

5 Infrastructure Supporting Programme (2007-2013)

The Infrastructure Supporting Programme identifies the need for specific priority marine infrastructures to enable the delivery of the objectives of the research programmes outlined in the Marine Knowledge, Research and Innovation Strategy for Ireland 2007–2013. The following specialist marine research infrastructures have been identified:

- 5.1 Seabed & Resource Mapping
- 5.2 High-End Computing Capacity (Access)
- 5.3 Test and Demonstration Facilities for Coastal & Marine Observation and Monitoring Systems
- 5.4 Extension of Ocean and Coastal Monitoring Network
- 5.5 Research Vessel – Fund to Access Ship Time
- 5.6 National Equipment Pool
- 5.7 Robotic Platforms
- 5.8 Test Facilities for Offshore Energy

Introduction

Research infrastructures are specialist facilities and/or resources that provide essential services to research communities in the public, academic and private sectors for basic and applied research. Examples include research vessels, instrumentation and sampling equipment, libraries, databases, *in-situ* and mobile observation systems, high capacity and high-speed communications networks, and high-level computing facilities. They may be 'single-sited', 'distributed' or 'virtual'. Research infrastructures are essential tools for the development of leading-edge research in scientific and technological fields. They can foster new science and partnerships and have a significant economic, social and environmental impact. In essence, they are the essential tools without which science cannot progress.

Over the last decade, Ireland has made very significant strides in closing an historic marine research infrastructure deficit. The provision of a multi-disciplinary research vessel fleet, the establishment of the National Ocean Data Buoy and preliminary tide gauge networks, and the initiation of a National Seabed Survey have greatly benefited Irish marine science. They have facilitated the development of new knowledge-based niche products and services, contributed to a better understanding of the Irish marine environment, and enabled stronger engagement in international research and development programmes.

To further progress and address the opportunities and challenges identified in the period 2007–2013 under the Marine Knowledge, Research & Innovation Strategy for Ireland a suite of specialised research infrastructures has been identified (Table 5.1). These are specifically linked to the priorities set out in the Strategy under the three research measures. The availability of, and access to, these specialist marine infrastructures will position Irish science and industry at the cutting-edge in marine science, technology and industrial development. In pursuing the ambitious objectives of this Strategy there will be a critical need for specialist laboratory infrastructure and facilities.

Table 5.1 Marine R&D Infrastructure Requirements 2007–2013

Infrastructure Requirements 2007–2013	Industry Research Measure	Discovery Research Measure	Policy Support Research Measure
Seabed & Resource Mapping	***	***	***
High-End Computing Capacity (Access)	**	***	**
Test & Demonstration Facilities for Marine & Coastal Observatories and Monitoring Technologies	**	***	**
Deep Sea Observatory	*	**	**
Robotic Platforms	**	***	**
Extension of Ocean & Coastal Monitoring Network	***	*	***
Research Vessel – Ship Time	***	**	***
National Equipment Pool	*	*	***
Test Facilities for Offshore Energy	n/a	***	*
Specialist Laboratories & Facilities	***	***	***

*** Critical ** Very important * Relevant

This infrastructure will provide essential support in areas where: (a) there are real opportunities for scientific and commercial development; and (b) there is already an existing core of Irish expertise (e.g. microelectronics, marine science, information & communications technologies, biotechnology and environmental sensors). It will also further advance Ireland's marine research and innovation capabilities, particularly in the areas of marine sensor development, marine biotechnology, ocean energy and marine environmental management. Finally it will facilitate Irish researchers and industry to participate in international research and development programmes and develop new knowledge-based marine products and services.

5.1 Seabed & Resource Mapping

The requirements for future seabed and resource mapping were considered by a foresight panel convened as part of the National Marine Foresight Exercise (see Appendix A & B). Consequently, as with the research programmes in the Industry and Discovery Research Measures, a 2020 Vision, 2013 Objectives, RTDI Requirements and Outputs have been defined for Seabed & Resource Mapping. The principal outputs (e.g. data and data outputs) from a seabed & resource mapping programme (defined below) will contribute significantly to the infrastructure needs of the marine sector.

5.1.1 Introduction

Ireland's seabed area is 10 times its land area and although significant resources are known to exist in, on, and over this seabed area, these resources and the morphology of the seabed itself have not been completely assessed and mapped. Considering the current and increasing number of legislative requirements and obligations across state and semi-state sectors, and the need to further encourage groundbreaking research and innovation, integrated mapping of the seabed under a cohesive national strategy and management approach is crucial. Such mapping will greatly assist in the management and sustainable utilisation of our marine resources.

Over the period 2000–2006, Ireland has developed a world-leading reputation for seabed mapping, including methodologies, human capacity, know-how and physical infrastructure. This has been accomplished through the successful implementation of the Irish National Seabed Survey (INSS), which has already mapped 87% of the Irish continental marine area, producing over 300 paper-based charts and a total of 5.5Tb of digital information stored on the INSS database.

Consistent with the national goal of developing a knowledge-based economy driven by a world-class reputation for research and innovation, the INSS database and associated expertise has already leveraged earnings in excess of €5m for leading-edge Irish research and services associated with integrated seabed mapping and geosciences. As interest in deep ocean research and observation systems grows within the EU, there is great scope for Ireland to increase future earnings in this area; given that we have already averaged €2m+ per annum in 2004 and 2005.

Although significant outputs and benefits have already accrued from the INSS and other marine programmes to date, there remains a crucially important body of work to follow—mapping

In addition to the direct benefits associated with mapping the priority inshore areas, major national benefits can also be derived from an expanded focus and enhanced capabilities related to fully developing the potential of the INSS database. In particular, there are opportunities to be targeted in the marine data integration field—where Ireland has the potential to be a significant world player—and in the areas of added-value research and commercial services.

INFOMAR will deliver the cost effective solutions for Government that are demanded by:

- 1 A significant and diverse range of national legislation and EU Directive obligations;
- 2 The information requirements to underpin national policy and governance associated with wisely developing the major potential of our significant marine resources; and
- 3 The opportunity to maximise the leadership position that Ireland has achieved to date by enhancing the focus and effort devoted to data management and integration, thus ensuring the delivery of optimal value chain outputs to Ireland.

All of which call for the provision of:

- 1 A prioritised suite of integrated marine mapping surveys; and
- 2 The delivery of integrated knowledge products, services and competencies.

The INFOMAR strategy was drafted after a detailed preparatory phase that included commissioned research, independent assessment, and extensive consultation with stakeholders.

The INFOMAR strategy recommended the establishment of three core programme elements, which will be supported by a range of identified mechanisms:

- 1 Data Acquisition, Data Management and Interpretation—to contribute to the management of activities and resources in Irish inshore areas by completing a comprehensive mapping and data interpretation programme for priority areas followed by completion of remaining areas;
- 2 Data Exchange and Integration—development of processes and procedures to establish an Inter-Agency National Marine Data Discovery and Exchange Service; and
- 3 Value-added Exploitation—to deliver a range of value-added opportunities linked to user demands, commercial markets and external funding sources (e.g. 7th Framework Programme).

Funding and resourcing of INFOMAR will focus primarily on data acquisition, management and interpretation. Funding the remaining programme components through other means will present a challenge. The data asset will provide the necessary leverage to unlock RTDI funds from a range of sources including the EU, National RTDI Programmes and the private sector. A key element of INFOMAR is the provision of basic information to enable the development of beneficial decision support tools and other products.

5.1.3 2020 Vision

2020 VISION

By 2020, Ireland will have completed baseline mapping of the Irish seabed area. Through the application of state-of-the-art techniques and the development of integrated data management and interpretation, Ireland will be internationally recognised as a leader in seabed mapping and resource evaluation. Information gathered will be used for the generation of critical decision support tools for policy makers.

Building on this reputation and utilising the expertise and experience gained, new commercial opportunities will develop, linked to consultancy and data interpretation. Irish expertise will be sought-after in international marine resource research and development projects.

5.1.4 2013 Objectives

The following objectives have been identified as critical milestones to be achieved by 2013:

2013 OBJECTIVES

- 1 Provide baseline data to contribute to the evaluation and management of marine resources in priority inshore areas in support of the adoption of integrated coastal zone planning, coastal protection and management approaches.
- 2 Undertake an evaluation of priority resources and protected habitats, e.g. gas hydrates, oil and gas, marine aggregates, fisheries and deep-water corals, to support the development of appropriate management and regulatory approaches.
- 3 Be internationally recognised as a strong research performer in the areas of marine survey, habitat mapping and resource evaluation, enabling the development of international collaborative research opportunities that will add value to nationally held data sets.

5.1.5 RTDI Requirements/Key Outputs

The identified RTDI requirements and key outputs for delivering on the 2013 Objectives are presented below.

Table 5.2 Research Requirements & Key Outputs for Seabed & Resource Mapping to 2013

Objectives 2013	RTDI Requirements	Key Outputs
<p>1 Provide baseline data to contribute to the evaluation and management of marine resources in priority inshore areas in support of the adoption of integrated costal zone planning, coastal protection and management approaches.</p> <p>(*See <i>Marine Environment Research Programme, Section 4.1</i>).</p>	<ul style="list-style-type: none"> > Future (next 5-10 years) mapping activities to be focused on priority areas as identified in Figure 5.1 > Baseline mapping > Data analysis, integration & visualisation > Habitat classification > Environmental baseline measurement > Develop technology and expertise to deliver customised decision support tools and solutions 	<ul style="list-style-type: none"> > Bathymetry data > Hydrographic maps > Seabed classification maps > Habitat maps > Inshore management plans > Input to development of international standards > Decision support tools driven by policy and/or commercial clients
<p>2 Undertake an evaluation of priority resources and protected habitats, e.g. gas hydrates, oil and gas, marine aggregates, fisheries and deep-water corals, to support the development of appropriate management and regulatory approaches.</p>	<ul style="list-style-type: none"> > Continue priority mapping to provide data for the quantification of priority resources > Develop and apply new tools and methods for data interpretation > Develop an accessible online resource database 	<ul style="list-style-type: none"> > Resource management plans > Input to the development of regulatory frameworks > Online seabed resource database
<p>3 Be internationally recognised as a strong research performer in the areas of marine survey, habitat mapping and resource evaluation, enabling the development of international collaborative research opportunities that will add value to nationally held data sets.</p>	<ul style="list-style-type: none"> > Significant national programme of value added research on data acquired including: <ul style="list-style-type: none"> • Geophysical analysis • Biological processes • Physio-chemical processes • CO₂ sequestration • Oceanography and climate change 	<ul style="list-style-type: none"> > Expansion of national capacity and capabilities > International research and business opportunities in seabed surveys, habitat mapping and resource management > Participation in European Programmes

5.1.6 RTDI Capacity/Capabilities

Current Research Capacity

Third-level Sector

Six research groups in five third-level institutes are currently actively involved in seabed and resource mapping research. Together, these groups comprise approximately 32 researchers in seabed and resource mapping research (Table 4.12). The research focus of these groups covers areas such as acoustic data interpretation, deep ocean ecosystem research (including cold-water corals), aggregate resource mapping, advanced mapping technologies and ocean floor dynamics. Much of the ongoing research work in the third-level sector is, in some way, linked to the Irish National Seabed Survey (INSS); e.g. using acquired data for seabed mapping and habitat classification.

Table 5.3 Overview of Current Seabed & Resource Mapping Related Research in the Third-level Sector

Institutes	No. Research Groups	No. Researchers*	Research Focus
NUIG UCC UL UCD DIAS	5 Large Groups 1 Small Group	32	> Marine geology and geophysics > Aggregate resource mapping > Deep ocean research > Habitat mapping > Geobiology > Crustal tectonics > Marine and petroleum geology > Sedimentary geodynamics > Marine robotics for seabed mapping > Marine seismics > Marine electromagnetics > Rheological and geodynamic modelling > Sea floor/slope stability > Deep-water ecosystems/past climate change

Large: >10 researchers; Medium: 5–10 researchers; Small: <5 researchers

* In some cases, research groups may focus on more than one theme and the total number of researchers in these groups is greater than indicated here. The total number of researchers in the groups identified is approximately 85.

A further 8-10 research groups and a number of individual researchers (approximately 50-75 researchers in total) have relevant skills and research interests that can be applied to the future RTDI requirements for seabed and resource mapping. Much of this expertise could be applied to the RTDI requirements of Objective 3 (adding value to acquired data), with research groups focused on topics such as understanding benthic processes, physical oceanography and modelling, fisheries, biodiversity and climate change.

State Sector

Since the inception of the INSS, the Geological Survey of Ireland (GSI) and the Marine Institute have built up considerable seabed mapping expertise, e.g. in geophysics, hydrography and data management. At present there is approximately 20 staff (GSI & Marine Institute) actively involved in seabed mapping. This expertise can contribute to the ongoing seabed mapping requirements in support of the 2013 Objectives.

Identification of Research Skills/Competencies to Meet Future RTDI Requirements

A summary, based on the identified future RTDI requirements, of the competencies required to meet the 2013 Objectives is presented in Table 5.4. Also included in Table 5.4 is an assessment of whether there are current strengths (S), areas that require strengthening (R), or gap areas (G), in relation to the identified requirements, within the existing research community.

Table 5.4 Competencies Required to Meet Future Research & Innovation Requirements Related to Seabed & Resource Mapping

Objectives 2013	Competencies Required	Assessment
1 Provide baseline data to contribute to the evaluation and management of marine resources in priority inshore areas in support of the adoption of integrated coastal zone planning, protection and management approaches.	<ul style="list-style-type: none"> > Seabed mapping > Hydrography > Habitat classification > Marine spatial planning and ICZM 	<ul style="list-style-type: none"> S R R G
2 Undertake an evaluation of priority resources and protected habitats, e.g. gas hydrates, oil and gas, marine aggregates, fisheries and deep-water corals, to support the development of appropriate management and regulatory approaches.	<ul style="list-style-type: none"> > Seabed mapping > Hydrography > Habitat classification > Marine spatial planning and ICZM > Data management, integration and visualisation > Socio-economics/cost-benefit analysis 	<ul style="list-style-type: none"> S R R G R G
3 Be internationally recognised as a strong research performer in the areas of marine survey, habitat mapping and resource evaluation, enabling the development of international collaborative research opportunities that will add value to nationally held data sets.	<ul style="list-style-type: none"> > Seabed mapping > Hydrography > Habitat classification > Geophysics > Fundamental marine sciences > Understanding climate change processes and mitigation 	<ul style="list-style-type: none"> S R R S S R

* S – Current Strength; R – Requires Strengthening; G – Gap Area.

The considerable expertise that has been built up over the period of the INSS, primarily within the state sector (Marine Institute and GSI), is clearly a strength that can contribute significantly to the ongoing mapping requirements needed to meet the 2013 Objectives. The acquisition of seabed mapping data is, however, just the first step in achieving these objectives. Appropriate management and utilisation of this data is vital, and there are a number of RTDI competencies that need to be strengthened to optimise use of the current data set and any future acquired data. For example, management and integration of the data with other data sets (e.g. fisheries and environment) is a big challenge. Although much expertise in hydrography and habitat classification has been built up over the course of the INSS, further strengthening is required—particularly, given Ireland's reliance on the UK Hydrographic Office for navigational charts. The interpretation of seabed survey data to produce habitat classification maps is currently the subject of ongoing research within the third-level sector. Further strengthening in this field is required.

A national programme of value-added research using seabed-mapping data can draw on a wide range of researchers within the third-level sector if research programmes are accurately defined. Although there are clear strengths within the third-level sector in some of the fundamental marine sciences needed to achieve this, e.g. zoology and microbiology, other disciplines such as marine chemistry are, perhaps, not as well represented. An understanding of climate change processes and mitigation measures are also areas that require strengthening.

Finally, exploitation of seabed resources cannot proceed in the absence of a structured management regime and a cost-benefit analysis. There is little expertise in Ireland in the practical application of marine

spatial planning and Integrated Coastal Zone Management. Cost-benefit analysis of seabed resource exploitation is also considered a research gap.

Current Strengths	Require Strengthening	Gaps
<ul style="list-style-type: none">> Seabed mapping> Geophysics> Fundamental marine sciences	<ul style="list-style-type: none">> Hydrography> Habitat classification> Data management, integration and visualisation> Climate change processes and mitigation	<ul style="list-style-type: none">> Marine spatial planning and ICZM> Socio-economics/cost-benefit analysis

Figure 5.2 Research Competencies Required to Meet 2013 Objectives for Seabed & Resource Mapping

5.2 High-End Computing Capacity (Access)

In order to support the programmes proposed in this Strategy, a basic prerequisite for the research and commercial sectors is access to High-End Computing facilities. Such facilities are defined as 'computers operating at, or near, the current highest operational rate possible, coupled with techniques for parallel problem solving'. High-End Computing facilities have associated data storage, processing, visualisation and retrieval systems. This is necessitated by the very large volumes of data emanating from marine research streams utilising sensors and satellite and aerial remote sensing, and the requirement to process and turn these data into knowledge in real-or near-real time.

High-End Computing capacity is required across many sectors and disciplines to meet national Research and Innovation aspirations. Marine sector requirements can be facilitated through access to the National Centre for High-End Computing. This exists in embryonic form, with support from Science Foundation Ireland, and as it evolves into a National Facility it could be accessed and utilised by the marine sector through a grid computing facility.

A Marine High-End Computing Facility would provide:

- > Access to supercomputers and ancillary services for data management, visualisation and analysis;
- > Trained specialists to develop and run existing modelling systems and provide advice and services to the research community in the public and private sector; and
- > Enhanced linkages to cabled observatories, test-bed facilities, permanent monitoring networks and continuous sensor streams.

The High-end Computing Facility would be used to support a number of research areas including:

1 Seabed & Resource Mapping

Very large data sets are generated from the digital multi-beam survey operations carried out in the National Seabed Survey. The manipulation and mining of these data sets requires advanced computational capacity and capabilities to support the delivery of a wide range of products and services. These include:

- > Modelling deep seismic data;
- > Evaluation of gas hydrate resources;

- > Modelling gravity/magnetic data;
- > Modelling oceanographic data;
- > Tidal predictions;
- > Investigation of seafloor processes;
- > LIDAR (Light Detection and Ranging) waveform analysis;
- > Deep ocean habitat mapping;
- > Seabird & cetacean distribution maps;
- > Hydrodynamic modelling for pollution;
- > Geohazard identification; and
- > Quantification of seaweed resources.

2 Bioinformatics

The Marine Biodiscovery Research Programme and associated Biotechnology Research Programme provide new challenges for adding value to the investment made in marine data acquisition. Bioinformatics capability will require the integration and analysis of complex interactive data sets from a wide range of sources and activities, including marine taxonomy, metagenomic analysis, synthetic chemical data sets, cell biology readings and clinical trials. High-end computing capabilities are an important supporting infrastructure for the future development of activities in this field.

3 Environmental, Climate Change and Circulation Modelling

Climate change is one of the greatest environmental, social and economic threats facing the planet. Global monitoring activities will grow exponentially over the next decade. The ability to incorporate complex marine data sets into models will greatly improve the resolution of marine and coastal climate change scenarios and predictions. Met Éireann runs and part-funds the Community Climate Change Consortium for Ireland (C4I) project. This project runs ocean and atmospheric models, in collaboration with CosmoGrid (a network of distributed computing resources in Ireland), to examine the impact of climate change at a regional level on Ireland and surrounding coastal areas.

The need for sophisticated ecosystem modelling to support the 'ecosystem approach' to environmental management (e.g. EU Marine Strategy) and the ability to assess 'what if' scenarios related to marine resource development (in fisheries, aquaculture, shipping, energy and tourism, etc) would benefit from access to enhanced computational resources.

The increasing complexity of environmental data sets, coupled with a continuous stream of environmental data from in-situ and autonomous environmental sensors, demands a new approach to data storage, quality control, processing, visualisation and output formats, and computational capabilities that are beyond the operational scope of many institutional computer systems.

5.3 Test & Demonstration Facilities for Marine & Coastal Observatories and Monitoring Technologies

Initially driven by 'big science' drivers such as climate change and plate tectonics studies, there is now a significant and growing level of international activity in the development and deployment of an array of novel observation and monitoring systems; notably in the US, Canada, Japan and a number of European countries. These systems involve the synthesis and application of technologies in areas such as photonics, sensing and ICT, and result in entirely new scenarios for coastal and marine observation and monitoring. A vision is emerging, internationally, of networks of systems that are both feasible and cost effective, and which will become ubiquitous in environmental monitoring over the next decade.

An example of this is the EU Global Monitoring for Environment and Security (GMES) initiative, which plans to establish a European capacity in earth observation and environmental monitoring based on remote sensing and *in-situ* observations (e.g. ocean/coastal data buoys, seabed observatories). An important component of this will be the marine observation system that the European Commission is considering fast tracking over the period 2007–2013. Recent events, such as the 2004 tsunami in the Indian Ocean, have further emphasised the need for an operational European Ocean Observing System with active links across the Atlantic to the USA and Canada.

This new class of technologies and methodologies will directly and significantly affect and benefit:

- > weather forecasting (including storm and coastal flooding warnings);
- > safe navigation;
- > harmful algal bloom warnings;
- > circulation and climate modelling;
- > input to the fisheries and aquaculture sectors by facilitating the 'ecosystem approach' to resource management; and
- > the development of enhanced tools (including ICZM) to support the water-based tourism sector.

In addition to improved environmental data, the establishment of coastal and marine observation and monitoring systems provides opportunities for equipment/sensor designers and manufacturers, and services industries providing value-added services (e.g. forecasting services). They will be very important tools for realising the developmental objectives of the programmes proposed in the Discovery Research Measure.

Autonomous sensor networks and cabled observatories with power availability and reliable broadband communications represent the future of freshwater, coastal and marine observation and monitoring systems and very large markets for components and systems will emerge over the next decade.

Ireland has already begun the process of applying new technology-based methodologies, through the establishment of the National Ocean Data Buoy and Tide Gauge Networks and the Harmful Algal Blooms Database and Monitoring System. Our strategic location on the western seaboard of the European Union (emphasised, for example, in the European Seafloor Observatory Network Report, see below) provides Ireland with an opportunity to be an important player in this emerging knowledge-based, high-tech area.

To facilitate and support Irish participation and benefit from future developments in coastal and marine observation and monitoring systems, two initiatives are proposed:

1 SmartBay

In order to accelerate the capability for development of advanced marine technologies in Ireland and to inform and enhance a range of activities of strategic significance to a wide variety of agencies and stakeholders in marine sector industries, a catalytic national innovation project, **SmartBay**, has commenced. This will be an inter-disciplinary and inter-agency project, in a major multi-use bay in the west or south-west of Ireland, designed to test and demonstrate new marine technologies and to pilot their application to a wide range of monitoring and management applications; including coastal zone management, habitat mapping, electronic charting and navigation, and algal bloom forecasting. The component technologies will include:

- > a fibre-optic cable from shore to an underwater hub;
- > a variety of instrument nodes and sensor packages;
- > a calibration site/facility;
- > multi-beam digital map and geotechnical survey of the area;
- > deployment of a moored buoy, and possibly drifting buoys; and
- > navigation and telemetry infrastructure.

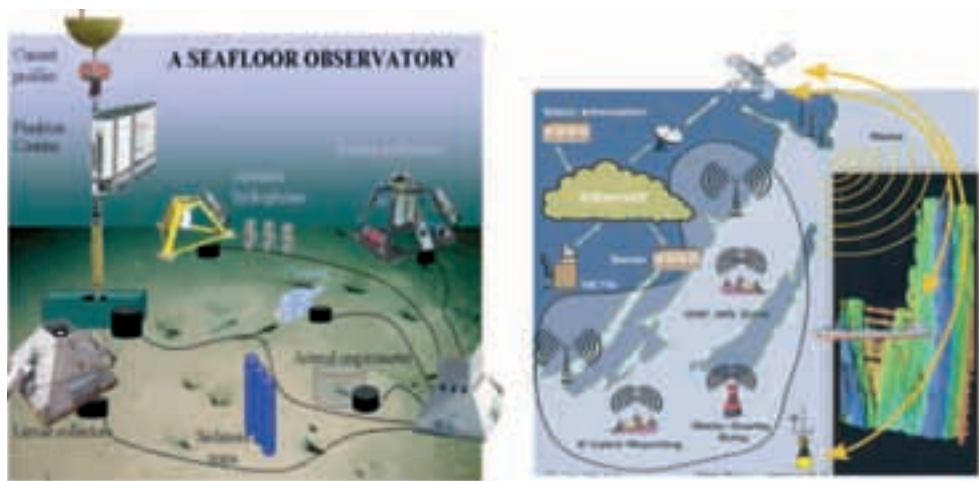


Figure 5.3 Elements of the 'Smart Bay' Concept (Canadian Centre for Marine Communications, 2004)

This infrastructure will be available to researchers and industry to:

- > Test new concepts in instrument design;
- > Field test and demonstrate new products prior to marketing;
- > Integrate these new technologies with the innovative methodologies for resource management that are being developed and applied in fisheries, aquaculture, shipping, tourism and leisure, etc.; and
- > Attract significant international funding to what will be a unique infrastructure facility.

SmartBay has direct links, and is an essential precursor, to active Irish participation in the design, installation and operation of continental shelf and deep-ocean cabled observation systems. The schedule for developing **SmartBay** is outlined in Table 5.5.

Table 5.5 Schedule for SmartBay Implementation

Steps/Tasks	Time Scale	Benefits/Deliverables
1 Identification of SmartBay site in association with user community	2006	Agreement with user community (shipping, fisheries, aquaculture, tourism and technology sector) on site location and specific infrastructure requirements
2 Comprehensive baseline assessment and seabed/environmental survey	2006	Integrated foundation data set for chosen site
3 Establishment and testing of cabled hub infrastructure (including data collection platforms)	2007 – 2008	Provision of national and international test site for advanced coastal observation and monitoring technologies
4 Initiation, operation and installation of sensor packages	2008 – 2013	Accelerated commercialisation of advanced sensor and sensor system technology International partnerships and technology transfer

2 Deep Sea Observatory – Cabled Network

The establishment of a cabled Deep Sea Observatory on the Irish Continental Shelf, as an extension of the SmartBay concept, will provide an essential scientific tool for deep-sea research and observation and add to our understanding of deep-sea ecosystems.

In addition, the cabled Deep Sea Observatory would serve a similar function to SmartBay in providing a deep-sea test facility for researchers and, in particular, industry to test new concepts in instrument and sensor design, optoelectronic, and wireless and other communication technologies and to field-test and demonstrate new products prior to marketing. A proactive national decision in respect to this initiative will place Ireland in a strong position for EU contributory funding for what the Commission regard as a strategic European priority.

The European Seafloor Observatory Network —ESONET

In 2004, the EU-funded ESONET project (The European Seafloor Observatory Network) provided a vision of a European Seafloor Observatory Network and identified nine potential locations. One of these locations, the Porcupine Abyssal Plain, is off the west coast of Ireland. Ireland is currently leading a follow-up feasibility study and cost benefit analysis (ESONIM) on the establishment of a seabed observatory in the Porcupine Seabight.

In early 2006, the Commission propose to fund a €7 million Network of Excellence on Seabed Observatories as a step towards the establishment of an operational European Seabed Observatory System. The EU, through its GMES initiative and 7th Framework Programme (2007–2013), is considering fast tracking elements of the European Ocean Observing Network and it is anticipated that supporting grant -aid will become available for research and demonstration projects.



5.4 Extension of Ocean and Coastal Monitoring Network

Over the past five years, Ireland has developed important elements of an ocean and coastal monitoring network.

- > The Marine Institute, in collaboration with Met Éireann, the UK Met Office and DCMNR, has established an **Irish Marine Data Buoy Network** of five strategically placed data buoys. The Data Buoy Network, which currently focuses on meteorology, provides on-line information for weather forecasts, shipping bulletins and gale and swell warnings. The network is being up-graded to collect oceanographic data, including currents and temperature at depth.
- > **The Harmful Algal Blooms (HABs) Database** provides up-to-date information on HABs in shellfish growing areas around Ireland. The HABs database is not strictly oceanographic in its nature but will soon incorporate temperature data as part of the routine data output to shellfish producers. The phytoplankton and toxin chemistry components of the database are truly operational, providing data that permits sound decision-making on whether harvesting of shellfish is permitted or not on a day-to-day basis.
- > **The National Tide Gauge Network** is a Public Private Partnership providing on-line information on tide levels at five strategic harbours around the Irish coast. The data provided is essential for port management, hydrographic mapping, maritime safety, sea-state forecasts and research and development.

Further extension of the geographical coverage of the ocean and coastal monitoring network, expansion of data collection parameters, enhancement of data management and modelling capabilities, and further development of data products are required.

5.5 Research Vessel – Fund to Access Ship Time

The Marine Institute operates the national marine research fleet (*RV Celtic Explorer* and *RV Celtic Voyager*), on behalf of the Irish Government and the Irish marine research community, on a charter basis. Government agency users (including the Marine Institute) pay a fee for use of the ships. These fees come from annual operational budgets or from earned research grants. The funding of ship time poses a problem for academic researchers who do not normally have a ship charter allocation in their research budgets. It also poses problems for co-operation in International R&D Programmes (e.g. EU) where ship time is either 50% funded (with an upper cap) or expected as part of the Member State contribution to the co-operative research.

The Marine Knowledge, Research & Innovation Strategy proposes to address this issue by including a dedicated competitive R&D Research Vessel Funding Programme. This Programme, similar to that operated in other countries, would make grant-aid available to researchers on a competitive (annual) basis, enabling them access to ship time as part of institutional and co-operative international marine research programmes.

Supporting access to research vessels via competitive funding of RV ship time will:

- > Maximise the utilisation of world-class infrastructure on strategic national projects consistent with the objectives of the Marine Knowledge, Research and Innovation Strategy;
- > Maximise value for money and return on investment by the state in national infrastructure;
- > Significantly improve competitiveness of Irish research groups in applying for strategic and high profile EU and international funding;
- > Increase the general perception (brand) of Ireland as a significant international player in marine science, with knock-on benefits;
- > Maximise the contribution that research performers in the third-level sector can make to various national marine scientific programmes as outlined in this Strategy; and
- > Enhance the 'brand' image of Ireland as a strong research performer and knowledge economy player globally by contributing to international scientific and ocean governance undertakings.

5.6 National Equipment Pool

The Marine Institute operates a National Equipment Pool for specialised marine research equipment on an informal basis. This includes Marine Institute equipment and other equipment that owners place, for an agreed maintenance fee, under the care of the facility. In the future, the intention is to operate the pool on a commercial basis with charges levied for:

- > design and build of equipment;
- > modification of equipment;
- > provision of equipment operators (if applicable);
- > engineering calibration of instruments (if applicable);
- > scientific calibration of instruments (if applicable); and
- > transport and usage of the equipment.

The establishment of more formal arrangements will enable the Marine Institute to play a key role in the 'mechanics' of Marine RTD, optimise equipment and resource usage, and facilitate inter-institutional co-operation. It will also support the developmental objectives of the advanced technologies component of the Discovery Research Measure and provide a valuable service to technology developers in industry.

5.7 Robotic Platforms

A wide, and growing, range of marine activities requires the use and intervention of robotic and semi-robotic platforms, e.g. remotely operated vehicles (ROVs). These activities include oil and gas exploration and development, deployment and inspection of underwater cables, installation and monitoring of instrument packages, and marine biodiscovery. It is anticipated that these systems—ROVs, autonomous underwater vehicles (AUVs), towed systems, manned submersibles, floats and buoys—will continue to evolve and reduce in price as a result of developments in other areas of science (e.g. materials, nanotechnology, power systems & ICT).

Ireland has no ROV or other vehicle capable of operating in waters greater than 200m. Even this limited capability is currently sourced through the hiring of equipment from specialist contractors. In order to take advantage of growing opportunities to develop commercial products and services in this niche area, and to service existing and planned instrument platforms, research projects and potential salvage operations, it is proposed to acquire a mid-range ROV, (rated to 4000m) capable of supporting research, development, survey, and search and salvage operations. The system should be capable of carrying a significant payload including cameras, scanning sonar, side-scan sonar, profiling sonar, sub-bottom profiler, transponders and manipulator and skid.

5.8 Test Facilities for Offshore Energy

Following the early design and testing stages, the critical requirement for ocean energy prototype development is to demonstrate the performance and operational capabilities of devices in a 'real' environment. The phased **Renewable Ocean Energy Programme**, developed by SEI and the Marine Institute (launched in 2006), outlines a series of measures to support the emergence of a commercially successful wave energy industry in Ireland. It has also led to the establishment of an enhanced **Centre of Excellence in Ocean Energy Research** and a developing programme of research and development aimed at underpinning Ireland's ambitions to be among the world players in this emerging technology sector. Achievement of these objectives is dependant on access to a supporting infrastructure, in the form of wave tank facilities and a fully equipped test-bed facility for ocean energy research and development.

In line with the measures proposed in the Renewable Ocean Energy Research Programme (Section 3.4), a two-step approach is proposed in respect to the provision of test facilities. The first stage, completed in early 2006, involved putting in place an interim marine test site in Galway Bay to assist offshore energy device developers to deploy and test scale devices in a near-operational environment. This will enhance the capability of Irish device developers to meet the need for visible operational demonstration of their devices in what is a competitive international arena for this emerging technology. Expanded wave tank facilities will also support developers through this phase.

Following the successful conclusion of the first phase of the programme, a second stage test site will be required, for the testing of full-scale production devices. The facility will be in an operational open-ocean environment and will include a cabled grid connection.

5.9 Summary

The specialist marine research infrastructures identified above are essential if Ireland is to achieve the aims and objectives outlined in the Marine Knowledge, Research and Innovation Strategy (2007–2013). They represent a very significant and long-term financial investment in the national marine science and technology infrastructure. Some of the requirements may be amenable to Public Private Partnerships and they will act as ‘research and technology enablers’, facilitating the development of niche knowledge-based products and services. They will also provide a powerful ‘attractant’ to the type of joint Public Private research partnerships with international and multinational companies (e.g. in the medical, pharma, energy and sensor technology sectors) that will be an essential feature of Ireland’s economic development over the next decade. Specific opportunities are already evident for potential funding from the EU Framework Programme.

In addition to new investments, the ongoing maintenance of existing state-of-the-art marine research infrastructure—such as the ocean-going *Celtic Explorer*, and the Ocean Data Buoy Network—and the completion of National Seabed Survey (INFOMAR) are essential. The availability of this infrastructure has already brought Ireland and Irish researchers to the forefront of marine research and has facilitated participation in prestigious international and regional (European Union) research and development programmes. The proposed new infrastructure, to be established over the period 2007–2013, will further advance Ireland’s marine research and innovation capabilities, facilitate participation by Irish researchers and industry in international research and development programmes, and facilitate development of new knowledge-based marine products and services.