the light of experience to convert excellent R&D results into strong market impact. But the pace at which microelectronics technology progresses necessitates ongoing efforts to maintain the achieved European position.

About JESSI

JESSI (Joint European Submicron Silicon) is a cooperative research and development EUREKA programme which started in 1989 and finishes at the end of 1996. Its broad aim is to establish world competitive microelectronics capabilities in Europe. The organisation to achieve this aim is led by the JESSI Board, made up of participant organisation members, which oversees project selection and management and deals with strategic issues. The six countries (Belgium, France, Germany, Italy, Netherlands, and the United Kingdom) and the European Commission which together provide most of the public funding have established the JESSI Committee to coordinate their activities towards the programme.

The total spent over the duration of JESSI will be more than 3 billion ECUs of which public funding makes up half the total cost. The European Union has contributed 25% of the public funding total, the balance coming from national governments. JESSI projects are subdivided into four main subprogrammes with funding in 1994 divided as follows - technology (43%), applications (32%), equipment and materials (19%), and basic/long term research (6%).

The JESSI assessment

The assessment of the JESSI programme was commissioned by the JESSI Committee to assess achievements, evaluate mechanisms and provide lessons for future actions in the field of microelectronics. The assessment was carried out by an international team of independent consultants who interviewed the majority of JESSI participants plus some non participants using structured questionnaires.

Results

JESSI results are positive and impressive. European industry is now able to compete on level terms in world markets. The technological gap perceived at the start of the programme has

been much reduced and in some areas completely closed. During the programme the capability to manufacture with ever increasing precision has evolved through 0.7 and 0.5 micron CMOS circuits towards 0.35 microns, in line with developments in other parts of the world. European expertise in computer aided design (CAD) is now stronger within integrated circuit manufacturers and systems houses and within CAD companies themselves, albeit that these are now almost all owned by non-Europeans. In the equipment and materials area, as well as technical advances, relationships with European customers have strengthened, although more could have been achieved.

Impact on participants

Participants report that, through JESSI, they have saved R&D expense, reduced development times and raised employees' competence both technologically and in the management of collaborative projects. More than 25% stated that their competitive situation has improved. In consequence, their positioning for inter-company sales in Europe has also improved.

Cooperative R&D

JESSI participation has also been a strong factor stimulating cooperative R&D and the establishment of partnerships inside Europe. The benefits of carrying out some R&D collaboratively are growing with time and now, as a consequence of the trend towards globalisation in microelectronics, it is becoming quite natural to search for partners outside as well as inside Europe - a fact which future programmes must take into account.

Reasons for participating

90% of organisations cited access to funding, with the associated sharing of costs and risks, as a major reason for participating in JESSI. Equally critical as a reason for joining the programme was reducing the time to market for both products and processes. Other important reasons for taking part included gaining access to complementary expertise and wider information on microelectronics R&D.

Funding mechanisms

The assessment is somewhat critical of the funding mechanisms which supported JESSI. The Public Authorities (countries and European Union) because of their different legal administrative and cultural starting points, operate dissimilar funding practices. The assessment points out the need for these to be brought closer together in the areas of speed of decision making, in the area of duration of funding, and in the area of eligibility (what types of organisation are eligible, what sort of work is supported and what costs are eligible for support). Thanks to the ways which the Public Authorities have developed of working with each other and with industry in JESSI the situation has improved significantly in recent years but there is still room for further harmonisation.

- Good leverage* Despite these criticisms, JESSI funding is money well spent. It is seen as very important to many companies' overall R&D strategies and has taken many companies into quite new domains. Overall JESSI funding is seen as having a strategic importance out of proportion to the fact that it represents only a small part of all R&D expenditure (public and private) in Europe on microelectronics.
- JESSI objectives* There has been a great deal of change in objectives during the life of JESSI. At the start there was what turned out to be a fairly accurate technology road map, a whole shopping list of technical objectives, and an extensive basic and long range research programme. Memories were seen as a priority and much of the application subprogramme was targeted towards computer aided design.
- Numerous changes* Over time the changes have included a reduced emphasis on memories, large and unforeseen budget cuts of about 75% in the basic research area, the almost total disappearance of European CAD vendors, the stopping of the high definition TV project now replaced by a digital TV one and a much higher degree of focus in the equipment and materials subprogramme. 71% of participants say that their project objectives have changed along the way.
- The need to manage change* Continuous change is a likely characteristic of a programme like JESSI. It is necessary for the objectives to be altered pragmatically and efficiently according to market conditions and the needs of industry.
- Low overheads* JESSI has a light organisational structure and, compared to the overall size of the programme, low overheads. The industrial JESSI office, which carries out the central administration of JESSI projects, employs just 10 to 12 people and a culture has developed which keeps paperwork to a minimum. Milestones are used instead of technical results for reporting purposes and documents have well defined formats and size limitations.
- "Bottom up" planning* At the start, the strategic framework for JESSI was only defined in the broadest terms. The planning was industry driven from the bottom upwards with a result that a wide range of projects with detailed definitions were proposed. To bring these into a coherent programme within the budget constraints took a long time. For the future, a more effective approach would be for the strategic framework to be more closely defined so that projects can be planned under a number of "umbrella" topics.

Project selection

A two stage approach was used for the selection of projects to be funded within the JESSI programme. The assessment found that the relatively low investment required to present an initial project idea in the first stage was particularly welcome. There was, however, criticism that the selection criteria were opaque and not clearly understood. Satisfaction with the project selection process was coloured by the actual rejection rates experienced ; the rejection rates were very low for technology projects, quite high for equipment and materials and applications projects and dramatically high for basic research due to the unexpected budget cuts.

Reporting

The reporting and monitoring mechanisms in JESSI are seen as necessary and clear to administer. Smaller and non funded participants would like to see them simplified further. Double reporting where it happens to both the JESSI Board and to Public Administrations is seen as unnecessary and a waste of time and effort. For the future this is an area where harmonisation offers dividends ; indeed, the Public Authorities have made an effort to align their reporting calendar to that of JESSI.

Intellectual property

The intellectual property arrangements within JESSI are based on experience gained in earlier EU programmes. Some third of projects changed the standard contract framework usually to increase the precision where commercial risk and profit was at stake. Nevertheless, overall it was felt that the guidelines used within project cooperation agreements gave a fair balance between private self interest, responsibility to partners and to the public good.

Cooperation mechanisms

The cooperation mechanisms within JESSI worked well especially within projects and between projects and the core technology activities. Other cooperative interactions, where the commonality of interest is not so clear, between subprogrammes or with organisations outside the programme, were less fruitful. There has been some cooperation with Sematech in the US which has not been wholly satisfactory. Information has flowed from Europe to the US in exchange for setting up trials in the US but reciprocal arrangements are difficult and perhaps cannot be established.

Follow up programme

For the future, JESSI participants would like to see a follow up collaborative R&D programme. It is suggested, that clear strategic goals would be established with Public Authorities at the outset. This could generate a framework in which projects can be selected and managed efficiently. It is suggested that future activities which the Public Authorities should consider should concentrate on technical advances from the standpoint of market development. The areas to concentrate on are those where Europe

can play a major role. Important among these are developments by systems companies using the most up to date integrated circuit technologies. While the main thrust of the follow up activities should be towards market development, space should be created for industry guided long term research.

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1. Introduction

JESSI (Joint European Submicron Silicon) is a cooperative R&D programme in the field of submicron silicon microelectronics. Its objective is to secure the availability in Europe of resources for the design, manufacturing and application of integrated circuits. It started in 1989 and is to finish in 1996 with an expected global expenditure of around 3 billion ECUs. The strategic importance of microelectronics industry and the scope of the programme led the Public Authorities belonging to the JESSI Committee to launch a European assessment of JESSI according to a common set of terms of reference.

This assessment is targeted to the Public Authorities and the Parliaments in Europe, as well as to the JESSI participants. Rather than evaluate the achievements of specific projects compared with their objectives and costs, the overall purpose is to assess what has been achieved so far in JESSI, to evaluate the JESSI mechanisms and cooperative interactions and to provide lessons for any future actions in the field of microelectronics.

Dutch, English, French, German and Italian consultant teams undertook national assessments in their own countries, they also analysed the situation of the countries which were not represented inside the JESSI Committee, e.g. Belgium, Denmark, Ireland, Spain, and other European countries. Another consultant was appointed by the European Commission to evaluate the Intellectual Property Rights and related issues. In total, some 300 respondents were interviewed, either participants to the programme, companies as well as research institutes or universities, non participants, public authorities and members of the JESSI structure.

Representatives of the teams harmonised their works within the co-ordination group. This document summarises the co-ordination group's findings on the present programme and its suggestions for any follow-up, if there were to be one.

All along the document:

- *elements appearing as important will be in italics*
- *summaries of findings within a chapter will be presented as in the example below*
 - JESSI organisation has proven to be an efficient operational mechanism*
- *recommendations of the co-ordination group for any follow-up of the JESSI programme will be in bold*

2. JESSI operational mechanisms

The JESSI organisation has proven to be an efficient operational mechanism. In particular:

- Permanent structures have been kept to a minimum, providing for a low organisational overhead;
- JESSI planning was carried out bottom-up, which reflects the new approach of an industry-driven programme but did not establish a strong focus for the programme;
- The two-step labellisation process has been efficient.

JESSI has provided a basis for discussions between large companies and public authorities which seems to have established confidence, allowing exchange of information and the development of efficient compromises. JESSI has not discriminated against SMEs, however large companies remain more at ease with the programme, reflecting the structure of the industry but also the continuing difficulties SMEs face to mobilise limited resources for such activities.

2.1 JESSI organisation

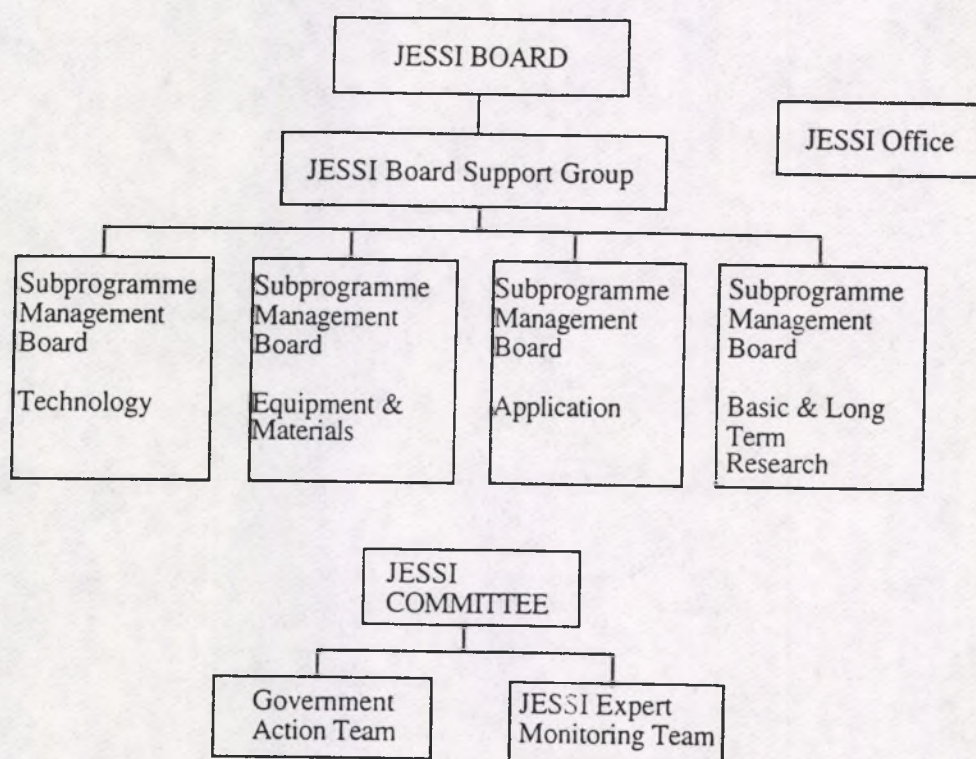
JESSI is characterised by a parallel management structure :

- the JESSI Board (JB), made up of senior representatives of participants (industries, universities or research institutes), which is in charge of the management of JESSI and project selection,
- the JESSI Committee, made up of senior representatives from the Public Authorities (six countries and the European Commission), which provides the majority of the JESSI public funding.

The JESSI organization is described in the annexe 7.1.

The working procedures are largely consensus-driven, however this does not mean that no debate takes place. The only JESSI structure where majority vote took place is the JESSI Subprogramme Management Board for Applications (JSMBA), due to the broad range of covered domains and also to the difficulty of cooperation between competing system houses.

Among JESSI organisational features, one has to emphasise its light structure and low overhead (the JESSI Office which is the only permanent structure includes only 10 to 12 people), as well as the willingness to reduce paperwork to the minimum required: use of milestones instead of technical results; documents to be produced have very specific formats with strict size limitations (see annex), in contrast for instance with ESPRIT reports.



JESSI organisation

2.2 Planning Mechanism

JESSI was created in order to address the downturn in the European microelectronics industry. Several factors helped JESSI to materialise, including the Mega-project between Siemens and Philips and the support of Public Authorities. The planning started in 1988 with Siemens and Philips joined by SGS Thomson. Soon a core team of six people was created and expanded to roughly 30 highly motivated players from Basic Research, Equipment and Materials (E&M), Applications companies and further IC companies who co-operated together.

The JESSI concept had on the one hand a very broad strategic definition and on the other hand a very detailed project list; a framework with a defined focus and goals at the subprogramme level was not created. The planning concentrated on having industry driven projects. Consequently project objectives were defined by the participating companies, i.e. a bottom-up approach.

The planning phase of the JESSI programme was undertaken in 1988 as a Eureka project and was on the whole completed within the planned budget and time. However, from the participants point of view the process took much too long.

To speed up the planning process of a possible follow up programme, participants have suggested to define umbrella projects in a first step, and in a second step, to organise workshops with interested potential participants for the identification of appropriate projects below these umbrellas.

The planning as embodied in the Green Book covered legal, financial and organisational aspects. It covered almost all areas in microelectronics and has generally been seen as too detailed and not focused enough. In 1991 the decision was made to introduce clusters and flagships in order to provide more focus and to improve coherency.

One of the most important lessons of the planning phase has been the importance of collaboration between PAs. In the start-up phase, strong efforts were made to overcome the lack of harmonisation of funding mechanisms between the different PAs and these efforts continued throughout the operation of the programme.

One should consider in how far national funding mechanisms could be harmonised directly at the beginning of a possible follow-up programme.

2.3 Selection process

The selection process within JESSI is based on a two stage approach:

- stage 1: the project initiator prepares and submits a Project Disclosure Document (PDD) to the relevant JESSI subprogramme board;
- stage 2 follows upon approval of the PDD, the project initiator has to organise the preparation of a more detailed proposal - a Blue Book Abstract (BBA) - which is then submitted to the relevant JESSI subprogramme board, subsequently to the JBSG and finally to the JESSI board for labelling.

The relatively low investment required to present an initial project idea (PDD) has been welcomed by candidates as helping to test ideas and initiate a dialogue with JESSI structure on objectives. The selection process clearly played a role in helping companies to identify partners.

Partner Selection

The primary motives given by organisations for their decision to participate in JESSI are as follows:

- Access to funding and sharing of costs and risks were critical or significant in their decision to participate in JESSI for 90% of organisations.
- Accelerating the development and market introduction of products and processes was equally critical.
- Maintaining contact with other companies in the field, gaining access to complementary expertise and wider information on R&D in microelectronics were also cited as being important.

Overall, there was general satisfaction with the time and effort required to identify partners. Most of the organisations participating in JESSI already had some experience of collaboration with one or more of their latter JESSI partners prior to the start of the programme. However, it is also apparent in some countries that very few organisations had been in contact before the programme started with all their JESSI partners. Therefore, *JESSI has been an important vehicle for establishing a wider network of contacts* (through the efforts of other partners and of the JESSI structure) as well as cementing existing relationships. Contact with other companies was most highly valued if companies felt it would be possible to create new sources of market information, exchanges between customers, users and manufacturers in order to better target their own products. This was particularly the case for smaller firms wishing to sell to the large IC manufacturers.

66% of those participants who expressed an opinion felt that the eligibility criteria used in the selection process had a positive or very positive impact on the development of cooperation between European companies. Respondents were slightly less positive about the impact of the procedure on JESSI achievements as a whole, but this was primarily due to a greater number of organisations not expressing an opinion. Indeed, many organisations at the time of application had no direct knowledge of the details of the selection procedure itself, but were positive about the size and organisation of projects it produced.

In a minority of cases the dominance of the large IC producers was cited as a negative influence. Other organisations took this to be a natural reflection of their position in the market and accepted it as a condition of involvement in the programme. Some concerns were expressed at the wider objectives of the European Commission to promote participation of partners from European countries not being represented in the JESSI Committee and the impact this could have on project achievements.

On the whole, the selection of European partners was judged positively. Some participants felt that the non involvement of non-European companies (especially American firms as opposed to Japanese/Far East companies) had, on balance, a negative impact on JESSI achievements. Equipment and Materials companies felt that this was a particular weakness, which should be overcome in a follow-up programme.

Labelisation Process

The labelisation process (see also annexe 7.2) is seen by the participants as follows: 53% of the surveyed participants feel that the labelisation process has been performed well or even very well, 27% showed some concern and the remainder of participants were indifferent (mainly because of their indirect involvement only. e.g. meaning that they have only been in a subcontractor role).

These discrepancies seem to divide the community of participants into two groups. IC manufacturers and other players with long term and well-proven links to JESSI have an intimate knowledge of the approval procedures and, in some cases, have people who are dedicated to the proposal handling. SMEs and new entrants to the programme do not enjoy such close cooperation nor do they have resources to create them. It is interesting that only 57% of the participants declared knowledge of the official criteria for obtaining the JESSI label. **For a possible follow up programme increased support and consulting for SMEs and new entrants to help them to gain early transparency in the labelisation process should be considered.**

In more detail the participants judge the various aspects of the labelisation process as follows:

- Satisfaction of respondents with regard to task allocation within the team (87%), the selection of partners (77%) and the negotiations among them (74%).
- 55% are also (very) satisfied with the resources and man-years negotiated for their organisations.
- 25% of the respondents indicated that the time scale for getting the label was too long

Indeed, the time scale from project initiation to project labelisation might vary between three months and one year and a half. However, as a significant amount of this time is spent on the preparation of the BBA as the second bidding document, the two stage approach is useful to find a good balance between time investment and probability of getting the label.

This is even more important as the rejection rate has been quite high in some subprogrammes: while there was no rejection in Technology, the rejection rates in E&M and in Applications were quite high. BLR was a specific case because of the negative effects of significant budget reductions.

Overall, the labelisation process is well regarded by participants because of the efficiency of the two stage application procedure and because the JESSI label is awarded for the full term of the project; this approach has allowed companies to plan ahead with greater certainty and consequently increased their commitment to JESSI projects.

2.4 Technical reporting and monitoring in JESSI

JESSI developed specific techniques for reporting and monitoring, results of which are used both by the JESSI Board (to decide if the label should be maintained) and by national PAs (to decide if funding should be continued).

Flexibility is a positive feature of JESSI because R&D projects have a high level of uncertainty both technically and with respect to the external market conditions and companies' strategies. To allow the necessary degree of flexibility in project management, change request procedures have been established, for both top-down and bottom-up request. The same degree of flexibility in funding arrangements is not always possible for PAs operating with annual budget constraints. **PAs should consider, for a possible follow-up programme, which funding mechanisms could be applied responding to changes of project scope and direction.**

The experience gained in reporting, monitoring and review activities during the past five years has significantly improved the effectiveness of them. The reviews work better than at the beginning; the reviews allow the discussion of critical points till common decisions are taken. A few projects had to be cancelled, and a majority of projects could be substantially modified. The judgement of participants on reporting and monitoring activities is usually positive.

Reporting and monitoring activities are generally considered necessary, clear, well defined, even if probably not as simple as possible.

55% of participants give a positive or very positive judgement on the impact of JESSI monitoring mechanisms on both project advancement and project quality. Less than 15% have a negative opinion on this. Some participants stressed the existence of a "club effect" in monitoring: large companies are major actors in the monitoring process and also drive the main projects.

Non funded participants are the least satisfied and would prefer a much lighter system. Small participants or participants to small projects also consider the system too onerous. The double reporting to the JESSI organisation and PAs could be considered a waste of money and time.

A harmonisation of structures, languages and dates for all reporting activities should save time and human resources, increasing the efficiency of the public presence. Some steps have been taken in this direction,

indeed the experience gained during the last five years has significantly improved their effectiveness. This should be continued.

Technical monitoring has significantly helped to move the programme into the right direction, while, in some other Eureka programmes, the lack of an adequate monitoring system is considered as a weakness. In addition, technical reporting and monitoring give the opportunity to the project leader to push all activities forward in the right direction.

The PAs have installed a JESSI Experts Monitoring Team (JEMT), whose tasks are very broad, according to JESSI documents (GAT document : "JESSI GAT WHJCLUW/910314-3) : to maintain an overview of the progress of the programme, to compare continually the position of the programme with technical and commercial developments in the rest of the world, to assess the effectiveness of cooperation, collaboration and information sharing within and between the four subprogram areas. In practice, they answer to a limited number of questions from the JESSI Committee, using mainly documentation coming from participants. According to the co-ordination group, the JEMT is under-resourced in some countries, in relation with the task set.

The JEMT should focus its activities on a shorter list of issues in order to enable more in depth analysis; otherwise its structure and manpower should be reinforced in some countries. The goals, tasks and interaction with other parts of the organisation of such a body should be clearly defined in any possible follow-up programme.

2.5 Industrial Property Rules

The guidelines for the Industrial Property Rights (IPR) rules which were used in the Project Cooperation Agreements (PCA) were defined in the JESSI Frame Agreement after incorporating comments from the Public Authorities. These were used without amendments for two thirds of the PCAs; one third of the respondents altered the details to suit the project circumstances (generally, the larger companies considering that the guidelines were insufficiently precise when commercial risk and profit were at stake); in each case, as stated in the JFA, the partners were required to attest that their IPR arrangements were aligned with these guidelines, but since there was no policing of them, it has been impossible to confirm that they were.

The negotiation of IPR arrangements caused difficulties in 25% of cases (and in a limited number of cases smaller companies decided not to take part in JESSI because they felt that the totality of the IPR rules presented to them were unacceptable) but, once negotiated, IPR has not been considered generally to have been a problem during the course of the research phase. These rules have neither assisted nor hindered cooperation and information exchange. Some of the smaller companies (25% of respondents) have reported that they have yet to determine whether the IPR rules in their PCAs will have an impact upon their freedom in commercial exploitation, being suspicious of the larger companies' motives in their redrafting of them.

Since the IPR and licensing rules for the JESSI programme have been based upon the experience gained by the parties to the JFA, by the Public Authorities and by the CEC in earlier EC programmes, it would be unlikely that, when balancing the respective criteria of private self-interest, responsibility to one's partners and the public good, any major flaws could be found, even though the larger companies often felt that they needed amendment for exploitation purposes. They reflect a graduation of the benefit of being close to the creation of foreground property with the cost of being able to use it; this

applies even to the use of background property brought to a project and, thus, to the programme (and to ESPRIT in the case of appropriate projects).

2.6. Cooperative mechanisms in JESSI

Overall, for participants, cooperative mechanisms have performed well.

- within projects, cooperation has largely met high prior expectations;
- vertical cooperations were more prevalent than horizontal cooperations. However, horizontal cooperations were just as frequent as vertical when partners were based in different countries;
- between participants and the JESSI organisation, cooperation is rated positively by a majority of participants;
- cooperation between subprogrammes varied depending on their relative structural positions, with Technology being the pivotal subprogramme. Formal cooperation between projects was much less frequent although informal contacts remain possible routes for information exchange;
- coordination of JESSI with external organisations such as SEMATECH has brought fewer benefits than expected. A stronger European industry would allow in theory a more balanced communication but political obstacles from the American side would remain.

Cooperation within a project

Cooperation between partners within a project has to be viewed within the context of the partners' expectations when starting the project. The degree of cooperation was generally expected to be close and, within the commercial framework of the IPR rules, open between partners. Generally, cooperation has been judged as positive or very positive by 84% of the respondents, with 95% of them stating that the benefits of cooperation outweighed the problems encountered. When asked what were the main problems hindering cooperation, participants identified insufficient involvement of other partners; this issue is wider than the issue of information exchange and touches on the qualitative aspects of cooperation. Notwithstanding these comments, the projects have been described as meeting their objectives and the cooperation mechanisms have included information exchange, exchange of tools (usually under transfer arrangements) and, in a few cases, exchange of people.

Overall, JESSI projects involved vertical cooperation (i.e. with partners at different stages of production) more often than horizontal cooperation (between companies who are more likely to be direct or indirect competitors). Only 14% of the interviewed participants are not involved in vertical cooperation but 37% have no horizontal cooperation within JESSI. Horizontal cooperation is easier between companies of different countries (54% of the participants have such cooperations) than between companies of the same country (35% of the participants have such cooperations).

Communications between subprogrammes and clusters

54% of participants who expressed an opinion felt that the introduction of the cluster concept has brought greater coherence to the programme. The remainder felt that the cluster concept has no effect, reflecting the view that some of the clusters are rather

artificial. Indeed, a non negligible minority of companies (around 15%) identified critical or very important effects on the visibility and demonstration of commercial potential and enabling a pooling of expertise to achieve critical mass. No specific exchange of information takes place between clusters: the communication place is the JSMB (Subprogramme Management Board).

As far as communication between subprogrammes is concerned, the JBSG considers all the project proposals and suggest connections but no other specific mechanism has been planned. It also may suggest that new relationships between subprogrammes be strengthened. To date relationships have been built according to the needs. Communication have been limited to a few mechanisms: interface groups, exchanges of guests between subprogrammes, common workshops (see annexe 7.5). These have helped not only within each cluster or subprogramme but also between the participants in different subprogrammes; these have intensified the vertical cooperations between participants and have had a significant effect upon the informal communication right across.

Clearly the centre of exchanges was the Technology subprogramme, which developed a close relationship with BLR. Relations between Technology and E&M occurred mostly through direct collaboration inside projects: the participation of an IC (Integrated Circuit) manufacturer was mandatory for all Equipment projects, in order to prove the project interest, and to guarantee that its results will be tested and validated. Application projects mainly have relationships with Technology and very little connections to E&M and BLR reflecting industry structure. Personal communication has also been widely cited as a way of communicating ("There is little general information available, but it is always possible to call somebody to find out"). This informal mechanism operates at all levels within JESSI.

Cooperation between public authorities and the JESSI organisation

- Regular meetings take place between the JESSI Committee and the JESSI Board. Among the topics discussed, the main difficulty was related to funding and the problems caused by a lack of harmonisation between public authorities. In order to minimise such funding effects, a complex mechanism has been set, which greatly improved the situation (see annex 8.1). This improvement has also led to a better working relationship between GAT members and JESSI participants, based on increased confidence.
- The European Commission shaped major projects of JESSI, including Joint logic, MST and Adequat in such a way that these projects are found beneficial by their participants and are considered as a success. The joint discussions between national public authorities and the European Commission allowed for a much better understanding of the strategies and plans of all participants. Informal relationships were achieved through individuals being active in both programmes.
- The relationship between companies and JESSI organisation have had an overall positive impact on the development of cooperation between companies, according to 41% of the respondents. Perhaps more significantly, only 5% of the respondents see the impact as negative or very negative.

Co-ordination between JESSI and SEMATECH

There have been some benefits from it, not only within the research programme (e.g. the supply of the SEMATECH cost of ownership model to Participants free of charge) but

also, particularly, in commercial arrangements between companies and US companies. However, the relationship has failed to achieve its promise because the participants have approached each decision from a narrow project-by-project basis rather than strategically; it has been reported that neither JESSI nor SEMATECH have had a clear rationale for their relationship. The co-ordination concerned mainly Equipment companies and consisted in information going from Europe to the US in exchange for the trial of European equipment in the US.

The co-ordination between JESSI and SEMATECH has brought fewer benefits than expected. As the European microelectronics companies have meanwhile achieved to reach world-wide recognition, and even a leadership position in some fields, in theory it should be possible in future to have a more balanced and beneficial communication between JESSI and SEMATECH. But real cooperation would go against American laws.

3 Funding mechanisms

Since the JESSI organisation in itself is not a funding mechanism but relies on different national and European policies and funding regulations, this has led to a lack of synchronisation in funding for projects. The impacts of these decentralised and non-harmonised procedures have in the past been dramatic.

End 1991 this situation has been improved, mainly as a result of "learning by doing", but still remains a potential problem.

3.1 The funding issue

Between 1989 and 1994, public funding of JESSI amounted to approximately 850 MECUs representing half of the total cost (1,700 MECUs) of the projects undertaken in JESSI. The European Commission has contributed for 25% of the 850 MECUs and not for 50% as announced when JESSI started (the European Union devoted more than 50% of FW3 Microelectronics in ESPRIT to seven JESSI related projects concentrated in Technology and BLR subprogrammes).

Only a few participants did not receive public funding for their activities.

The substantial public contribution has led to many projects being undertaken on a larger scale, more quickly or with broader objectives, creating a European environment for micro-electronics R&D. For 39% of participants, at least one of the projects in which they are participating would not have been carried out without public support.

This positive contribution did have a down side; funding is one of the main problems met by JESSI mechanisms: the problem arises from the organisational choice to keep the labelling process at the JESSI organisation level, while the funding process is managed at the national level or at the Commission.

During and to a certain extent after the labelling process, candidates are uncertain whether funds are available. However, the large majority of selected projects and participants have been funded, but initial difficulties were numerous.

The main distinctions in national funding procedures are as follows:

- responsible organisations have different structures and traditions; harmonisation required a comprehension of these differences;

- most of the countries have a special fund devoted to the programme, some of them put JESSI projects in competition with other Eureka projects or national microelectronics R&D activities;
- timing is very different: in the United Kingdom and the Netherlands the answer to the participant is given in three to four months, in Italy two years are usually needed, while all the others are usually below 12 months;
- eligible organisations: universities and public research laboratories are excluded in Italy and Netherlands (except for subcontracting), while SMEs and universities are primarily funded in the UK;
- the proximity to the market of eligible projects is different: SERICS in France gives funds to projects closer to the market than BMBF in Germany does; in Italy basic research is excluded from funding;
- some technical aspects like allowable costs, average acceptable cost of man/month, taking equipment depreciation into account and timing of fund distribution, haven't been harmonised;
- most countries can enter into multi-annual funding contracts, while France can enter into annual contracts only;
- the normal rate of contribution is similar in the different countries (usually 50% of total costs, but 40% on average in the UK, 45% on average in Netherlands and often less in Belgium). As the probability to get funded may vary from one country to another, this can determine large companies to switch research activities from one country to another.

Besides the above mentioned difficulties, it has also been mentioned that sometimes a company forgets to send its application for national funding after getting the label, thus provoking delay.

3.2 The effects

The consequences of these decentralised and non-harmonised procedures have sometimes been dramatic: too many projects received the JESSI label in the first few years, while national administrations were still implementing their funding procedures. Some projects were disrupted, others were affected by incomplete funding, others suffered from delays or asynchronous decisions between countries. "Core projects" and large companies were less affected; while basic and long term projects, small projects and SMEs were more affected.

For instance, problems were created by the Italian delays in funding procedures; in Germany the limited budget for E&M in 1991-92 persuaded some companies to withdraw from their projects; some French participants had a short-term approach to the projects, because of the annual agreements they sign with their PA; some British participants withdrew after the decision of their Government not to give funds to companies of over 250 employees.

The participants' degree of confidence in JESSI mechanisms suffered from these problems.

3.3 Improvement of the funding mechanisms

The funding problem was recognised by the PAs, and since the end of 1991, this situation has progressively improved, mainly as a consequence of a "learning by doing" process. Greater collaboration between JESSI organisation and the PAs was introduced to assess the probability of funding all partners for a specific projects. This allowed for a more efficient funding management. This also provided for a more efficient communication between participating PAs.

Notwithstanding those efforts, delays in project starts and time gaps between partners remain for some projects. In practice, after initial phase of the programme, the large majority of labelled projects have been funded. Only 5 to 10% of labelled projects still had funding problems in 1994. In the future, changes in national policies may make this problem more prevalent.

According to the interviews, the funding mechanisms had no clear effect on the number of candidates. Only a relative majority (48% of respondents, while 28% have no opinion) think that they favour the diversity of candidates (i.e. small companies and universities as well as large companies). 52% of the respondents do not perceive funding mechanisms as less or more of a problem during the project course, but 23% of the respondents say that delays in funding may be an (important) impediment in the project advancement. Most latter respondents are SMEs or universities / research institutes.

Funding problems increase the cost of participating, and in some cases deter possible participation. The combination of labellisation and funding is still too complex, especially for research organisations and SMEs.

A greater level of harmonisation and the shortening of waiting periods should be highly beneficial to enhance the effectiveness and efficiency of public money invested in JESSI. Multi-annual funding has a very positive impact on the progress of projects.

Two main sources of funding exist for microelectronics R&D : national funding (including JESSI) and European funding through ESPRIT. Individual projects are funded either by national authorities or by the European Commission but not by both. Several companies have still difficulty understanding which source they should apply for funding.

National policies may be somewhat different, but exchanges between GAT members allowed for a good understanding, thus leading more easily to rational compromise.

4. Importance of JESSI R&D related to European microelectronics R&D

JESSI has a much greater overall influence on the R&D efforts of participating companies than is apparent from the funding level alone.

To put JESSI in perspective with European R&D is difficult because of the lack of global data on European R&D in the microelectronics field.

Even the companies cannot estimate the weight of JESSI in the European microelectronics R&D, and the few figures advanced by company representatives differ

widely (the estimations of the weight of JESSI funding by PAs as compared to the European R&D expenses in the same domain range from 3% to 25%).

For 64% of participants, the JESSI programme is important or very important for their company's R&D strategy. The result was more marked for IC and equipment manufacturers than for system houses. As the main reasons of participation in JESSI are also speeding of development, market introduction and search for cooperation, this emphasises the strategic importance of the JESSI public funding.

The weight of JESSI public funding is very often minor in the total companies R&D expenses.

JESSI induced 30% of interviewed companies to start R&D in a new domain. This was more important for system houses and equipment manufacturers than for IC manufacturers.

JESSI R&D is complementary with other European funded projects. In 62% of the answers, these projects coexist with other nationally funded or EC funded projects.

5. JESSI initial and present objectives

JESSI objectives evolved in a very pragmatic and very efficient manner, according to market evolution, technological evolution, standards changes, and large company strategies. A basic reason for that is that it is industry-driven, thus obtaining the fastest possible feed-back from the market.

The main practical difficulty of this approach has been the need to deal with changes in partner's strategy or changes in partners; however the absence of a complete strategy including precise goals and priorities has also limited JESSI's ability to define a future direction except by what it is currently doing.

5.1. JESSI initial objectives

They were of three types:

- technical objectives, as defined in the Green Book. These objectives are not presented in terms of priority, but are mostly a "shopping list", including almost all possible activities in the field of silicon microelectronics, with the major exception of microprocessors, although it is one of the fastest growing sector in microelectronics. Depending on the subprogrammes, calls for proposals have sometimes been made, but little effort was made to ensure that all of the Green Book was covered, which was anyhow difficult because - as mentioned in Chapter 2- the Green Book covers all possible areas in microelectronics.

It should be pointed out that the JESSI technical road map has proven to be a very accurate prediction : 0,35 μ technology was expected for 1996, and 0,5 μ for 1993.

- Strategic objectives are also to be found in the Green Book. No specific document defining a complete strategy including precise goals and allowing to define priorities has been produced, although it seems that some effort has been made at the beginning, at

least inside some subprogramme. The very general objectives to be found in the Green Book are summed up in the annexes.

- implicit objectives : in addition, there were clearly some implicit objectives, without any written status. A basic objective was "save the European microelectronics industry". The main priority was memories (during these years the Japanese industry was taking the world lead for DRAMs, and trying to use it for dominating the world market for semiconductors). Several explicit ideas were mentioned during some interviews including closer working of European manufacturers (up to a merger of micro-electronic activities), as well as the creation of R&D centres of excellence in Europe.

Application programme was mainly there for CAD, and possibly to be used as a test bench (see annex). BLR was also much more developed; the Green Book included 14 projects, divided in 4 groups: design methodology, modelling & simulation, advanced processing steps, process integration.

5.2. Present objectives

Several factors contributed to a major change moving the programme centre of gravity towards Applications (and system houses). The *development of memories, stressed in the Green Book, was strongly reduced*, due to changes of strategy in some large companies (see annex). The reaction to this evolution was to develop the Applications part, and to aim at chip sets to be developed before the end of the programme.

In BLR, the major change came from unforeseen non availability of budget : the BLR budget was expected to be 22% of total JESSI budget; it is currently 5%, with its content limited to technology . This implied the complete disappearance of research in design technology in BLR with some aspects transferred to the Application subprogramme.

Regular project reviews enabled the adaptation to a changing environment, especially as a reaction to project results and market changes.

- The "Request for Change" procedure has been widely used, both for minor and important changes.

- Another factor is the capability of JESSI to launch new projects with no fixed calendar: no call for papers is needed and companies may ask for a project label at any time. This capability is of course limited by the limited amount of money available, but new projects continue to be launched.

The following describes some examples of new objectives by subprogramme:

- inside Technology subprogramme, flash memories were not present at the start, since they appeared more recently;
- inside Applications, HDTV project was stopped, then replaced by a digital TV project;
- inside E&M a major strategic change took place, centred on strengthening the European strong points, without trying to cover the complete technical domain.

The objectives of developing a complete CAD system collapsed due to the rapid changes in CAD industry, having as a consequence the quasi total disappearance of European vendors (Racal-Redac becoming Zuken-Redac, Anacad being bought by Mentor, several smaller companies bought by US large CAD companies). Current objectives are to

develop non existing tools on top of American commercial CAD tools available on the market.

The large number of changes is confirmed by the respondents: 71% of them said that their projects objectives have been changed. Among these changes, about 42% are considered important.

The most frequently mentioned reasons for changes are the modification of the strategy of a partner, the change of partners and the fact that initial objectives became inadequate.

Half the respondents have no opinion about changes in their cluster, their subprogramme or JESSI objectives. Among the expressed answers, half estimate there have been changes. This confirms a general impression: there has been little information exchange above the project (and possibly cluster) level.

6. Results already achieved compared with the objectives

Overall results are positive, with JESSI clearly meeting its technical goals. It has resulted in a European semiconductor industry more technically able to compete.

This chapter deals with JESSI results as compared to the objectives. JESSI impact is analysed in the next chapter.

One should take into account that many projects are not yet finished (some are not even started at this time). JESSI is planned until the end of 1996.

A detailed list of results can be found in the annexe 10.

6.1. Results in terms of technical objectives

Most projects were carried out within time and within budget. A study conducted by JESSI Office-states that the majority of projects were in time with their interim milestones, the average delay of approximately two to three months being considered as uncritical in view of the complexity of the programme and general uncertainties. This has been largely confirmed by our interviews.

According to the report of the project leaders, 90% of the final milestones of their projects will be achieved in time, with only three months delay for the other 10%. It is thus very clear that JESSI will be able to reach its technical goals.

It should also be stressed that these goals are in line with the overall world technology evolution, which implies that the gap has been much reduced: European industry, technically late in the 80s, is more fitted to compete.

Some general comments can be made about the results:

- For Europrojects, it is too early to measure the commercial impact of the availability of chipsets, but they were clearly needed in order to remain competitive, and results exist in terms of equipment available.

- The main results for CAD are still the continuation and increase of a European expertise, both in CAD companies owned by non-European companies and inside European IC manufacturers and system houses. Another result is the internal use of high level tools, not available on the market. SIFRAME is a specific case, since the

product evolved from an IC dedicated tool to a more general design framework, not limited to microelectronics.

- It is in Equipment and Materials that commercial results can be shown, and they seem to have been very effective for large companies, but also for some smaller ones. Most European E&M were complaining that it was easier for them to sell outside Europe. JESSI has contributed to inverse the tendency. A large impact was the increased relationship to customers. JESSI allowed the codevelopment of prototypes, which were a large opening for future contracts.

- In Technology, results are clearly very positive for small companies: JESSI added to their technical credibility. For large ones, important results included development of basic technologies for 0,7 μm and 0,5 μm CMOS, and major contributions for manufacturing science. They also benefited from their increased relationships with system houses.

6.2. Analysis of companies opinions

At the European level, a clear opinion (58% of the respondents) is that JESSI has had a significant contribution to the development of the European micro-electronic industry; only 6% of the people met think that JESSI has had no significant effects.

When asked if their project(s) will contribute to JESSI general objectives, as stated in the Green Book, a large number of respondents indicated that results satisfying these objectives are already currently available.

The most important recognised effect is that JESSI has accelerated the progress of European IC suppliers (the average answer is 7 on a scale of 1 - low effectiveness of JESSI - to 10 - high effectiveness of JESSI). This exhibits the fact that the JESSI centre of gravity was clearly near the Technology programme, which is the most funded subprogramme.

All other questions dealing with the strengthening of the European electronic industry chain, the availability of advanced design and tools for transformation from systems into silicon, the strengthening of equipment and materials, increase of the competitiveness of European system houses are rated above 6. One should note that actual values ranged from 2 to 10. (Differences in the assessments on JESSI results made by the participants are analysed in annexe 10.1).

As regards the CMOS technologies, which are at the heart of JESSI, an unanimity exists - even from non European companies- that the gap between European companies and US or Japanese companies is much narrower or even closed. It has been even mentioned in several domains that Europe is now on a par or ahead.

7. Impact on participants

JESSI created and improved cooperation in the European microelectronics industry and played here a "starting role". The programme also helped companies with their R&D activities, mainly due to cost savings and shortening of development time. Major results in terms of economical results are still to come. A possible follow-up programme could aim explicitly at commercial results.

The assessment of the impact of JESSI on participants is made against the background of some important autonomous trends. Firstly, at the beginning of the Nineties the commercial position of the main European suppliers in the sub-micron market was rather weak, however nowadays the situation has clearly improved. Many companies have actually experienced a rise in sales and profits. Secondly, the need for cooperation in R&D activities is growing continuously. Cooperation -in comparison to isolated R&D activities- makes it easier to integrate an increasing number of different fields of technology; to minimise the time period associated with development and respond to the increase in the critical size of investments in several R&D facilities. Third, all national economies are affected by the mega-trend of globalisation, which implies that it has become quite natural to search for partners not only in Western Europe, but also and increasingly so in non-European countries.

7.1 Impact on network relations

With respect to network-relations, a large majority of the participants states that, *because of JESSI, cooperation in R&D activities has been stimulated*. When such an impact was noted, in 61% of the cases it implied a strengthening of already existing alliances. Also in 58% of the cases it was noted that JESSI facilitated new alliances inside the JESSI-network, whilst in 17% of the cases an impact on new alliances outside the JESSI-network is reported. Before JESSI, cooperation often implied a bilateral contact. According to participants, JESSI has created a much wider network of potential partners. Contact with other companies was most highly valued if they felt it would be possible to create new sources of market information and exchanges between customers, users and manufacturers in order to better target their own products. This was particularly the case for smaller firms wishing to sell to the large IC manufacturers.

- *European cooperation* JESSI has taught firms to co-operate, and hence cooperation is no longer an incident but has become a structural phenomenon. Nowadays firms which have experience with JESSI-projects consider it much easier to exchange technological knowledge, with members of a rather large network. An illustrative example of an active network can be given for CAD-technology: The names of 600 researchers are included in a database and regular workshops are organised where exchanges of information take place. Several respondents noted that JESSI had an instructive effect on other fields of activity within their organisation, where a growing interest in cooperation could be observed. After JESSI, without external funding, 70 % of companies will continue to cooperate with some partners and 18% with all.

- *Informal cooperation* Due to intensification of informal, personal relations, European companies are no longer working in an isolated environment. At the beginning of JESSI there was little communication between companies, and there was no common European feeling. Thanks to JESSI a cultural change occurred: participants note a feeling of "togetherness" and consider themselves part of the integrated European industry. A direct communication has been established between technical managers of most IC companies, which are able to discuss technical matters between them. This is a totally new phenomenon which contributes to close the gap with US, where informal exchanges are common -and very effective- practice. *These informal communication, still to be continued and improved, is certainly an important result of JESSI.*

- Furthermore, companies are in a better position for inter-company sales, and several of them report an increase of input-output relations within Europe due to JESSI participation.

- The programme has obviously had a signal-function for "keeping R&D and also production in Europe" wherever it is possible.

- *Cooperation characteristics* Information exchanges and common meetings were most often mentioned : in the case of vertical cooperation by 86% and 88% of the respondents, for horizontal cooperation up to 93% and for cooperation with universities by 80%. Somewhat less important has been the exchange of tools, which has taken place in 55% of the vertical cooperations, 46% of horizontal cooperations and 54% of cooperation with universities. Personal exchanges have mainly occurred in the frame of cooperation with universities and research institutes (29% of the cases). There has been a limited amount of joint teams, half of them are connected with cooperation with universities and research institutes.

- *Benefits as seen by the companies* Participants have reported almost unanimously that the benefits of cooperation far outweigh the problems. They have benefited from their understanding of the technical challenges, the sharing of results (73%), the knowledge of products and of the market (51%). Cooperation has spread both vertically and horizontally and has crossed national borders. 62% of the vertical alliances have been considered (very) important to the participants and have contributed to their organisations' business portfolios. With regard to the horizontal alliances, 44% believe these to be (very) important but not as crucial as the vertical alliances; these are more difficult to sustain because the projects tend to result in prototypes, at which stage the partners are, in fact, competitors; the Manufacturing Science and Technology for IC Production project is an example where a horizontal project can have far-reaching benefits if the partners approach it from a strategic viewpoint. *They have varied opinions as to whether these alliances will be extended to commercial exploitation arrangements, but the majority consider that they will.*

So there are several important signals of a positive impact of JESSI on R&D-networks. However, there are also *mechanisms with opposite effects*. Of the interviewed persons 12% mentioned that JESSI has hindered the formation of alliances outside the JESSI-network. This effect can partly be attributed to the fact that non-European partners are not always welcome as a participant in a cooperative project. In this respect some companies consider it is rather important that non-European companies which have both R&D and production activities in Europe are allowed to act as members of a partnership. Finally, the JESSI structure does not seem to stimulate the mobility of researchers. There are examples where the government funding of R&D-expatriates, working abroad on a cooperative project, was refused.

7.2 Impact on individual firms

The most obvious direct impacts are savings on R&D-expenses because of the obtained subsidy and because of the sharing with other partners, and shortening of development times. 66% of the participants have already observed a positive impact on their employees' competence. Also 76% of the respondents state that their know-how in managing national and European collaborations has increased and 66% that their technological domain of competence has expanded due to easier access to new technologies.

Also mentioned, but less important, are the following effects of participation in JESSI activities:

- a higher level of efficiency of R&D-investments, because co-ordination in JESSI prevents similar R&D-projects being undertaken by different players and a decrease of financial risk, since it is shared with other partners;
- a better internal cooperation (26% of respondents): a better integration of R&D with the other functions of the company; in large companies, cooperation between divisions has been intensified;
- the smaller companies in particular have noted the impact of the label on their prestige in the market; the accessibility of other governments funds for R&D stimulation, especially European programmes, has improved.
- in a few cases the mobility of specialised professionals has increased;

Results measured in terms of commercial figures

Most interesting, of course, are the results measured in terms of commercial figures. Such impacts are, however, not easy to quantify. The first reason is that JESSI activities concern R&D, with no guarantee of a successful commercial development and with sometimes rather long time lags between development and application. The second reason is that commercial results also depend on other factors.

Participants have been asked to express their view on the impact of JESSI on their competitive situation at the national, European and world level. Between 25% and 29% respondents reported a significant improvement at all three levels, against approximately the same percentage that did not note any change at all, and the remainder that noted a slight marginal improvement of their competitive situation. If we consider the commercial results into more detail, we can note that 45% of the participants have already observed an amelioration in product quality (among others because of an intensification of benchmarking practices and the increasing importance of world standards), and also 44% of the participants reported the introduction of new products. If one takes into account that JESSI is primarily a R&D programme and not a market penetration programme this reported intensity of new product introduction can be judged as quite acceptable. An observation slightly contradictory to the previous one is that only 20% could already observe a significant impact of JESSI on their market share. However, it is quite often reported that JESSI has helped to maintain rather than improve a certain market position, which is also considered to be a significant impact, taking into account the poor condition of European microelectronics industry in the 80's.

It is also quite interesting to consider possible *impacts on employment*. We asked the participants to give an assessment of JESSI participation on the recruitment of new personnel. 39% of respondents reported that indeed such an effect already occurred. However, the information is not detailed enough to produce a quantitative evaluation of this effect. We believe that JESSI has not created a large number of new jobs, but seems to have helped in saving existing jobs and has contributed to a slight increase in related employment.

On the other end, there have also been some examples of negative experiences with commercialisation :

- in the Applications subprogramme development of common standards was not easy; this prevented some companies from participating;
- several respondents mention the non-funding of engineering and production of prototypes in some countries as a limiting factor;
- a start up of new companies could hardly be observed

Individual companies have seen several direct positive impacts of JESSI, and a significant number of participants could report results in terms of commercial figures, including an amelioration in product quality and the introduction of new products.

8. JESSI Perception

The survey shows that the image of JESSI in the public is improving. However, it also indicates that a focused and strong public relations work is not only vital for a public funded programme, but also important for setting the right industrial/political signs for the development of the related industry.

Improvement could here happen e.g. if each participating organisation named a PR representative, who will be in charge of all JESSI-related PR activities. This group could then work closely with a PR specialist, employed by the JESSI organisation.

JESSI perception and media response have improved, due to the fact that results can be shown while the European microelectronics industry is recovering. In general, the media response is more positive and more regular in the trade press than in the common press.

The results of the undertaken assessment show that 46% of the participants are using the JESSI label in their communication policy. Smaller and midsize companies are using the label more often than larger organisations.

However, there is also some indication that the public relations (PR) activities of JESSI could still be exploited more beneficially as there is a larger proportion of participants reporting that JESSI public relations have no significant impact on important aspects of their business activities:

- Only 31% of the surveyed organisations indicated that the JESSI label is significant or even very significant for their reputation in the market
- 24 % reported a significant or even very significant impact on the image within their own organisations
- For 19% of the respondents, it has been important for the attraction of new partners and for 20% of them for the attraction of extra funding.
- Not more than 13 % of the surveyed organisations reported that the recruitment of highly qualified manpower can significantly be influenced by the label.

Large organisations in particular, with in-house public relations expertise, do see improvement potential in the following areas:

- PR activities within JESSI should be part of a long-term and consistent communications strategy

- Communication must happen on different levels and in a "customised" manner. In contrary to special interest groups who know of JESSI and its objectives, its objectives are widely unknown or unclear to the general public:

- PR professionals rather than R&D experts should help to communicate JESSI objectives to the general public in a distinct and understandable way
- Information should be written in a customised manner related to the target group (e.g. general public, special interest groups)

- In the past, negative image transfer also happened to the JESSI programme due to the weakness of other large R&D programmes, which are seen as highly bureaucratic, slow in decision making, and unclear in terms of funding mechanisms. Those negative impacts of image transfers need to be counteracted continuously by putting JESSI into the right context and making the differences clear.

9. Impact on Non-participating Companies

Some companies, being possible JESSI partners, have taken the decision not to participate. Despite their non-participation, many of the respondents considered they would benefit from JESSI, albeit indirectly through the creation of a more sophisticated and structurally integrated microelectronics industry in Europe. Reasons for their non-participation include lack of information or resources, as well as viewing JESSI as not addressing the market conditions.

The fieldwork undertaken in this study included interviews with a limited number of companies who had not participated in the Programme even though their field of operations might have made them potential partners. Their decision not to get involved in JESSI can generally be attributed to one or more of the following factors:

- inadequate knowledge and information about JESSI objectives and procedures;
- lack of resources to get involved with collaborative arrangements (particularly for SME's or for larger firms concerned about the cost of the implied programme bureaucracy);
- a strategic view that such collaborations were not an appropriate way forward for the firm (often related to the need to have complete control over IPR to secure markets or not disturbing cooperation with established partners).

Many non-participants held the view that JESSI was too technology-driven and from their knowledge did not address the market conditions and client relationships. Despite their non-participation, many of the respondents considered that they would benefit from JESSI, albeit indirectly through the creation of a more sophisticated and structurally integrated microelectronics industry in Europe. This was helping to stimulate new ways of thinking and new technical standards. The promotion of cooperative working and greater focus on European industry will on the supply side stimulate demand for products and processes produced by non-participants as well as those from companies within JESSI, whilst customers of JESSI participants will benefit from improved products and processes. It was felt that wider dissemination of the JESSI results would increase the overall benefits.

For every five participants who felt that JESSI was likely to improve cooperation with other JESSI firms, one thought that programme had facilitated new alliances with organisations outside of JESSI. However, only slightly fewer respondents felt that JESSI had hindered alliances outside JESSI which reflects the concerns of some organisations that JESSI restricted possibly productive collaborations with non-European firms.

10 . Overall impression and suggestions

10.1 Overall impression

JESSI is a light organisation driven by industry and funded by public authorities that allows for bottom-up approach. In this structure, the driving forces are more specifically the larger companies in microelectronics. The programme has adopted a dynamic and flexible project management, enabling it to adapt to the changes of strategy within industry.

On a technical level, JESSI was successful, allowing for the bridging of the gap between European, and US and Japanese companies, by allowing individual firms to reduce R&D expenses whilst shortening the development time. It is difficult to prove the connection between the current health of the European industry and JESSI, since the world market is expanding, but JESSI has allowed the European industry to benefit from this expansion. JESSI clearly contributed to the creation of an European network of exchanges at several levels: between industry and public authorities, between public authorities and between individual firms. These networks have facilitated efficient cooperation in R&D activities. JESSI has contributed to the establishment of a wider inter-company network of contacts, as well as cemented existing relationships. Formal and informal communications which have developed contribute to a continuous transferring of knowledge, and to increased inter-company sales.

10.2 General policies

Three distinct policy options could be considered for "after JESSI":

- The first one would be to stop the public support for a specific microelectronics programme at a European level, assuming that national programmes would start or continue in some countries.
- The second one would be to continue JESSI alongside other EC funded technology programmes, either in ESPRIT4 or in a new European programme.
- The third option would be to have post-JESSI activities following along the lines of the Eureka model, i. e. industry driven.

These three options are not equivalent neither from participants' point of view nor if one considers the effects they would have on the European microelectronics industry.

The first policy option would recognise that JESSI has established a substantial degree of cooperation between European organisations involved in microelectronics. In many cases, as stated by participants, cooperation would continue and develop without public funding on the basis of strategic commercial decisions. In this respect, companies would benefit from a great freedom to select who to choose to co-operate with away from

programme rules. To the extent that public funds currently devoted to JESSI projects would be transferred to national programmes, this option would not produce substantial cost savings.

There would be a danger in this approach, that without public subsidy to reduce the risk, partnerships might ossify and new partners might not be considered. JESSI has encouraged broader and deeper relationships but there is no substantial evidence to suggest that companies will adopt cooperation as a fundamental element in their activities. Furthermore, participants are strongly against a JESSI continuation in separate national programmes.

Equally, subsidies to non European industries persist which would leave European firms at a disadvantage. More generally, the structure and diversity of the IC industry would be left wholly to the market.

The second option would in principle combine the approval and funding decision, promote wider dissemination of activities and results, and so be more open to organisations of all sizes. Microelectronics would be placed in a wider technological context. However, this structure would not be industry driven, would very likely suffer from excessive bureaucracy and would impose more criteria on partner selection (primarily to promote the inclusion of partners from more countries).

The option of a continuation of the present approach is in line with the desires of the companies that are present part of the network. Almost all present participants would be prepared to participate in a follow-up collaborative programme and in the majority of cases, there is support for the continued relevance of the generic rationale; It should be noted that 35% of respondents wants the programme to continue with its current structure, while national programmes are largely refused.

JESSI has demonstrated flexibility and dynamism based on a largely effective and efficient structure. A similar follow-up programme will benefit from the substantial learning process derived from JESSI. Nevertheless, modifications will be required to address the lack of strategic approach, the limited dissemination of information and results and through these the disadvantages faced by SMEs.

10.3 Recommendations for the possible follow-up programme

Before starting with recommendations for improvements for a possible follow-up programme we would like to point out that it is very important to be clear about the goal a follow-up programme would have. **Government strategies should be defined and indicate clearly what they intend to achieve with their programme.** As an example, if the clearly defined goal is to build-up a European industry, comparable to the US and Japanese industry, support on the political level is necessary. Being clear about the goals will also generate a "framework" and help to select the appropriate subprogrammes, allocate very focused funds and will be the "umbrella" under which proposals for projects can be managed very efficiently.

Firstly, in our opinion, **the focus of a follow up programme should look at technological advance from the view of market development.** Areas where Europe can play a major role and develop them should be identified and used as a starting point. Therefore, activities like engineering, prototyping, testing, design as well as cost-efficient and flexible manufacturing technologies should be equally well accepted.

Secondly, the programme should give more emphasis on final products, **taking as a major goal the development and selling of equipments** developed by system houses using up to date IC technologies. Non-European leading companies should have better access to cooperative projects.

Thirdly, one should recognise that a programme that should address itself more closely to **the requirements of the microelectronics marketplace** will by nature leave little room for long term research. If funding of R&D in microelectronics is limited to JESSI, funding should be reserved for non-guided long term research for emerging technologies.

Fourthly, the programme should become much **more accessible for companies who do not belong to the "core group"**. More efforts must be made to make the programme more accessible for small and medium enterprises. This requires a generally more professional communication effort and especially a clearer communication of the opportunities in becoming a partner in the post-JESSI programme. In addition, much more can be done on the dissemination of results towards potentially interested companies. Experiences of the Medium sized Industry Support project can be used as one of the points of departure.

Fifthly, operational mechanisms are well established but certain aspects could be improved. **Funding procedures need to be harmonised between public authorities. The levels of funding could be more flexible** than at present, thus allowing more companies to participate. As examples, there could be a time limit for applications projects or the funding rate could be less the closer a project gets to market introduction.

Still more efforts should be undertaken **to intensify information exchange among participants**. For this purpose an internal technical data base could be installed. The **quality of monitoring and review could be further increased and simplified** by the elimination of double reporting.

In any case, a post-JESSI activity should be flexible, able to adapt to unexpected changes, related for example to the emergence of an information society.