



National  
Microelectronics  
Institute





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### **A LETTER FROM THE CHAIRMAN**

Welcome to the NMI's 1998 Annual Review. In it we have summarised the collaborative work that the industry has undertaken over the last year in the UK. I am pleased with the results we have achieved together - indeed our educational support base and collaborative work on cost reduction equals that in the US.

However, we now find the global microelectronics industry in the midst of a rapid wave of change. Over-capacity and the collapse of East Asian economies have reduced ASPs for most manufacturers. Plants throughout the world have had to reduce costs. Some have been forced to close. We, as an industry, have lost staff that we will need in the future.

Value has, at least for the present, moved from manufacturing to product design and development. Only those companies with close links to end applications and the users of those applications can rapidly bring attractive products to market with a competitive edge.

In this turbulent environment we still need the NMI. It is helping us to identify areas in which we can collaborate to reduce costs. It is moving on to support collaboration on product development in the UK.

It will also let us share the cost of continuing to work on the longer-term goals that must be achieved if we are to be prepared for the next upturn in demand.

I would encourage everyone in the industry to work with us to ensure that the design and manufacture of microelectronic devices survives, and indeed thrives, here in the UK.

Dr George Bennett

# NMI represents the interests of the U.K. Industry

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## ABOUT THE NMI

**The National Microelectronics Institute (NMI) provides a mechanism for collaboration between members, educational organisations, regional bodies and government.**

Through this collaborative activity we are working to:

- Improve the support infrastructure and the value chain for the industry.
- Meet the demand for skilled staff and support continual development of existing staff.
- Improve community understanding of the industry.
- Provide a link between the global industry and University research and development in the UK.

NMI's members are semiconductor manufacturers, design houses, vendors and suppliers to the industry. Its remit covers all aspects of the design, product introduction and manufacture of integrated circuits.

Most of the NMI's programmes have the shared objective of, directly or indirectly, improving the profitability of its members.

## HOW NMI OPERATES

NMI's activity is based on the understanding that the semiconductor industry faces many common problems that are best addressed collaboratively.

Collaboration allows us to reduce industry costs in two ways:

- The workload and costs are shared amongst the membership. Each company can focus on a few of the issues to be addressed and reach a good solution on behalf of the whole industry.
- Adopting standard approaches to activities allows duplication to be eliminated and performance to be raised to best in class.

NMI's forums and working groups identify areas in which cost savings and improvements can be made. The staff of the NMI has over 60 years direct experience in the microelectronics industry, giving them the necessary background to co-ordinate and facilitate this activity and foster a culture of collaboration. The employees of member companies carry out much of the work.

Many initiatives require benchmark data to be collected. NMI acts as a trusted intermediary to collect any confidential information. This is then distributed in the form of summaries and analyses of the data so that the confidentiality of participants is maintained.

To encourage participation in benchmarking activities only those companies that contribute their data to a benchmarking activity gain access to the full results.

## Interaction with the regions

Many creative developments have occurred in the regions of the UK to support the microelectronics industry, especially in the field of Education and Training. This regional activity continues with the support of the NMI and its members.

NMI members work on industry boards to define a national framework for microelectronics to meet the industry's needs in their area of activity. These frameworks provide one input into regional initiatives. They allow best practice to be shared between the regions and for common standards to be adopted across the UK.

## Representing a global industry

As is evident from its membership, the NMI represents the interests of a global industry operating in the UK. It is one of the few organisations to have member companies originating from Europe, North America and Japan. NMI's main concerns are therefore associated with ensuring that the UK remains a competitive location for its members to operate in.

Its initiatives are not proprietary to the UK. Indeed, the NMI has established working relationships with other industry bodies world-wide - especially those with shared membership. It participates in joint programmes, exchanges their outcomes and looks to minimise the duplication of effort.

# the question is when, not if, demand will exceed supply again

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## ECONOMIC TRENDS THE IMPACT ON NMI STRATEGY

It seems only an instant since everyone in the semiconductor industry was working hard to try to keep up with insatiable demand. Sales had grown at an average rate of 18% per year for 30 years - sometimes growing more than 40% a year and slow to zero growth or a small reduction in sales every 5 years of so.

In 1995, a shortage of manufacturing capacity and ever rising demand for memory and microprocessors had pushed prices higher. In that year about \$45bn of the memory that goes into computers, DRAM, was sold. Total sales exceeded \$150bn. Margins were high and the industry was highly profitable. So profitable that many corporations, investors and governments around the world saw it as an industry that they had to be a part of.

Plans were put in place to build new fabs and most of these came to fruition in 1997. Some were heavily subsidised by governments for 'strategic' reasons. Others were funded by companies that were able to borrow excessively by European standards.

One of the reasons that NMI was established was to support the demand for manufacturing staff that was expected from 3 new state of the art manufacturing facilities in the UK.

Since 1995 the number of integrated circuits shipped has continued to increase dramatically and the functionality of each circuit has grown. For example, typical memories sold today store 4 times as much information as those shipped in 1995.

However, so much manufacturing capacity has been built that prices have fallen. Indeed, in 1997 the value of the DRAM memory sold had fallen to only \$14bn - memory plants (and others) have been forced to run at a loss.

During a normal slowdown in the semiconductor market manufacturers would simply wait for the demand to rise to match the available capacity. But in 1998 the recession in the Asian economies has made the situation worse. Growth in the use of integrated circuits has slowed somewhat and too much capacity has been built.

Manufacturers have not been able to sustain their losses. They have put the construction of new plants on hold, closed existing capacity or put factories up for sale. This has occurred throughout the world with major closures in the US and Japan.

In the UK, the Korean manufacturers Hyundai and LG Semiconductor put their major new plants in Dunfermline and Newport, Wales, on hold. Siemens and Fujitsu announced the closure of their plants in the North East. National Semiconductor and Seagate have put their plants in Scotland up for sale.

History would tell us that now is the time to invest in semiconductor manufacturing. Facilities and equipment are available at bargain prices. Capacity has been reduced somewhat and demand continues to rise to meet it. Given the rising use of semiconductors in every day life the question is when, not if, demand will exceed supply again.

On present trends the turning point will be at some point in 1999. And the empty fabs in the UK will then be attractive locations to bring back into production rapidly.

Nine multinational semiconductor companies, with manufacturing and design operations in the UK, founded the NMI in 1996 with the support of the DTI and LEEL<sup>1</sup>.

Founding members:

Fujitsu Microelectronics  
Newport Wafer Fab  
Mitel Semiconductor  
Motorola  
Philips Semiconductors  
National Semiconductor  
Seagate Microelectronics  
Siemens Microelectronics  
NEC

## THE RESPONSE FROM NMI

NMI was founded with two main objectives: to ensure that adequate skills were available in the UK and to reduce costs through collaborative programmes.

Given the cutbacks in the UK we no longer face an immediate shortage of skilled staff in manufacturing. However, the demand for IC designers is still very strong.

NMI has therefore redirected its programmes to focus on:

- Cost reduction for manufacturing industry. This has been through increased emphasis on our support infrastructure and value chain initiatives.
- Improving the quality of education and training available for existing staff in fabs

- Implementing its plan to extend activity into the design and product introduction of integrated circuits, in line with its constitution.

We must not allow the current problems in manufacturing to cloud our view about the benefits of high technology. The electronics industry is the fastest growing in the world. It employs over 30,000 people designing integrated circuits in the UK and 12,000 directly in semiconductor manufacturing (even after the reductions announced this year).

It is vital that we continue to nurture the talent required to work in these high technology areas that will contribute much of the wealth of the 21st century.

<sup>1</sup> Lothian and Edinburgh Enterprise Limited  
- a Local Enterprise Council operating  
within Scottish Enterprise.

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## ACTIVITIES AND FUNDING

In 1998 the semiconductor industry has experienced the worst recession in its history. Against this background the NMI works to reduce the costs of its members.

It has had to do so with far fewer Associate Members than planned - quite understandably, many companies have been unwilling to finance a new and unproven organisation during such difficult times.

The NMI will have operated through 1998 on revenue of £420,000, compared to a planned budget of £620,000. To achieve this we have limited headcount to five rather than the seven budgeted. This has limited our progress in some areas but results have still been significant.

The next four sections of this report summarise NMI's work to date in our four main areas of activity:

- Support infrastructure and the value chain
- Education and Training
- Communication to the wider community
- Links to University R&D

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## SUPPORT INFRASTRUCTURE AND THE VALUE CHAIN

The strategic goals for these initiatives are focussed on cost reduction, quality improvement and cycle time reduction through the sharing of industry best practice, removal of duplication of effort, and enhancement of the value chain. The programmes are focused on action and the delivery of savings to all participants.

### Utilities working group

NMI has been successful in convening the first industry wide working group to address issues relating to utilities supply to semiconductor manufacturing sites in the UK. Over the last year the NMI has run workshops with its members and associate members covering quality and total cost for the utilities in the UK.

The major activity has centred on the security and cost of electricity supply as an area of particular concern to NMI's members. This has provided a unique opportunity for Facilities and Purchasing experts to meet and identify opportunities for collaboration.

Extensive benchmark data on power failures and overall electricity costs has been exchanged between members. Sharing of non-competitive data of this kind is a core activity for the NMI. By acting together the industry is in a far stronger position to influence the electricity regulator and electricity providers.

The NMI has joined the Major Energy Users Council (meuc) on behalf of its

members and has driven a focus on the quality of supply. It has established contacts with other industry segments that are also concerned about the issue.

This year has seen the NMI invited to present on power quality issues at a new all industry power quality forum attended by many of the electricity generators and suppliers. Such activity has given real opportunity to elevate the issues being faced by the NMI's membership, and represents another major step forward for the NMI's consortia activity.

The group now meets directly with the electricity regulator (Offer) and with the government's Action 2000 group. With Offer we are working to propose additional (not replacement) levels of measurement to be used by the electricity distributors. With Action 2000 we intend to increase the information available on the level of preparation for the year 2000 of the utilities in the UK.

The NMI have been invited to sit on the Business User Advisory group of Offer Scotland. This is a major opportunity at a time of change in the electricity supply market.

The next major cost reduction for electricity will focus on the potential for collaborative group tendering for the April round of contract negotiations.

The working group is now moving on to repeat the benchmarking exercise for water and gas. Opportunities for cost reduction remain the top line focus for the group.

# NMI works to reduce the costs for members

### Health and Safety Pass working group

European and UK legislation requires all visitors working on manufacturing sites to be given appropriate Health and Safety training. Historically this has been given separately at each site that an individual visits. Therefore certain individuals (especially supplier staff) can receive similar training a number of times each year.

This initiative aims to remove this unnecessary repetition by introducing a standard training course to be given at a limited number of accredited locations across the UK. Individuals who successfully complete the course will be awarded a pass, which will be recognised at all fabs in the UK. Only site specific training will then be required.

#### There are ten modules in the course:

Clean Room Protocol and Procedures Emergency Procedures Accident and Incident Reporting Personal Safety and Manual Handling Hazardous substances & H.F Environmental Precautions Risk assessment, PTW, method statements Energy sources, isolation, Lockout/tagout Electrical Safety and portable tools CDM
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The working group has now completed the development of all ten modules. The course will be fully operational in 1999.

### Manufacturing Practices Forum

This forum seeks to evaluate and improve wafer fab performance. The working groups met for the first time in September and initial activities have centred on identifying best practice in areas such as:

- Cycle time reduction
- Yield improvement
- Cost reduction (e.g. test wafer usage)
- Key equipment throughput
- Total Productive Manufacturing, TPM

### Equipment Forum

The objective of this forum, which met for the first time in August, is to identify areas relating to equipment, its costs, spares availability and stocking, and issues around the millennium bug as it relates to manufacturing.

The working group has been one of the most actively supported NMI initiatives. The objectives cover development of common databases on equipment related topics, which will be accessible to all contributing members. Examples of data being collated are key spare parts per tool set and their typical usage, main second source vendors, and their potential to supply. The group is also formalising an open database of redundant equipment available for exchange or purchase at each site.

The working group is clearly focused on realising opportunities to reduce costs via joint ventures between members or with vendors. This activity of this working group can be seen as having a true potential to deliver quantifiable savings to NMI members. The working group offers a neutral forum for open and honest communication between NMI members on topics relating to equipment and spares supply.

The group aims to complete at least 2 collaborative initiatives in the next 8 to 10 months.

### IT Review

In August the NMI convened a forum to review the IT issues being faced by the industry. It was agreed by the participating members that in the short term a working group targeting sharing participants experience on ensuring that systems are year 2000 compliant should be convened.

The objectives for the group are to identify key strategic areas in IT that would be profitably addressed via consortia activity and to foster the sharing of industry best practices.

The NMI has been successful in bringing together Y2K experts from member companies into a neutral environment where by the exchange of knowledge and the identification of best practice to make effective use of limited support resources can be more fully addressed towards the goal of achieving full equipment compliance.

All work on year 2000 compliance will be carried out in conjunction with the equipment forum.

Overall measures of success for the group will include a minimum of two collaborative initiatives complete by end of August 1999.

#### Links to UK EH&S and UKMEAC committees

Representatives from NMI's members have attended the UK Environment Health and Safety committee and the UK Microelectronics Advisory Committee (UKMEAC) for waste management for a number of years. These groups have introduced world-class standards in both areas. A NMI representative now attends both of these meetings.

The UKMEAC is considering programmes on Environmental Benchmarking, shared waste streams, and the WEEE directive.

## EDUCATION AND TRAINING

Education and Training strategy is decided by the NMI's Education and Training Board. This establishes a UK-wide framework for the industry, which provides one input into regional activity. The ETB works with the following regional groups:

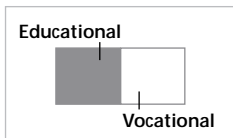
- Scotland - Long Term Skills Group and Education Industry Group
- Wales - Semiconductor Training Advisory Group
- North East England - NEMI

### Skills pipeline and skills forecast

A skills pipeline for the industry has been developed during the year. This is shown in the diagram below.

A skills forecast for the industry in the UK is completed each year. The 1997 forecast indicated that we need to plan for an increasing proportion of the fab workforce to be skilled technicians. This directed the industry's close involvement with Further Education (FE) colleges over the last year.

We hope shortly to issue the results of the 1998 skills forecast, which covers the NMI membership and a number of suppliers.



## Engineering and science in schools

The semiconductor industry in the UK has always looked to play its part in encouraging pupils to continue to study mathematics and science subjects. This has included links between fabs and local schools.

The NMI has built on this by:

- Developing an information pack on the industry which regional groups can customise it to meet their local needs.
- Running sessions for careers teachers to provide information about the industry and the careers available within it.

### Technician training programme

The microelectronics industry in the UK has developed an excellent series of educational and vocational training courses for its workforce.

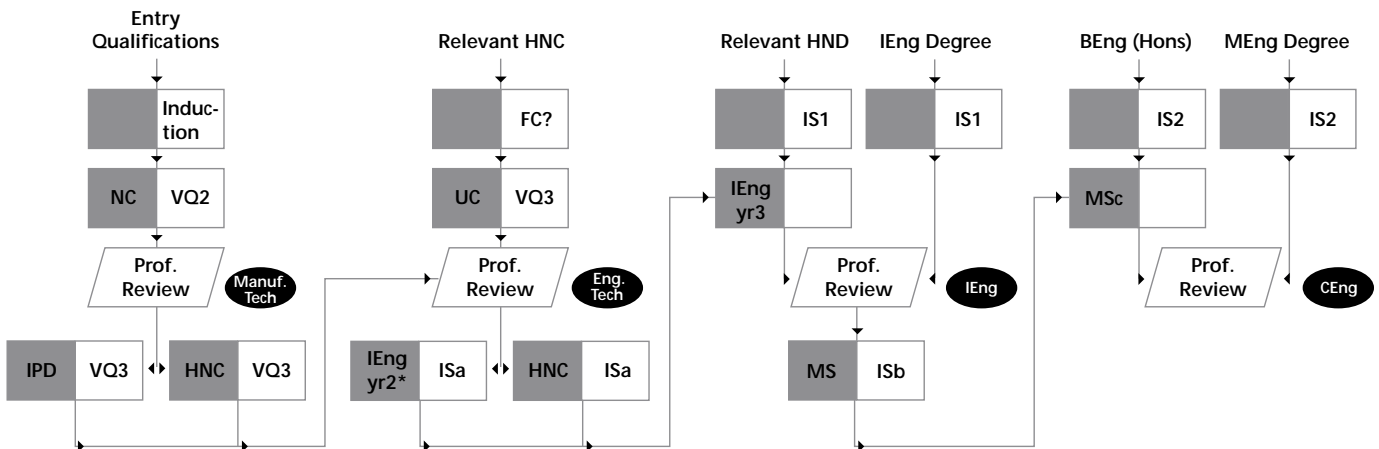
The Education Industry Group in Scotland initiated much of this work, involving the Scottish Qualifications Agency (SQA), FE colleges and the industry in Scotland. Subsequently FE colleges and industry from England became actively involved.

Educational qualifications for operators and technicians are offered by the FE colleges shown in the following table:

Qualification	FE College
NC Semiconductor Process Technology	Gwent Tertiary College
NC Engineering with Science	Scottish Advanced Manufacturing Centre (SAMC)
HNC Mechtronics with semiconductor options	(SAMC) James Watt Lauder Darlington North Tyneside
HNC Semiconductor Process Technology	(SAMC) James Watt Lauder Darlington Bell
HND Mechtronics with semiconductor options	(SAMC) James Watt North Tyneside Darlington
HND Semiconductor Process Technology	(SAMC) James Watt Darlington

Vocational qualifications have been developed in collaboration with the Engineering and Marine Training Authority (EMTA) which is the National Training Organisation for Electronics in the UK. During 1997 EMTA and NMI members held a series of meetings to move to a new set of vocational qualifications. The vocational qualifications available (as NVQs in England & Wales and SVQs in Scotland) can be viewed on the NMI website.

In parallel with this the Welsh Semiconductor Training Advisory Group developed a set of Technician Packs, which summarise the outcomes to be demonstrated to achieve a Modern Apprenticeship for the industry.



IPD - Initial Professional Development  
\* - only if already have HNC

UC - upgrade Course  
FC - Foundation course (VQ2)

IS - Industry Specific vocational training  
MS - Matching Section (further learning)

A new working group has been established to extend the Technician Packs for use across the UK and to develop support material to assist companies to institute VQs for their staff.

#### College Microelectronics Workshops

The fabs in the UK work with 10 nominated FE colleges to support the majority of the technical education needs of their operators and technicians. By focusing industry support on these 10 colleges we raise the commitment that they give to the industry and raise the quality of their courses.

Over the course of the last 18 months the NMI has run a series of 3 workshops for FE college lecturers. These have been held in the North East of England, Scotland and Wales. The local region sponsors each workshop and all training is provided by industry at no charge. Lecturers gain access to state of the art manufacturing facilities and world-class engineering expertise that would otherwise not be available to them.

The workshops have been a real collaborative effort between the semiconductor manufacturers, vendors and colleges and we would like to thank everyone who has supported them. They have fostered a collaborative spirit between colleges across the UK and visibly raised the enthusiasm of the lecturers involved.

The fourth workshop is currently under development and will be run in Scotland.

#### UK College Forum

Heads of Department from the nominated FE colleges or their regional representatives attend this forum. The remit of the forum is to:

- Identify issues of common interest to colleges and drive them forward at a management level for the whole of the UK.
- Maximise the return on funding available for regional, national and European sources.
- Act as a communication channel between colleges, industry and others.

Most recently the colleges have been collaborating to develop high quality material for the HNC and HND in Process Engineering. By sharing the development the material is being produced to open learning standards. The work will be progressed further by the regional working groups for local use.

#### MSc in Advanced Silicon Processing

NMI has been working with a consortium of ten of the foremost UK universities engaged in Silicon research to develop a new part-time MSc in Advanced Silicon Processing and Manufacturing Technologies. The consortium is led by Prof. Peter Hemment from the University of Surrey.

By enabling industry to work with academia to define the course and develop the content the NMI has ensured that the MSc will meet the future needs of the industry.

University consortium:

Cardiff	Newcastle
Edinburgh	Southampton
Glasgow	Surrey
Heriot-Watt	Swansea
Liverpool	UMIST

The Engineering and Physical Sciences Research Council (EPSRC) is contributing £440k to the consortium to support the development of the course under its Integrated Graduate Development Scheme (IGDS).

Development activity is being shared between the Universities and industry to share costs, increase quality and ensure that it fully meets industrial needs. Overheads have also been reduced by using a single Validation Board for the course accepted by all the Universities.

The MSc will be available in early 1999, and will typically be taken as a three-year part time course. Participants elect to take 8 modules from the 16 available. These cover a wide subject range at different levels ensuring that the course will have appeal for both experienced engineers and for more recent graduates. The taught modules are complemented by a significant project - normally undertaken in industry.

Individual modules may also be taken as Continuous Professional Development without commitment to the full MSc.

Devices and process integration
Quantitative Methods (SPC etc)
Doping and layer deposition
Interconnect and metallisation
Process optimisation
QA, yield, reliability and failure analysis
Production management
Design and processing of power devices
Device and circuit design for VLSI
Doping and ion implantation
Photolithography - physics and chemistry
Etching - physics and chemistry
Test, assembly and packaging
Oxidation and isolation technologies
TCAD and compact modelling
Device operation and process architectures

# NMI's remit is to raise awareness of the industry

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## COMMUNICATION TO THE WIDER COMMUNITY

The Communications Board has been meeting regularly since March 1998. Its remit is to raise awareness of the industry with key decision-makers, the media and the general public. In particular, it works with the Education and Training Board to encourage school pupils to continue to study mathematics and science subjects.

Work has included:

- FAB - a quarterly publication for the industry in the UK.
- A video which is being produced to inform 12 to 16 year olds about the industry. This is being jointly funded by industry, the regions (Wales, Scotland and North East England), the DTI and the NMI. This is being redefined to include more design content.
- An information pack and workshop on the industry for school teachers and careers specialists. This has been used successfully in Fife and the North East of England and further workshops are being planned throughout the UK.
- Contributing a balanced industry view into the general, financial and technical press as issues arise.
- NMI released the first version of its Web site in early 1998. An updated version will be released shortly.

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## LINKS TO UNIVERSITY R&D

This work is a relatively small proportion of NMI's activity, but provides an important route for communication with Universities.

The majority of links between the semiconductor industry and University R&D need to occur with the companies' global research centres. The NMI is working with EPSRC to enhance these links.

The NMI is also encouraging the research collaboration between Edinburgh, Southampton and Surrey Universities, Rutherford Appleton Laboratories (RAL) and the Defence Engineering Research Authority (DERA).

During 1999 NMI will be adding pages to its web site summarising the relevant research activity in UK Universities.

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## SUMMARY OF ACHIEVEMENTS IN 1997-98

In its first year of operation the NMI has made significant progress towards its goals in the face of the severest recession ever experienced by the semiconductor industry.

Forums and working groups have been established and collaboration between companies has been increased.

Benefits are starting to accrue to our membership as the results of our activity accumulate. The outcomes of the work can be grouped according to the benefit that results.

### Progress towards significant cost savings for the industry:

- Benchmarking of utilities (initially electricity) has revealed substantial opportunities for cost savings to many members.
- A Health and Safety pass will be launched in early 1999. This will prevent repeated training on multiple sites, increasing the overall quality of training.
- Work is underway to agree initiatives in the areas of equipment support (including year 2000) and manufacturing practices.
- The results of initiatives to support the industry in the regions are being shared across the UK.

### Improved education and training:

- 2 annual forecast of the skills required by the industry have been undertaken.
- A 'skills pipeline' has been defined.
- Support material has been produced to assist encourage school pupils to continue to study maths and science subjects.
- NC, HNC and HND courses and vocational qualifications for operators and technicians have been adopted nationally.
- 3 workshops have been run for FE College staff to give them an in-depth understanding of the industry.
- FE Colleges have been encouraged to collaborate and support each other across the UK.
- A programme to launch an MSc in Advanced Silicon Manufacturing is approaching completion.

### Promotion of Microelectronics:

- A video promoting the industry to pupils has been commissioned for completion in 1999.
- The NMI has completed its web site.

### A common voice with influence:

- NMI has been recognised as a body representing the industry in the UK by many bodies, including DTI, EMTA, SQA, the Engineering Council, IEE, Offer, Scottish Enterprise, WDA, and SEMI.

These are all small achievements to set against the irresistible economic forces that have hit the industry this year. Our objective in the short term is to persevere through the recession to ensure that the core infrastructure remains in the UK to support renewed growth in 1999.





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## MEMBERSHIP CATEGORIES FOR THE NMI

The work of the NMI is funded by its industrial members to support their operation in the UK and to share the results of the work on a wider basis. The NMI also receives funding from the DTI, Scottish Enterprise and other bodies as appropriate.

Your membership of the NMI is needed to support the continuation of the work described in this report.

Membership is available in two categories:

## MEMBERSHIP AS AT OCTOBER, 1998

### Members (Board Members in brackets)

Fujitsu Microelectronics (Len Davies)  
Mitel Semiconductors (Francois Cordeau)  
Motorola (George Bennett)  
National Semiconductor (Gerry Edwards)  
NEC (Jim Weir)  
Newport Wafer Fab (Steve Byars)  
Philips Semiconductor (Gary Munro)  
Seagate (Gordon Hutchison)  
Siemens Microelectronics (Adolf Scheibe)

### Associate members

Align-Rite  
Applied Materials  
Du Pont Photomasks  
Shin-Etsu Handotai  
South Scotland Valve and Fitting Company

Category of Membership	Annual (*) subscription	Additional benefits of membership
Non members	Nil	Improved profile of the microelectronics industry Potential share in reduced business costs Improved supply of skilled staff Participation in NMI programmes by invitation
Associate Member	> £5,000	<i>Non-member benefits plus:</i> Access to NMI staff to influence lobbying etc. Participation in NMI programmes Access to 5 NMI courses at discounted rate Invited to Associate forums Vote for a Category Director on the NMI Board Regular contact with NMI staff Influence over choice of NMI programmes Ability to update entry on NMI web database (β) Unlimited NMI courses at discounted rate (β) Use of 'NMI Associate' logo
Member	> £30,000	<i>Associate Member benefits plus:</i> Director on NMI board Strategic Guidance of NMI activity Use of 'NMI Member' logo

(\*) Companies may wish to contribute on a one-off basis to individual initiatives as part of their company's sponsorship or educational programmes.

(β) When available.

There are two classes of Associate Member: Design Associate and Manufacturing Associate. Each class elects a member to the NMI Board.