JRC Scientific and Technical Reports

ERAWATCH Country Report 2008
An assessment of research system and policies

Malta

Lisa Pace

EUR 23766 EN/12 - 2009

JRC EUROPEAN COMMISSION

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JRC 50330
EUR 23766 EN/12
ISBN 978-92-79-11615-5
ISSN 1018-5593
DOI 10.2791/76764

Luxembourg: Office for Official Publications of the European Communities

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ERAWATCH Network - Independent Expert

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Acknowledgements and further information:

This analytical country report has been prepared as part of the ERAWATCH project. ERAWATCH is a joint initiative of the European Commission's Directorates General for Research and Joint Research Centre. For further information on ERAWATCH see http://cordis.europa.eu/erawatch.

The analytical framework and the structure have been developed by the Institute for Prospective Technological Studies of the European Commission's Joint Research Centre (JRC-IPTS, project officer: Jan Nill) and have been improved based on comments of DG Research, Ken Guy, Stefan Kuhlmann, Nikos Maroulis, Patries Boekholt, Aris Kaloudis, Slavo Radosevic and Matthias Weber.

The report has been produced by the ERAWATCH Network in the framework of the specific contract on ERAWATCH country reports 2008 (project manager: Nikos Maroulis, Logotech). It makes use of information provided in the ERAWATCH Research Inventory (http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.home) with support of the ERAWATCH Network. It has benefited from comments and suggestions of Patries Boekholt, who reviewed the draft report. The contributions and comments of Anna-Maria Rozentalska (JRC-IPTS) and Benedikt Herrmann and Dermot Lally (DG Research) are also gratefully acknowledged.

The report is only published in electronic format and available on the ERAWATCH website: http://cordis.europa.eu/erawatch. Comments on this report are welcome and should be addressed to Mark Boden (Mark.Boden@ec.europa.eu).

Executive Summary

Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy is at the heart of the Lisbon Strategy. The strategy reflects this in guideline No. 7 of the Integrated Guidelines for Growth and Jobs which aims to increase and improve investment in research and development, in particular in the private sector. The report aims at supporting the mutual learning process and the monitoring of Member States efforts. The main objective is to characterise and assess the performance of the national research system of Malta and related policies in a structured manner that is comparable across countries.

In order to do so, the system analysis focuses on key processes relevant for system performance. Four policy-relevant domains of the research system are distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. This report is based on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

This Section of the report presents a synthesis of strengths and weaknesses in the research system in Malta across the four domains analysed.

The national research system has undergone rapid changes and progress in developing more joined-up (i.e. coordinated) approaches to research policy. The Research & Innovation (R&I) Strategy, launched in 2006, calls for shared competencies for R&I among public entities, with the Malta Council for Science & Technology (MCST) having an oversight role in coordinating policies and measures among the key players in the public and private sectors. The Strategy presents a very broad set of recommendations intended to guide policy initiatives and investments with a bias towards business-oriented research.

Coupled with these changes in governance, there has been an increased deployment of public funds for research through competitive grants of the national R&I funding programme and initiatives co-financed by structural funds. These investments, together with a good track record of participation in EU's Framework Programme for Research & Development (FP), have served to boost R&I activity. Nonetheless, the lack of a culture for research (and innovation) and the still limited investments in R&I coming from the public and private sectors are acting as bottlenecks to a thriving research and innovation system.

A key driver of knowledge demand is the government's vision to orient research and innovation in four sectors that offer potential for economic growth (ICT, Energy & Environment, Health-Biotech, and High Value-Added Manufacturing). Also, the use of foresight in policy processes is helping identify drivers of knowledge demand (e.g. in the higher education sector and innovation in enterprise). It has stimulated a bottom-up approach in defining knowledge demands and orienting research and innovation needs by engaging with relevant actors from the public and private sectors.

In a context where resources are limited, a critical aspect for Malta lies in building research capacity in niche sectors, through setting up platforms of strategic importance, with adequate human resources. The current low level of S&T graduates and researchers could actually limit this growth where the education system will not be able to supply adequate skills and in adequate supply in these areas (such as ICT

and pharmaceuticals). The current reform of the Higher Education System is addressing issues of skills mismatches and timely provision of skills.

There is limited leverage on the private sector contribution to the gross R&D spend and a lack of structured mechanisms for capturing knowledge demand from the private sector. On the other hand, private-public collaboration is being encouraged through the national R&I funding programme.

Since the private sector is mainly dominated by small and medium sized and micro-enterprises, with minimal R&D activity, there is limited absorptive capacity of this sector for R&I activity. The low level of indigenous R&D is being addressed by the new Enterprise Aid Schemes (2008), co-financed by the European Regional Development Fund, that will support industry-led research and development and research and innovation initiatives within SMEs with a wider mix of grants and fiscal measures.

A perceived weakness is the absence of sustained monitoring and evaluation of research programmes and instruments, the extent of their take-up by the research system and emerging lacunas that are not being addressed as a result.

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	• Research and innovation were given a higher profile when responsibility for R&I was taken over by the Office of the Prime Minister in 2005. • The National Strategic Plan for Research & Innovation 2007-2010 sets for the first time targets for boosting the country's R&I investments in defined priority areas.
	Securing long term investment in research	• Long-term investments in research are mainly those tied to European funding for the period 2007-2013. Research and innovation projects are being funded through the priority axis on Knowledge & Innovation of the Cohesion Policy. • Ministries and public agencies receive their annual budgets as block funding from the central government so that generally there are no multi-annual funding cycles/programmes. The National R&I funding programme follows a yearly budget cycle. • Malta has a good track record of participation in EU's FP6 and has attracted €3.26m in the first year of FP7.
	Dealing with barriers to private R&D investment	• Although business sector investment in R&D has risen from 0.08% to 0.42% of GDP over the period 2004-2007, this is still low in comparison with the EU average. • A new package of incentives was launched in 2008 by Malta Enterprise to promote international competitiveness, innovation, research and e-business development. These schemes are supported through structural funds. • Initiatives are underway to generate demand for R&I through public procurement for research and innovation.
	Providing qualified human resources	• The national landscape is characterised by a low percentage of S&T graduates and researchers, with the additional concern of a brain drain of graduates.

Domain	Challenge	Assessment of strengths and weaknesses
Knowledge demand	Identifying the drivers of knowledge demand	• The National Foresight Project and other future-oriented exercises, provide key input into the updating of the RTDI Strategy and helped flag niche sectors in which to target public research investments.
	Co-ordination and channelling knowledge demands	• Mechanisms for coordinating knowledge demand between different sectors of the research system are not well developed.
	Monitoring of demand fulfilment	• The evaluation of policies and programmes and their impacts is still in an embryonic phase.
Knowledge production	Ensuring quality and excellence of knowledge production	• International peer-review of the public research funding programme ensures quality of knowledge production and transparency.
	Ensuring exploitability of knowledge	• Malta has low levels of patent applications and licences compared to the EU25 average and needs to build more momentum towards defining an Intellectual Property Rights strategy.
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	• The national R&I funding programme facilitates collaboration between academia and the business industry sector. • Insufficient inter-sectoral researcher mobility.
	Profiting from international knowledge	• Malta has a good track record of international collaboration such as through the EU's FP, COST and other international programmes (UNEP, FAO). The highest success rate of participation in FP involves primarily academia with SMEs lagging behind so far.
	Enhancing absorptive capacity of knowledge users	• There is an evident disparity in the private sector: large multinational affiliates undertaking R&I probably account for the largest share of BERD; whilst the more numerous SMEs, that are often family-run micro-enterprises, report minimal R&D activity.

In the face of Malta's limitations in terms of scale and critical mass, a policy opportunity lies in developing a sector-specific approach to identify and define research requirements and investments in niche areas. The MCST is undertaking a priority-setting exercise in 2008 for the health sector; a consultative process has been launched in order to formulate a health research strategy. A second initiative on green manufacturing is also under consideration.

These initiatives, together with the recent thrust to promote innovative public procurement, also aim to create an impetus for boosting private sector demand for R&I; though they must be accompanied by an adequate framework promoting inter-sectoral collaboration and researcher mobility.

The reform of the higher education system, together with the re-orientation of the University's long-term strategy, creates opportunities for fine-tuning skills supply with industrial needs.

The main policy opportunities and policy-related risks are summarised in the table below.

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	• Increased resources for research deployed through Structural Funds especially in the second wave of funding 2007-2013. • The National Strategic R&I Plan provides a framework for long-term investments in qualified human resources. • The newly approved legislation determining the conditions for admittance of third country researchers should help attract researchers and research collaboration to Malta. • A number of public entities are to allocate 0.25% of their budget for R&I.	• There is no distinct research policy and innovation policy – with the risk that a lack of coordination of policy initiatives and measures, leads to ineffective deployment of resources.
Knowledge demand	• The setting up of Platforms of Strategic Importance in priority areas for better integration of knowledge demands into the national research system; • An emerging opportunity lies in stimulating the demand for innovation-oriented public procurement. • As one of the principal knowledge producing institutions, the University of Malta has the potential to steer its strategy around societal, environmental and economic needs of the country, thus making its research more relevant to national needs.	• Lack of a formal setting for evaluation and systematic monitoring of policy measures and programmes constrains further development and evolution of policy initiatives addressing specific weak areas. • There is a need for more bottom-up approaches to addressing knowledge demand;
Knowledge production	• The re-orientation of the university's long-term strategy, currently underway, to more closely reflect economic and demographic changes; • Attracting careers in science and technology.	• Limited penetration and diffusion of knowledge in the absence of adequate policy support system e.g. in the form of Intellectual Property, and public procurement Frameworks as well as adequate infrastructures.
Knowledge circulation	• Operational Programmes implementing the Cohesion Policy 2007-2013 provide for support to knowledge circulation such as through consolidating business-academia links and setting up platforms of strategic importance in priority sectors; • A national science popularisation strategy has the potential to stimulate careers in S&T;	• Nurturing R&D "in a vacuum" without providing necessary incentive measures and schemes for circulation of knowledge among key players (industry-academia-public sector).

Malta is still in a catch-up phase, where the restricted financial and human capital is restraining the growth of the research system and its potential to attract more effective international collaboration. There is a limited penetration of the ERA dimension at the country level; this is constrained by barriers that stem from the contextual reality of the national research system. The elements of particular concern relate to the mobility of researchers where Malta already faces a brain drain; and the opening up of national funding programmes to international participation due to the already limited resources deployed for R&I.

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1 - Introduction and overview of analytical framework

1.1 Scope and methodology of the report in the context of the renewed Lisbon Strategy and the European Research Area

As highlighted by the Lisbon Strategy, knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are at the heart of the Lisbon Strategy. The strategy reflects this in guideline No. 7 of the Integrated Guidelines for Growth and Jobs. This aims to increase and improve investment in research and development (R&D), with a particular focus on the private sector. One task within ERAWATCH is to produce analytical country reports to support the mutual learning process and the monitoring of Member States' efforts.

The main objective is to analyse the performance of national research systems and related policies in a comparable manner. The desired result is an evidence-based and horizontally comparable assessment of strength and weaknesses and policy-related opportunities and risks. A particular consideration in the analysis is given to elements of Europeanisation in the governance of national research systems in the framework of the European Research Area (ERA), relaunched with the ERA Green Paper of the Commission in April 2007.

To ensure comparability across countries, a dual level analytical framework has been developed. On the *first level*, the analysis focuses on key processes relevant to system performance in four policy-relevant domains of the research system:

1. Resource mobilisation: the actors and institutions of the research system have to ensure and justify that adequate public and private financial and human resources are most appropriately mobilised for the operation of the system.
2. Knowledge demand: needs for knowledge have to be identified and governance mechanisms have to determine how these requirements can be met, setting priorities for the use of resources.
3. Knowledge production: the creation and development of scientific and technological knowledge is clearly the fundamental role of a research system.
4. Knowledge circulation: ensuring appropriate flows and distribution of knowledge between actors is vital for its further use in economy and society or as the basis for subsequent advances in knowledge production.

These four domains differ in terms of the scope they offer for governance and policy intervention. Governance issues are therefore treated not as a separate domain but as an integral part of each domain analysis.

Figure 1: Domains and generic challenges of research systems

Resource mobilisation	Knowledge demand	Knowledge production	Knowledge circulation
• Justifying resource provision • Long term research investment • Barriers to private R&D funding • Qualified human resources	• Identification of knowledge demand drivers • Co-ordination of knowledge demands • Monitoring of demand fulfilment	• Quality and excellence of knowledge production • Exploitability of knowledge production	• Knowledge circulation between university, PRO and business sectors • International knowledge access • Absorptive capacity

On the *second* level, the analysis within each domain is guided by a set of generic "challenges" common to all research systems that reflect conceptions of possible bottlenecks, system failures and market failures (see figure 1). The way in which a specific research system responds to these generic challenges is an important guide for government action. The analytical focus on processes instead of structures is conducive to a dynamic perspective, helps to deal with the considerable institutional diversity observed, and eases the transition from analysis to assessment. Actors, institutions and the interplay between them enter the analysis in terms of how they contribute to system performance in the four domains.

Based on this framework, analysis in each domain proceeds in the following five steps. The first step is to analyse the current situation of the research system with regard to the challenges. The second step in the analysis aims at an evidence-based assessment of the strengths and weaknesses with regard to the challenges. The third step is to analyse recent changes in policy and governance in perspective of the results of the strengths and weaknesses part of the analysis. The fourth step focuses on an evidence-based assessment of policy-related risks and opportunities with respect to the analysis under 3) and in the light of Integrated Guideline 7; and finally the fifth step aims at a brief analysis of the role of the ERA dimension.

This report is based on a synthesis of information from the European Commission's ERAWATCH Research Inventory[1] and other important publicly available information sources. In order to enable a proper understanding of the research system, the approach taken is mainly qualitative. Quantitative information and indicators are used, where appropriate, to support the analysis.

After an introductory overview of the structure of the national research system and its governance, chapter 2 analyses resource mobilisation for R&D. Chapter 3 looks at knowledge demand. Chapter 4 focuses on knowledge production and chapter 5 deals with knowledge circulation. Each of these chapters contains five main subsections in correspondence with the five steps of the analysis. The report concludes in chapter 6 with an overall assessment of strengths and weaknesses of

[1] ERAWATCH is a cooperative undertaking between DG Research and DG Joint Research Centre and is implemented by the IPTS. The ERAWATCH Research Inventory is accessible at http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.home. Other sources are explicitly referenced.

the research system and governance and policy dynamics, opportunities and risks across all four domains in the light of the Lisbon Strategy's goals.

1.2 Overview of the structure of the national research system and its governance

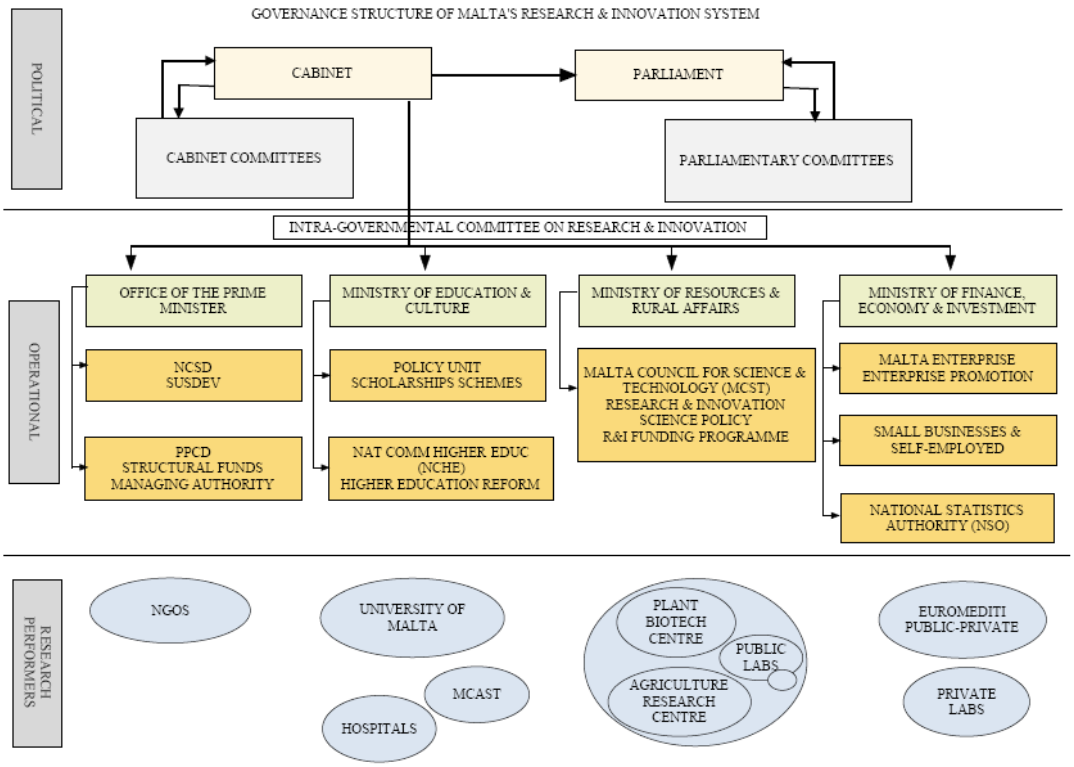
Malta is the smallest member of the European Union with the highest population density (1,287.8 inhabitants per km^2) and a real GDP growth rate of 3.9 in 2006 compared to the EU27 average of 3.0 (Eurostat, 2006). According to Eurostat data for 2006, a provisional estimate of Malta's total expenditure on research and development (R&D) sees this at 0.54% of Gross Domestic Product (GDP) which is well below the estimated 1.84% of the EU27[2]. There are indications that this value should increase (to up to 0.62% GDP) as the National Statistics Office (NSO) is engaged in updating R&D statistics, following additional input received from the government and business sector on their research activities.

Public expenditure on research and development reached 0.19% of GDP equivalent to approximately €10.5m in 2006, a 15% rise compared to 2005. It continued to increase in 2007 to €11.3m (NSO, 2008[3]). This figure represents mainly research undertaken by the University of Malta. Business expenditure on R&D increased from 0.08% in 2004 to 0.44% in 2006 and stood at 0.42% GDP in 2007 (EIS[4], 2007).

R&D policy has been given a strong business-orientation balanced with due attention to national government priorities, such as energy, environment and water. Figure 1 below is the most recent snapshot of the national research system in Malta following the general political election held last 8th March 2008 and the subsequent reorganisation of the Cabinet of Ministers. The diagram lists the principal political bodies responsible for research and innovation (first tier), the operational ministries and entities involved in implementing policies and measures (second tier) and the research performers (third tier).

[2] Eurostat, 2008 http://epp.eurostat.ec.europa.eu/ accessed on 12th August 2008
[3] National Statistics Office (NSO) 2008 'Expenditure on R&D in the general government sector: 2005-2007', Press Release 20 June 2008
[4] European Innovation Scoreboard (EIS) 2007

Figure 2: Structure of Malta's Research & Innovation System



Source: ERAWATCH Malta Country Profile – Structure of the Research System

There has been a shift in responsibility for science and technology policy and research from the Office of the Prime Minister (OPM) that took over these portfolios in 2005, to the Ministry for Resources and Rural Affairs. The OPM championed the drafting and launch of the National Research and Innovation Strategy (2006), and today the implementation of this strategy is being monitored and coordinated by the Rural Affairs Minister, who is also following research and innovation developments at European level. OPM maintains a strategic role in determining priorities for research and innovation in the Cohesion Policy 2007-2013, through the Planning & Priorities Coordination Division (PPCD) which is the national authority managing the Structural Funds and evaluating proposals including those related to research and innovation.

In order to reinforce the policy coordination across ministries, the government set up in 2006 an Intra-Governmental Committee for Research and Innovation that was active in consultations leading to the drafting of the national R&I strategy. Future developments, in terms of coordination of R&I policy/initiatives across ministries, will require further monitoring as these begin to unfold in the forthcoming five-year legislature.

The Council for Science & Technology (MCST) that fell under the responsibility of the OPM during 2005-2006 has been relocated within the Resources and Rural Affairs Ministry; its key roles lie in implementing the national R&I strategy and managing the national funding programme. It is also in the process of drafting action plans for the setting up of platforms of strategic importance in niche sectors (with priority towards Health-Biotech and Manufacturing) and coordinates Malta's participation in the EU's Framework Programme for Research and Development (FP).

Other key ministries with horizontal responsibilities for research and innovation include the Ministry of Education, Culture, Youth & Sport and the Ministry of Finance, Economy & Investment. The Education Ministry is currently overseeing the reform of the higher education sector (through the Commission for Higher Education, NCHE) and manages undergraduate and postgraduate scholarship funds for encouraging further training and researcher mobility. The Finance Ministry, through Malta Enterprise, deals mainly with enterprise policy and with implementing Enterprise Aid Schemes.

In terms of STI policy *coordination*, MCST has an important '*oversight facility*' on science and technology policy initiatives through maintaining close links with key players in the national research and innovation system. It maintains ties with Malta Enterprise (ME), the national innovation agency such as on the development of a regional innovation strategy (MARIS-RIS Project). ME is tasked with implementing the new Malta Enterprise Act 2007 that encompasses a research and innovation pillar and in managing the Aid Schemes for Enterprise co-financed by the European Regional Development Fund (ERDF) 2007-2013. Moreover, close collaboration on the reform of the higher education system is ongoing between MCST and NCHE.

The Advisory Council of the MCST, in place up to the political elections of March 2008, drew expertise from the public and private sectors and served as a platform for national players to submit recommendations on strategies and priorities to government through MCST.

The main R&D performer is the University of Malta and its institutes providing RD&I support and services to industry and government. University-industry partnerships are emerging more strongly through collaborative projects supported under the national R&I funding programme. Public laboratories and research centres rely heavily on government funding for their operations and their research is geared towards the priorities of the relevant ministries affording for limited coordination of practice and resources. To date there is no inventory on the number of private research laboratories and on the extent of the research that they undertake. The private sector is dominated in large part by small and medium sized enterprises (SMEs) and micro-enterprises, in which R&D activity is low to minimal, and a group of large multinational firms specialising in electronics for manufacturing and generic pharmaceuticals.

2 - Resource mobilisation

The purpose of this chapter is to analyse and assess how challenges related to the provision of inputs for research activities are addressed by the national research system. Its actors have to ensure and justify that adequate financial and human resources are most appropriately mobilised for the operation of the system. A central issue in this domain is the long time horizon required until the effects of the mobilisation become visible. Increasing system performance in this domain is a focal point of the Lisbon Strategy, with the Barcelona EU overall objective of a R&D investment of 3% of GDP and an appropriate public/private split as orientation, but also highlighting the need for a sufficient supply of qualified researchers.

Four different challenges in the domain of resource mobilisation for research which need to be addressed appropriately by the research system can be distinguished:

- Justifying resource provision for research activities;
- Securing long term investment in research;
- Dealing with uncertain returns and other barriers to private R&D investment; and
- Providing qualified human resources.

2.1 Analysis of system characteristics

2.1.1 Justifying resource provision for research activities

Research and innovation have gained a higher profile on the national political agenda in response to Malta's membership of the European Union and also as a reflection of government's vision of exploiting R&I towards enhancing national competitiveness and growth.

In 2003, an R&I Strategy and implementing funding programme were launched, primarily to address Malta's poor performance in the EU Lisbon rankings and European Innovation Scoreboard (EIS). The overwhelmingly high response obtained following a competitive call for research proposals, with a total budget request of €7m (and only €0.7m available), showed a high absorptive capacity for R&I funding.

The rationale for R&D investments evolved to embrace a more strategic role for research and innovation (R&I) compared to the initial responsive approach. The vision for R&I detailed in the National Strategic R&I Plan (2006) is to place these "*at the heart of the economy to spur value-added wealth and growth*".

Malta's commitments to Lisbon and the 3% objective foresee a phased increase in total R&I investments to 0.75% of GDP as defined in the National Reform Programme (NRP) and the National Strategic Reference Framework 2007-2013. Although research is not one of the five priority themes of the NRP, it is treated as a horizontal priority spanning competitiveness, employment and education and training themes.

It is only recently that public awareness on S&T is being addressed as a priority and government, through MCST and the Education Ministry, is discussing with key stakeholders on the implementation of a national science popularisation/communication strategy that will aim to engage the public in a science-society dialogue and bring them closer to the policy-making process[5]. Otherwise there are very few examples of public engagement of which two can be cited: a science week/fair for students and the general public held once yearly, and a science forum/debate for post-secondary students.

2.1.2 Securing long term investment in research

Public expenditure on R&D represents 0.19% of Gross Domestic Product (GDP) and business expenditure on R&D (BERD) is estimated to reach 0.42% of GDP (Eurostat, 2007). These values are well below the EU27 average of 0.65% and 1.17% respectively. Malta is placed among the "catching-up" countries in terms of its innovation performance and exhibits the lowest public R&D expenditure among its

[5] Pre-Budget Document 'Families Growing Stronger' 2008 pp 134-137

peer countries. Government appropriations for R&I have remained stable at 0.19% over the 2005-2007 period.

The National Strategic Research & Innovation Plan 2007-2010 has set targets for a phased increased in investments in research in order to bring Malta in line with its Lisbon commitments[6]. The public sector spend on R&D is expected to reach 0.30% of GDP by 2010 whilst the target for the private sector is of 0.45% GDP. The main resources for these long-term investments in R&D come from government (i.e. public funds) and from funds secured through European Union sources, typically structural funds 2007-2013.

There is an observable positive trend in the deployment of structural funds for research and innovation measures. The second wave of structural funds 2007-2013 foresees an investment of circa €45m to build R&I infrastructures, principally at the University of Malta, and soft (skills-related) R&I capacity through the priority axis on 'Enhancing Knowledge and Innovation' (Operational Programme I)[7]. In 2008, €19m in investments of a capital nature were approved for the university, mainly for building a new IT faculty and upgrading laboratories in engineering, biological and chemical sciences and €2.9m for the vocational College of Arts, Science & Technology (MCAST).

The priority axis is also supporting R&I investments in enterprise with new schemes to be launched in 2009 (such as Technical Feasibility Studies Scheme). This is a novelty compared to the 2004-2006 programming period where there was no targeted funding for research and projects were mainly oriented at supporting innovation in enterprise. Long-term investments were committed for strengthening research facilities and infrastructures.

R&D spend in the general government sector is showing a positive upward trend having increased from €10.5m in 2006 to €11.3m in 2007[8]. Much of this spend (an estimated €7.4m in 2007 or 65%) is allocated as block funding, through a Ministry for Education vote, to the University of Malta[9] which is the main research performer in the public sector and goes to support not only research aspects but also education/teaching and capital costs incurred by the university.

The research system so far lacks multi-annual funding programmes. Financial estimates, including those for the research agenda, are presented by the Prime Minister in his Budget Speech in November and must be approved by the national parliament on an annual basis. Thus, the R&I funding programme for collaborative research implemented by the Malta Council for Science & Technology (€0.64m), and the Government Scholarship scheme of the Education Ministry (€0.47m), are allocated an annual budget from central government through the respective ministerial votes.

At the level of each ministry, there is no dedicated research budget line, making it difficult to estimate the R&D effort of the public laboratories and research centres as a separate cost item to the operational costs. One of the recommendations of the national Strategic R&I Plan is that each ministry establish a separate R&D Cost centre to better capture research activity. Moreover, certain public entities, including

[6] National Strategic R&I Plan 2007-2010 Recommendations No. 58 and 60 pg 12
[7] Operational Programme I of Cohesion Policy 2007-2013
[8] National Statistics Office Release No. 111/2008
[9] National Statistics Office Release No. 108/2007

the water services division, agriculture department and the energy operator should be allocating 0.25% of their annual budget to research and innovation[10] (Recommendation No.22).

A mechanism for securing long-term public investments in research is through competitive grants of the national R&I funding programme that allocates public funds to public-private research consortia; this serves as a resource input for both the private and public sectors. This programme is targeted to specific priority areas (ICT, Energy-Environment, Health-Biotech and Value-Added Manufacturing). A special fund was instituted in 2007 to address issues of national bearing – the first one to be supported is looking at improving local grape varieties and is being implemented by the Viticulture and Oenology Unit within the Agricultural Services & Rural Development Division together with the Institute of Agriculture at the university of Malta.

The EU's Framework Programme for R&D has also served as a significant source of funds for research mainly for the University of Malta (as discussed in Section 2.5 below). Collaboration with international research organisations has yet to be formalised.

The main challenge to secure long-term investments in research is that of ensuring a timely response in mobilising public resources for research.

2.1.3 Dealing with uncertain returns and other barriers to business R&D investment

Malta's business expenditure on R&D (BERD), at 0.42%GDP in 2007, is the second highest in the group of "catching-up" innovator countries, after Hungary and ahead of Cyprus, Slovakia, and Lithuania in the same group. The Maltese economy experienced a shift in 2001-2005 from a labour-intensive market to a more service-oriented economy including in new high-value added sectors such as aviation maintenance and repair, the expanding generics pharmaceutical industry, financial services (that accounts for 12% of GDP), ICT and e-gaming (ETEPS, 2006).

The current observed level of R&D is a consequence of Malta's dual economy: the predominance of firms in Malta are domestically-owned small and medium-sized enterprises (SMEs) primarily oriented at the local market. These indigenous SMEs exhibit little or no in-house research and innovation activity. The National Statistics Office is in the process of analysing the results of the Community Innovation Survey (CIS2006) covering the period 2004-2006 for business sector R&D; though there are indications that out of the enterprises surveyed, only approximately 13% engaged in some form of R&I.

At the other end of the scale, there is a small group of foreign-owned affiliates of multinationals, including ST Microelectronics and De La Rue that undertake RTDI activities in home economies and generally transfer technology to Malta to service the needs of the local manufacturing arms. Their activity that centres on specific sectors related to high value added manufacturing in ICT, manufacturing of machinery and chemicals, accounts for Malta's excellent performance in high-tech exports and sales of new-to-market products (EIS, 2007).

[10] National Strategic R&I Plan 2007-2010 p 8.

The principal research and innovation challenges facing the business sector range from instilling a culture for R&I to structural factors relating to limited access to finance, excessive bureaucratic and administrative procedures in government departments and availability of R&I infrastructures.

A high share of the BERD is financed by government (>15% in 2003, Grablowitz A. *et al*., 2007) through direct and indirect measures. Direct government funding for business R&D takes the form of grants made available through competitive calls of the national R&I funding programme for collaborative research projects in areas of national importance (ICT, energy-environment, health-biotech and high value-added manufacturing). Companies may also apply for grants through the Eureka programme. Since Malta became a member of Eureka in 2006, nine local companies have benefited from Eureka funds; €350k were committed by Malta Enterprise for R&D activity through Eureka to leverage over €1.2m worth of research and development[11]. Participation in the Eurostars programme has had slower impetus; one causal factor being the requirement that participating SMEs invest 10 per cent or more of full-time equivalent or annual turnover in research activities – possibly few Maltese SMEs fulfil this criterion. Notwithstanding, Malta Enterprise is committed to cover the costs of participation in Eurostars next year[12].

Indirect support measures include loan guarantee and royalty schemes, measures co-financed through structural funds in support of enterprise competitiveness (such as start-up schemes), as well as a fiscal measure on R&D that includes tax deductions and social security benefits for SMEs employing R&D qualified personnel. Despite a number of attempts, there is no venture capital availability. Malta Enterprise will be setting up an equity financing programme in 2009 to tap international sources of venture capital.

The structural funds 2007-2013 will be playing a more prominent role in building an R&I capacity in industry through the priority axis supporting knowledge and innovation (Operational Programme I[13]). €19m have been deployed for enterprise infrastructure in 2008-2012 and there is a new package of Enterprise Aid Schemes that will be co-financed through ERDF funds. The latter aims to widen the incentive mix by promoting networking; eco-innovations; introducing incentives supporting a knowledge-based economy; stimulating high-value-added start-ups; sustain the manufacturing sectors; attracting FDI and introducing new concepts in incentive design. It has as one of its pillars supporting enterprise engaged in industry-led research and development (with a wider list of eligible expenditure). The innovation policy mix should increasingly aim at supporting the development of emerging clusters.

The funding opportunities available at EU level, such as through the EU's Framework Programme for Research and the CIP are still largely untapped, seeing that enterprise participation in, for example, the FP programme is low. In order to address this weakness, SMEs are being assisted in proposal writing and pre-proposal preparation through an Enterprise Exploratory Award Scheme 2007.

[11] The Malta Business Weekly Online "Less than 22 years away from Competitiveness? Much less" 15th May 2008
[12] Times of Malta "Malta Enterprise, Eureka and Eurostars in the R&D Scenario, July 2008
[13] Operational Programme I

At a macro level, another challenge for Malta to improve competitiveness is that of reducing the level of state aid (2.25% of GDP in 2006) and redirecting this towards horizontal objectives (European Commission, 2007a and b). Although state aid for industry and services has shown a sharp decline due to phasing out of pre-accession measures, Malta still ranks high on the State Aid Scoreboard due to heavily subsidized sectors such as the Malta Shipyards that absorb 10% of the total state aid. This situation is being redressed with the government launching a call for expression of interest for the privatisation of the shipyards in 2008[14].

2.1.4 Providing qualified human resources

Although the student population at tertiary level has progressively increased over the years, with close to 10,000 students attending the University of Malta in 2007, the share of science and technology graduates (3.4) is well below the EU average of 12.9 (EIS, 2007). Moreover, scientists and engineers represented 3.9% of the total labour force in 2006 compared to 4.8% of the EU27 average[15].

The national education system faces the challenge of providing the needed skills to supply emerging industrial sectors in order to avoid bottlenecks at the level of the industry. This is true for fast-growing sectors such as ICTs and pharmaceuticals (the latter sector is evolving from the generics pharma towards R&D for innovative products [Times of Malta, 2008b]. Investments in human capital and education are thus flagged as a priority in the National Reform Programme and the National R&I Strategy 2007-2010 and are given prominence in the National Strategic Reference Framework that sets the objectives for Malta's Cohesion Policy 2007-2013.

Another related challenge lies in arresting the brain drain of professionals that seems to be especially evident in the medical sciences with many new graduates leaving the island to specialise abroad. A recent initiative launched by the government in 2008 is the provision of in-house training in a variety of specialisms to newly graduated doctors in the state-of-the-art general hospital.

ICTs have also attracted a strong investment in terms of ICT training through the vocational college for Arts, Science & Technology (MCAST) and capital investments in a new Information Technology Faculty at the university in anticipation of the new IT smartcity@malta project. The private sector is also hailing to support human resource capacity building in this sector by offering specialist post-graduate training in collaboration with universities abroad.

The University of Malta (UoM), the only state-funded university that awards doctoral degrees, is attempting to re-orient some of its science courses towards addressing more specifically industry's needs such as through courses and curricula offered in applied chemistry. UoM is principally a teaching university with research undertaken at undergraduate and post-graduate levels within the various departments in the eleven faculties. The fields of specialisation are mainly in the humanities (social sciences, psychology, education) and geosciences, with no specific specialisation in any of the natural sciences (ERAWATCH Malta Specialisation Report, 2006)[16].

[14] Times of Malta 'Call for Expressions of Interest in Shipyards', 12th August 2008
[15] Eurostat Release No. 34/2008 EU27 R&D spending stable at 1.84% GDP in 2006, 10th March 2008
[16] Erawatch Malta Specialisation Report (2006) Figure 9 Number of publications per scientific field pg7.

The number of PhD researchers employed in R&D in the general government sector increased over 2004-2007[17], with the majority in the medical sciences followed by the social sciences field. Total employment in this sector increased to 957 employees in 2007 from 914 individuals in 2005 mainly due to a rise in part-time employment in R&D activity. However, numbers of researchers with a PhD in the natural sciences and engineering lag behind. Increasingly in recent years, the university is offering short-term fixed contracts for junior researchers, often at assistant lectureship level, to carry out research that is mainly linked with EU FP projects in which the university is a partner.

The government is supporting post-graduate education through the provision of scholarships for Masters and PhD studies held in Malta and abroad (Malta Government Scholarship Scheme). The scheme, launched in 2006 with an annual budget of €0.47M, is the first of its kind in providing state funding for post-graduate research. It has sponsored so far 86 students; approximately 30% of the awarded grants were in the science subjects including the natural and earth sciences, engineering and ICTs. The Ministry for Education that manages this scheme is seeking to secure European Social Funding (2007-2013) to part-finance these bursaries, with specific grants for training in science and technology studies. There is also a tax incentive scheme applicable to enterprise employing MSc and PhD students (ERAWATCH Network, 2008)[18].

2.2 Assessment of strengths and weaknesses

Malta is well on track towards achieving the set Lisbon target of investing 0.75% of GDP in research and innovation by 2010. Research and innovation investments have increased through targeted funding such as that made available by the national R&I funding programme. Moreover, there has been an increased deployment of structural funds (over 2007-2013) earmarked for research and innovation.

The putting in place of a national strategic framework for R&I, initially championed by the Office of the Prime Minister, has served to better guide research and innovation direction and investments towards business-oriented research and in areas where Malta is emerging as having a competitive advantage.

A weakness of the system in terms of resource mobilisation lies in the fact that public R&I investments are still closely tied to structural funds. Moreover, further incentives are needed to leverage private sector involvement in research and innovation activities in collaboration with academia and the public sector.

[17] National Statistics Office News Releases No 108/2007 and No. 111/2008 “Expenditure on Research & Development in the General Government Sector 2004-2006 and 2005-2007.
[18] Section on Fiscal Policies

Main strengths	Main weaknesses
• Research and innovation were given a higher profile in 2007 when responsibility for R&I was taken over by the Office of the Prime Minister. • National and European (structural) funds have been ring-fenced for research and innovation activities in 2007-2013; • The national R&I funding programme is now well established, running in its third cycle; • Good track record of participation in EU's FP6 and in the first year of FP7;	• Public investments in R&I remain limited and tied to structural funds; • Low private sector R&I investment compared to EIS indicators; • Private sector R&I limited to a cluster of large, foreign firms; with only minimal R&D activity in the more numerous small and medium-sized enterprises. • Limited human resources including researchers and science and technology graduates.

2.3 Analysis of recent policy changes 2007/2008

The National Strategic Plan for Research and Innovation defines the long-term goals and projected investments for Malta's R&I system in distinct priority areas. Complementing this Strategy, the Cohesion Policy 2007-2013 has given increased prominence to research and innovation initiatives. In Operational Programme I (OPI) of the Cohesion Policy, a specific priority axis on Knowledge & Innovation was introduced that gives a broad indication of potentially viable research and innovation projects and initiatives ranging from investments in knowledge infrastructure and research capacity in higher education to building RTDI infrastructures in support of local industry development. The OP also sets defined targets that need to be achieved such as boosting the percentage of SET graduates and increasing the number of SMEs adopting environmentally sensitive technologies.

In order to sustain business sector R&D, the new Malta Enterprise (ME) Act foresees specific incentive schemes for supporting RD&I in enterprise (the exact budget for such activities is not specified though there will be more support from ERDF funding).

With regard to policies on mobility of researchers, an amendment to the Immigration Act was approved as Legal Notice 102 in 2008 on the admittance of third country nationals for scientific research purposes. The Legal Notice provides a framework that clarifies the legal status of researchers in terms for example of social security and taxation with the aim of facilitating intake of researchers from these countries.[19]

The governance of the national research and innovation system has also undergone changes (as described in Section 1.2); the shift in responsibility of R&I policy from the Office of the Prime Minister to the Ministry for Resources & Rural Affairs reflects a need to monitor closely implementation of the national R&I strategy and further efforts to develop joined-up policy approaches with other sectoral domains and policy areas (such as environment and health).

[19] Legal Notice 102 of 2008 Immigration Act Chap 217 Third country nationals for scientific research purposes

Challenge	Main Policy Responses
Justifying resource provision for research activities	• Long-term National Strategy for R&I. • Research and innovation given more prominence in the Cohesion Policy for 2007-2013. • 0.25% of the budget of certain research entities is to be devoted to R&I.
Securing long term investments in research	
Dealing with uncertain returns and other barriers to business R&D investments	• The new Malta Enterprise Act is providing a wider policy mix to support research and innovation across enterprise, including small and medium-sized enterprises. • Initiative to generate demand for R&I through public procurement for research and innovation.
Providing qualified human resources	• New scheme in 2007 supporting undergraduate students and a separate post-graduate scholarship scheme for MSc. and PhD researchers; tax incentives to encourage employment of researchers in industry; Legal Act on Third Country Mobility of Researchers.

2.4 Assessment of policy opportunities and risks

The principal opportunities and risks for resource mobilisation in Malta, arising from recent policy responses and in the light of the Lisbon Strategy, are summarized in the table below.

The main opportunities stem from implementing the recommendations of the National Strategic R&I Plan in close synergy with the Cohesion Policy that is offering significant funding opportunities for research.

A critical issue is that of building capacity in the areas designated as priority areas for Malta, both in terms of research infrastructure and human resources capacity; here the re-orientation of the education system, especially at post-secondary level to provide the necessary skills in these priority areas becomes vital to avoid bottlenecks in the system.

Since the government's vision is that of favouring business-oriented research with innovative applications, there may be overlaps in governance and implementation of research and innovation polices and initiatives. This introduces the challenge of ensuring adequate dovetailing of policies and measures across relevant government ministries and in relevant sectors.

Main policy opportunities	Main policy-related risks
• Enhanced resources for research have been made possible through the deployment of Structural Funds and more so in the second wave of funding 2007-2013. • The National Strategic R&I Plan provides a framework for long-term investments in qualified human resources. • With the on-going reform in the higher education system, there is the opportunity to strengthen the human resource base in S&T and increase participation of women. • Newly approved legislation stimulating inward researcher mobility from third countries. • 0.25% of the budget of certain public entities is to be dedicated to research and innovation.	• There is a need to better capture the extent of R&I activity and expenditure. This was a 'point to watch' of the European Commission's assessment of Malta's NRP Progress in 2007.

2.5 Summary of the role of the ERA dimension

As noted in the ERAWATCH Country profile, Malta has supported initiatives at EU level on the establishment of the ERA such as its active participation in discussions leading to the approval of the Seventh Research Framework Programme and its support to the Charter for Researchers.

With regard to resource mobilisation, there has been a drive to channel increased European (structural and cohesion) funds for research and innovation activities. Circa €20m have been deployed over 2008-2010 for R&I infrastructures at the University of Malta (UoM) and the College for Arts, Science & Technology (MCAST) to upgrade existing laboratories and equip new ones (such as a material testing and prototyping R&D facility at UoM). Additional funds, at least €20m, are available under the Cohesion Policy, for further RTDI interventions: projects in renewable energy technologies have been earmarked.

Since 2006, there have been opportunities for Maltese enterprises to participate in R&I oriented projects together with counterparts abroad through the Eureka programme and more opportunities for funding will arise with the imminent launching of the new Enterprise Schemes.

Malta has recorded a successful participation in the EU's Framework Programme for R&D, attracting a total of €3.1m in FP5 and €11.39m in FP6 over the four-year period of the programme[20]. Recent statistics show that in the first year of FP7, Malta will be participating in 35 projects worth €3.26m in EU funds (Malta Council for Science & Technology, 2008a).

In FP6, circa €8.97m represented the EC's financial contribution whilst €2.42m or 21% came from public and private budgetary funds (Malta Council for Science & Technology, 2008a). The higher education sector, principally the University of Malta and its Institutes, attracted €4.09m worth of EC funds (46%) whilst the public sector share of European FP Funds stood at €2.79m (31%). The IST thematic area attracted the largest proportion of FP funding amounting to €3.2m, followed by

[20] Data obtained from Malta Council for Science & Technology, September 2007.

Aerospace that secured just over €1m to the University of Malta; other areas of research strength included INCO, SusDev and R&I policy and foresight.

35% of the organisations participating in FP6 were from higher education set-ups, 12% from industry, 49% from private commercial organisations and 3% from research entities. Industry participation remains weak.

The national research funding programme is open to participation by foreign (EU and third country) entities though these do not benefit from funding, unless this is in the form of a sub-contract for expertise that is not locally available.

The ERA Green Paper was subject of discussion at national parliamentary level within the Foreign & European Affairs Committee in September 2007 and a public debate on the ERA was held at the University of Malta on 12th May 2008 following a lecture delivered by the Chair of the ERA Rationales Expert Group.

3 - Knowledge demand

The purpose of this chapter is to analyse and assess how research related knowledge demand contributes to the performance of the national research system. It is concerned with the mechanisms to determine the most appropriate use of and targets for resource inputs.

The setting and implementation of priorities can lead to co-ordination problems. Monitoring processes identifying the extent to which demand requirements are met are necessary but difficult to effectively implement due to the characteristics of knowledge outputs. Main challenges in this domain are therefore:

- Identifying the drivers of knowledge demand;
- Co-ordinating and channelling knowledge demands; and
- Monitoring demand fulfilment

Responses to these challenges are of key importance for the more effective and efficient public expenditure on R&D targeted in IG7 of the Lisbon Strategy.

3.1 Analysis of system characteristics

3.1.1 Identifying the drivers of knowledge demand

Malta's economy has experienced a shift from supporting labour intensive activity towards the promotion of higher value-added manufacturing and service activities. Industrial output is predominantly made up of electronic products, while exports of pharmaceuticals are also growing rapidly. In 2006, the contribution of services increased from 69% to 75%. Apart from the hotels and restaurants sector, which remains a key service industry with a contribution to gross value added ranging between 5% and 7% in recent years, financial and ICT-related services have become increasingly important sources of employment and foreign exchange earnings (Central Bank of Malta, 2007).

During 2002 seven economic sectors exhibited a level of research and technological development activities. These were, in descending order based on their shares in

total BERD, the IT services (25%), electrical machinery (25%), electronic equipment (16.6%), water and electricity (8.3%), machinery (8.3%), fabricated metals (8.3%) and the food industry (8.3%). From these sectors, only the IT services and water and electricity received public funding (ERAWATCH Network, 2006). Private sector R&D, such as in the IT and electrical machinery sectors, is largely attributable to a cluster of 30-40 large firms, many of them being affiliates of multinationals; whilst R&D undertaken by the more numerous indigenous SMEs, consisting of low to medium-tech enterprises, is minimal.

The above is only in part reflected by the technological specialisation (patents) over the 2001-2003 period, wherein Malta was specialised in only three sectors, in the motor vehicles, electrical machinery and fabricated metals, while it became under-specialized over the same period in the traditional industrial sectors of furniture, transport equipment and textiles (ERAWATCH Network, 2006). There is a good correlation between BERD and patent applications in the electrical machinery, reflecting R&D efforts in engineering and design.

In 2005, 63.9% of government appropriations or outlays on R&D (GBOARD) went to finance research undertaken at the University of Malta and to a smaller extent to public research institutes – this funding is less targeted in terms of priority sectors it addresses and allows for bottom-up research activity defined by the research priorities of the university faculties. This trend continued in 2006. Sectoral specialisation of government-funded R&D compared to EU15 is more than 100% larger on exploration and exploitation of earth (oil exploration endeavour of government) and social structure and relationships (Eurostat, 2007b)[21].

Foresight has emerged as a relevant tool for systematic and participative RTDI policy formulation, including the definition of sector-specific and socio-economic priorities for research. The national foresight exercise implemented in 2001-2003 as part of an EU FP5 STRATA Programme for candidate countries, served to highlight strategic orientations and opportunities for Malta and also generated input into the updating of the National RTDI Strategy 2003. It was implemented as three pilot exercises addressing three sectors: ICTs, Biotechnology and marine environment and helped flagged those sectors, research and policy areas that needed strengthening.

Foresight-type mini-exercises have been carried out in 2007, co-financed by an Interreg IIIC Project - Futurreg, to address specific thematic/ policy discourses including:

- The initiative on creative measures for innovative futures in enterprise (organised by MCST in collaboration with Malta Enterprise's initiative on the Regional Innovation Strategy –RIS- Project);
- Further and higher education futures events organised in collaboration with the National Commission for Higher Education as part of the higher education reform undertaken by the Ministry for Education.
- Science Popularisation Futures aimed at creating a shared understanding of emerging trends and drivers of science-society futures.

Similar bottom-up approaches to policy formulation were used in the drafting of the National Strategic Plan for Research & Innovation 2007-2010 that identifies priority

[21] Eurostat (2007b): Science Technology & Innovation Pocket Book, pp8-9.

areas offering a competitive and economic advantage for Malta. These areas include ICT, Health-Biotech, Energy-Environment and high value-added manufacturing and complement the government's vision for Malta to strive for excellence in six sectors including: Tourism, ICT, healthcare, Education, financial services and high value-added manufacturing (Office of the Prime Minister, 2006). One of the National R&I Plan's recommendations is that these areas undergo a horizon scanning exercise every three years to identify new emerging trends and opportunities.

A shift is observed from a broad-based research system to one favouring business-oriented research activity with near-to-market applications. Research and innovation efforts are tightly knit around achieving Malta's NRP objectives.

Projects addressing national R&D priorities are implemented mainly through the national R&I funding programme that funds consortia between the public sector and industry. The government also commissions *ad hoc* studies to address issues of national priority that may arise in response to EU-level commitments and/or global threats and trends. For example in 2006, a study was commissioned by the Malta Resources Authority on the feasibility of setting up offshore wind farms along the Maltese coasts (Times of Malta, 2008a). Special research projects addressing thematic issues are also being funded by the government such as the project on local vine quality and properties being implemented by the university's agriculture institute and the Viticulture Unit (within ministry for resources and rural affairs, 2007).

Developments in the ICT sector are definitely acting as a significant driver of knowledge demand; this mirrors trends at European and global levels. The SmartCity@Malta project, a venture being developed with Tecom investments of Dubai, is seen to transform the knowledge-based industry in Malta with the potential to create over 8,000 new jobs in the IT business park (Department of Information, 2008). Government has allocated €19m (with co-financing from the EU) in investments of a capital nature for the University to sponsor, amongst others a new faculty of Information and Communications Technology and laboratories in the engineering, chemical and biology fields.

The setting up of platforms of strategic importance in priority sectors, a priority of the national R&I Strategic Plan, should afford for better public-private synergies and links with similar platforms at EU level. A proposal for the setting up of a Manufacturing research platform was submitted under the ERDF-funded Operational Programme I.

The use and application of innovative public procurement is one of the priorities for 2008. MCST in collaboration with the Department of Contracts within the Ministry of Finance, Economy & Investment organized an inception workshop on innovative procurement for the public sector in 2007 and is following up with a series of workshops in 2008 (Malta Council for Science & Technology, 2008b) that will address specific issues such as designing tenders that incorporate innovation, monitoring and evaluating innovative procurement, to inculcate knowledge on how this type of procurement can leverage innovation and innovative solutions.

3.1.2 Co-ordinating and channelling knowledge demands

The research system is experiencing a process of change with a clear shift towards enhanced coordination among ministries, public agencies and private actors as described in Section 1.2 of this report. The R&I system is increasingly relying on effective linkages and networking among key public agencies, namely MCST, ME,

Federation of Industry, in order to formulate systemic policies and ensure adequate diffusion of these policies and measures.

Up to 2007, the MCST Advisory board (that is now dissolved following the general elections held last March 2008) acted as a high-level forum for national players, representatives from government, industry, academia and the professions to submit their recommendations to government on strategy, policies and priorities to RTDI policy design (ERAWATCH Network, 2008). The business sector is able to bring to the fore its demands to political actors through fora such as the Chamber of Commerce and Federation of Industry. CompetitiveMalta is emerging as an importance lobby for the business sector to raise issues relating to national competitiveness with government and opposition.

Research and innovation policy-making is increasingly favouring an open consultative approach, as a means of engaging the relevant actors in priority-setting and in defining adequate measures for action. Thematic consultation sessions were held in 2005 and early 2006 in order to define the priority sectors of the National Strategic Research & Innovation Plan 2007-2010 together with experts from the university, the public and private sectors.

There is a growing trend to align the research strategy with national strategies in other policy areas as a means of promoting systemic approaches to policy implementation. In 2008, the MCST embarked on the development of a Health Research Strategy and Action Plan through the work of expert groups from the public and private sectors and academia, in order to put forward recommendations for action and identify concrete opportunities for local health research – this is linked with government's plans for developing the healthcare sector in Malta as centre of excellence in the region. Another example lies in the drafting of the national ICT strategy 2008-2010 that is being shaped in part by insight from the Strategic R&I Plan.

There is also scope for enhanced coordination with EU level initiatives. Malta has registered a good track record of participation in the EU's Framework Programme for R&D, especially in ICTs and the long-term objective is to increase participation in ERA-NETs which is to date limited to two projects. There is also need to establish better links with EU Technology platforms.

The Euro-Mediterranean initiative for Technology & Innovation (Euro-MedITI), officially launched in 2007, aims to establish itself as a technology and innovation platform in the Mediterranean. Through its network of EU and Mediterranean partners, including Fraunhofer (Germany) and Henri-Tudor Institute (Luxembourg), EuroMedITI fosters cooperation and enables transfer, dissemination and uptake of relevant technologies in the region. Focus sectors include Water & Environment; Sustainable Energy; ICT and Marine.

3.1.3 Monitoring demand fulfilment

Generally, Malta lacks an evaluation culture so that reviews and evaluations of policies and programmes lack a formal setting. Moreover, certain evaluation reports relating to a particular ministry or public agency are kept internal to the ministry or Office of the Prime Minister.

The most recent review of the national research and innovation system was carried out in 2005 when the Office of the Prime Minister commissioned an audit of the Malta

Council for Science & Technology. This audit recommended the articulation of a national R&I strategic plan that linked state R&I financing with areas that can act as economic growth drivers. The recommendations were taken up in the 2006 national budget when MCST was tasked with drawing up the national R&I strategy (TrendChart, 2006).

In 2008, MCST initiated a process of review and updating of the national R&I Strategy and Funding Programme in order to assess achievements and review targets where necessary.

The national R&I system is also benchmarked against EU countries on the basis of predefined indicators such as in the European Innovation Scoreboard (EIS) and the World Economic Forum's Global and Business Competitiveness Rankings.

The Structural Funds Programme 2007-2013 includes an ex-ante evaluation of the whole programme and expected output indicators for the individual priority axes of its operational programmes I and II. Research and innovation indicators relate to stimulating new RTD projects, such as in eco-technologies and boosting the percentage of S&T graduates amongst others.

3.2 Assessment of strengths and weaknesses

At a governance level, a strength of the system is the enhanced engagement of key actors in identifying priorities for research such as through the use of foresight approaches in defining the priority sectors of the National Strategic R&I Plan - this affords for better channelling of knowledge demands in appropriate areas/sectors.

Although the National Strategic Plan for R&I does specify the priority sectors where research investments should be focussed, these areas are still very broad and thus do not allow to channel and target investments and policy measures. Improved links with EU level technology platforms need also to be established.

There is also a difficulty in capturing the knowledge demand of the private sector since this is characterised by many small and medium-sized enterprises (SMEs).

Main strengths	Main weaknesses
• Skills base in foresight and future oriented policy approaches present within the principal science and technology agency (MCST) provide a good base for probing for knowledge demands; • Priorities for R&I defined in the national research and innovation strategy provide direction for policy measures and implementing programmes.	• lack of formal mechanisms for evaluating and monitoring impacts and effectiveness of policies and measures in relation to existing demands and needs; • There is a lack of sector-specific analysis that would better guide and target national investments, strategies and measures.

3.3 Analysis of recent policy changes

The national research and innovation governance system is undergoing rapid changes also vis-à-vis coordination of knowledge demands. With the new ministry taking over responsibility for science and technology, a period of adjustment will be necessary to observe for any developments in networking key players of the

research system. Such mechanisms must cater for more prominent representation of the private sector in addressing relevant knowledge demands.

The setting up of platforms of strategic importance in the priority sectors (a recommendation of the National Strategic R&I Plan), with priority being given in 2008 to the health and manufacturing sectors, should aim to develop more integrated approaches to policy across government, industry and academia. There is also a commitment to dovetail research policies and initiatives with other sectoral policy domains – the health research strategy and action plan currently being drafted and the national ICT strategy are valid examples here.

As mentioned in Section 3.1.1., MCST is following up an initiative launched in 2007 to generate demand for R&I through public procurement.

Challenge	Main Policy Responses
Identification of knowledge demand drivers	Long term national strategic plan for research and innovation Sector-specific approach to identify knowledge demands in key areas (Health, Energy – Green Manufacturing).
Co-ordination of knowledge demands	MCST Advisory Council, operative until March 2008, provided a forum for dialogue among key actors in the public and private sectors and academia on STI issues.
Monitoring demand fulfilment	No specific instruments/practices in place.

3.4 Assessment of policy opportunities and risks

In response to one of the weaknesses identified relating to the broadness of the national R&I strategy, an emerging opportunity lies in the initiative launched by MCST in 2008 to draw out a strategy and action plan for the health research sector; this should map niche areas to be given priority in this field. A second initiative on green manufacturing is also under consideration. The latter initiative links up with the government's plan to introduce new forms of public procurement that will generate increased demand for research and innovation.

Main policy opportunities	Main policy-related risks
• The setting up of Platforms of Strategic Importance in priority areas and concomitant sectoral action plans could afford for better integration of knowledge demands (e.g. from private sector) into the national research system; e.g. health; • Implementing new forms of public procurement (e.g. public procurement for research and innovation).	• Lack of a formal setting for evaluation and systematic monitoring of policy measures and programmes constrains further develop and evolution of policy initiatives addressing specific weak areas. • There is need for more bottom-up approaches towards addressing knowledge demand;

3.5 Summary of the role of the ERA dimension

Malta has benefited from extensive policy learning through its involvement in EU level projects and initiatives. Its participation in the eFORESEE STRATA Programme on the **e**xchange of **FO**resight **R**elevant **E**xperiences among **S**mall **E**nlargement

Economies provided strategic input into the updating of the national RTDI strategy in 2003; also MCST's involvement in the Forsociety Eranet (2004-2008) provided extensive insight into future research topics and demands for Europe.

The experience MCST gained with the use of foresight approaches was subsequently transferred to national policy discourses and policy processes such as input provided to the higher education reform and the building of a science popularisation strategy.

Additionally, benchmarking exercises such as that provided by the Pro-Inno TrendChart, naturally serve to monitor Malta's research and innovation progress vis-à-vis its peer countries. These initiatives have served to better align and coordinate national research policy efforts and programmes with those at EU level, highlighting existing strengths and opportunities.

There is a thrust to become more involved in Eranets and Eranet plus initiatives with the long-term objective of participating more fully in joint research programmes. Though, this will require the putting in place of an adequate legal framework that sets the base for joint funding decisions.

4 - Knowledge production

The purpose of this chapter is to analyse and assess how the research system fulfils its fundamental role to create and develop excellent and useful scientific and technological knowledge. A response to knowledge demand has to balance two main generic challenges:

- On the one hand, ensuring knowledge quality and excellence is the basis for scientific and technological advance. It requires considerable prior knowledge accumulation and specialisation as well as openness to new scientific opportunities which often emerge at the frontiers of scientific disciplines. Quality assurance processes are here mainly the task of scientific actors due to the expertise required, but subject to corresponding institutional rigidities.
- On the other hand there is a high interest in producing new knowledge which is useful for economic and other problem solving purposes. Spillovers which are non-appropriable for economic knowledge producers as well as the lack of possibilities and incentives for scientific actors to link to societal demands lead to a corresponding exploitability challenge. Both challenges are addressed in the research-related Integrated Guideline and in the ERA green paper.

4.1 Analysis of system characteristics

4.1.1 Improving quality and excellence of knowledge production

Malta has a recent history of competitive public funding programmes. In 2004, the first national RTDI programme was launched. This consisted of three sub-programmes addressing SME collaborative research, capacity building and scientific research funding schemes. The programme was superseded in 2006 by the national R&I funding programme which is a yearly programme offering grants for larger-scale collaborative projects with a focus on applied research.

Both programmes relied on external evaluation of project proposals to ensure scientific excellence and quality of projects funded. The 2004-2005 Programme was evaluated by top European domain experts who commented on the high quality of the proposals. Twelve projects were subsequently selected for funding and will shortly come up for the end-of-project review. Similarly the yearly R&I funding programme is subject to a two stage-proposal submission, where in the second-stage full proposals are reviewed by three independent international experts based on pre-established criteria (including conformity with priority sectors identified in the National Strategic R&I Plan, prospects of commercialisation of research; collaboration among academia, industry and public sector) as well as on scientific excellence.

Malta's participation in the EU's Programme for Research has had two important impacts on the national research system. On the one hand it has stimulated a process of networking of local institutions with counterparts abroad and in this sense has contributed to the internationalisation of research; on the other hand it has acted as lever for Malta to strengthen its research capacity in specific areas, such as ICTs and R&I policy.

The mechanisms of review and evaluation of projects operating at EU level such as within the EU's Framework Programme for R&D, serve to benchmark research undertaken by local institutions against those undertaken by established centres in the European Union and this has surely had a positive impact on the quality of knowledge produced and presented by Maltese research institutions.

The principal knowledge producer and the largest R&D performing actor is the University of Malta that is the only state funded university offering degrees at undergraduate and post-graduate levels in a range of subject areas. It is primarily a teaching university with strengths in the arts, engineering and medical sciences. According to data for 2001-2003, the largest proportion of publications was in the field of education and social sciences followed by medicine/clinical sciences. There is no specialisation in the natural sciences (chemistry, biology/biochemistry) and engineering. This trend is also reflected in the number of citations per scientific field where there is a strong specialisation in relation to the EU15 reference in the social sciences and education, followed by clinical medicine and economics (ERAWATCH Network, 2006).

In 2006, the social sciences accounted for 32.4% of total R&D expenditure in the general government sector, followed by the medical sciences and engineering accounting for 17% and 15% of this total respectively. Most of the R&D expenditure undertaken within the general government sector goes to fund research in the higher education sector, namely the university (National Statistics Office, 2007).

4.1.2 Ensuring exploitability of knowledge production

As the main knowledge producing institution, the University of Malta, together with the vocational College for Arts, Science & Technology (MCAST), have a key role to play in matching knowledge production with economic specialisation. The university is currently working to draw out an intellectual property framework that will contribute towards commercialisation and thus exploitation of publicly funded research and knowledge sharing.

Cluster development and the setting up of platforms in strategic areas, are conducive towards nurturing collaborative academia-industry links. The new Enterprise Act (2007) is more focussed on promoting the setting up of technology platforms and providing support to cluster development in niche sectors (e.g. ICT, aviation, marine-related industry, film-making etc.).

Moreover, at the level of human resource supply, the Higher Education Reform currently underway is addressing the issue of skills mismatches and the importance of the education system being able to provide the necessary skills that more closely match the labour market demands in a timely manner.

With 9 EPO patent applications per million inhabitants (2003), Malta's patent output is slim compared to the EU25 average of 137, though ahead of other new EU members including Slovakia (8), Latvia (6) and Lithuania (6) (Eurostat, 2007b). Malta acceded to the European Patents Convention (EPC) in December 2006, and the EPC entered into force on 1st March 2007. The Commerce Division within what was the Ministry for Competitiveness & Communications (now the Ministry of Finance, Economy & Investment) carried out an awareness raising campaign on patents and innovations in 2007.

4.2 Assessment of strengths and weaknesses

The quality of knowledge production is being given greater importance through international peer-review of publicly-funded research projects.

The absence of an Intellectual Property Rights (IPR) Framework limits exploitability of knowledge and academia-business knowledge flows. Another weakness is the fact that there is no system in place to track scientific publications and citations in order to monitor knowledge production and trace specialisation trends.

Whilst the research system aims towards achieving excellence, this is restricted by Malta's limited human and financial resource capacity.

Main strengths	Main weaknesses
• International peer-review of public research programmes ensures quality of knowledge production and transparency;	• Lack of centres of excellence due to limited human and financial resource capacity; • IPR policy not yet in place; • No system in place to track scientific publications and citations; • Limited academia-industry programmes.

4.3 Analysis of recent policy changes

The national R&I and Industry strategies emphasize the importance of establishing a nexus between knowledge institutions and business in the designated priority sectors (ICT, value added manufacturing, energy-environment and health-biotech) for more effective exploitation of R&I. Importance is being given to relevance of knowledge production wherein "knowledge suppliers provide the knowledge needs that industry requires at the right time to the right level and with the right skills set"[22].

[22] National Strategic Plan for Research & Innovation 2007-2010, Office of the Prime Minister 2006

Thus establishing closer synergies between business-academia, including the development of an intellectual property framework and the management of technology transfer facilities, emerge as a priority at a national level that will be supported by structural funds for the period 2007-2013.[23] In support of this, the 2008 national R&I funding programme is only funding projects involving both academic and non-academic (private or government) partners. This programme places increased emphasis on scientific excellence of project proposals and feasibly of implementation in the national context.

Public research is being re-oriented towards areas of national importance. As discussed in Section 3.1.1 of this report, environment and energy are areas of particular concern, not only for Malta but also for the Euro-Mediterranean region. The setting up of Platforms of Strategic Importance in these areas will enhance exploitability of knowledge along the research and innovation chain. Financial support for cluster development is being funnelled through the new Enterprise Aid Schemes.

Challenge	Main Policy Responses
Quality and excellence of knowledge production	External evaluation of project proposals submitted under national research funding programme, with emphasis on scientific excellence.
Exploitability of knowledge production	Setting up of Platforms of Strategic Importance; innovative clusters;

4.4 Assessment of policy opportunities and risks

In order to make knowledge more responsive to demands from society and the economy, an opportunity lies in re-orienting the University's strategy to more closely reflect such economic, environmental and demographic changes.

International research collaboration is an important avenue towards strengthening Malta's research capacity, given the country's limitations towards establishing national centres of excellence (e.g. through virtual network of researchers).

Main policy opportunities	Main policy-related risks
• The re-orientation of the university's long-term strategy, currently underway, to more closely reflect national economic and demographic changes; • Attracting careers in science and technology; • IPR framework being elaborated by the University of Malta;	• Limited penetration and diffusion of knowledge in the absence of adequate policy support system e.g. in the form of intellectual property, procurement as well as adequate infrastructures;

4.5 Summary of the role of the ERA dimension

Malta is striving to establish itself as a regional centre of excellence in designated priority sectors with environment and energy and ICT being put at the forefront. This will also serve to attract knowledge creators (knowledge-oriented institutions from

[23] Operational Programme I Cohesion Policy 2007-2013

education and business sector) and stimulate knowledge production and circulation in the Euro-Mediterranean region. An initiative addressing this dimension is the setting up of the Euro-Mediterranean Institute for Technology & Innovation described in Section 5.1.2 of this report.

Notwithstanding, Malta has a limited resource capacity to set up centres of research excellence and it is only recently that the country is exploiting opportunities provided through EU funds (such as the EU's Framework Programme for R&D and structural funds) to set up strategic platforms in the priority areas.

5 - Knowledge circulation

The purpose of this chapter is to analyse and assess how the research system ensures appropriate flows and sharing of the knowledge produced. This is vital for its further use in economy and society or as the basis for subsequent advances in knowledge production. Knowledge circulation is expected to happen naturally to some extent, due to the mobility of knowledge holders, e.g. university graduates who continue working in industry, and the comparatively low cost of the reproduction of knowledge once it is codified. However, there remain three challenges related to specific barriers to this circulation which need to be addressed by the research system in this domain:

- Facilitating knowledge circulation between university, PRO and business sectors to overcome institutional barriers;
- Profiting from access to international knowledge by reducing barriers and increasing openness; and
- Enhancing absorptive capacity of knowledge users to mediate limited firm expertise and learning capabilities.

Effective knowledge sharing is one of the main axes of the ERA green paper and significant elements of IGL 7 relate to knowledge circulation. To be effectively addressed, these require a good knowledge of the system responses to these challenges.

5.1 Analysis of system characteristics

5.1.1 Facilitating knowledge circulation between university, PRO and business sectors

Malta exhibits among the lowest levels of cooperation of enterprise with higher education institutes (4%) and public research institutes (4%) compared to the EU27 average of 9% and 6% respectively. These data reflect a situation at EU level where cooperation of enterprise with customers and suppliers is more frequent in the EU27 than it is with universities and public research institutes (Fourth Community Innovation Survey)[24].

[24] Eurostat News Release STAT/07/27 Fourth Community Innovation Survey More than 40% og EU27 enterprises are active in innovation 22 February 2007

The thrust of the national research and innovation system to support business-oriented research with near to market applications, places increased emphasis on bridging the gap between academia and industry and thus on strengthening links between knowledge creators and knowledge users. The two principal agencies promoting links between the research base and industry are MCST and Malta Enterprise in their respective portfolios.

As mentioned in the previous section, the national R&I funding programme, managed by MCST, includes a strong focus on inter-sectoral collaboration and thus knowledge exploitation and circulation, funding collaborative projects involving public-private consortia.

Networking activities are centred round the business Incubation Facility at Kordin (KBIC) that accommodates small and medium sized enterprises (SMEs) in Information and communication technologies (ICT); mechanical and electrical engineering design of equipment systems, as well as product design, renewable energy resources and biotechnology. Malta Enterprise also launched the Business Technology Network (BTN) in 2007 that aims to create links between major players in the field of technology: entrepreneurs, academics, implementers and investors, amongst others. The network assists innovative technology ventures tap different sources of funding during their start-up and expansion phases and facilitates knowledge transfer and collaborations between its members. A student entrepreneurship contact point office (2007) is providing a link between the University of Malta and the business sector and specifically final year students willing to start their own business. In this way, services and schemes offered by the government will be made more accessible to students[25].

MCST is also working to set up the platforms of strategic importance (in Health-Biotech and Manufacturing) that should seek to establish action plans for the respective sectors in consultation with key players from the public and private sectors and academia and operate closely with similar technology platforms at EU level.

With regard to mobility of researchers between academia and industry, this remains to date limited and addressed indirectly through pre-existing schemes. For example, enterprises can benefit from fiscal incentives in respect of R&D qualified personnel and gain tax credits on engagement of external expertise through the R&D Tax Credit Scheme.

The University of Malta's commercial interests have been grouped in the Malta University Holding Company (MUHC) that serves as the commercial interface between the University and the business community, brokering the University's resources and assets to provide added value through commercial activity. So far the company has proved a successful channel through which the University provides RTDI services (such as in engineering and science) to local industry and in so-doing generating additional funds for respective departments.

5.1.2 Profiting from access to international knowledge

Malta's limited human and financial resources supply, make it highly dependent on international links and support. As reported in Erawatch country profile for Malta, EU membership has acted as a significant driver on the one hand for leveraging

[25] Department of Information Press Release No. 0594 Student Entrepreneurship Contact Point at University 25th April 2007.

increased public investments in research and innovation and on the other stimulating international cooperation.

Malta has a good track record of participation in the EU's Framework Programme for R&D both in terms of the amount of EU funding tapped, around €11.3m in FP6, corresponding to an increase of over 150 fold compared to FP5, and also in successfully establishing an extended network of contacts with research institutions abroad. Public research institutes, including the university, have been the most successful participants whilst enterprise participation is lower, facing drawbacks relating to funding modes and finding partners.

The national R&I funding programme is open to participation by foreign (EU and non-EU) entities as long as these do not act as project coordinators; though they do not benefit from any funding.

There have been a number of success stories of R&D collaboration/technology transfer between Maltese enterprise and counterparts abroad through the Eureka programme and the Innovation Relay Centre (IRC) such as the METTTES (More Efficient Transnational Technology Transfer in the Environmental Sector) project on innovative technology transfer in the environmental sector.

Malta has signed agreements on scientific and technological cooperation with EU and non-EU countries that encourage the undertaking of joint research projects. Amongst these are the S&T cooperation agreement with Saudi Arabia (signed in February 2007) and the agreement in the fields of medical services and public health and ICTs signed with Tunisia. The Vth Italo-Maltese Financial Protocol is also financing research in the field of Health and Mental Retardation (€77,500). More recently, in January 2008, the government signed a memorandum of understanding with CERN (European Centre for Nuclear Research) as a step towards establishing formal links between the university of Malta and the nuclear research institute.

The Euro-Mediterranean Institute for Technology and Innovation – EuromedITI – is addressing the Euro-Med market by fostering cooperation and enabling transfer, dissemination and uptake of relevant technologies in the region. It is a public venture launched by government in 2007 with a seed capital of €0.35M. Its partners include local entities (Council for Science & Technology (MCST), Malta Enterprise, Federation of Industry) and high profile international partners (Fraunhofer, VTT Technical Research Centre and Henry Tudor). It is expected that this venture evolves into a majority private holding in the near future. It is supporting development, customisation and transfer of innovating technologies in sectors of relevance to the Euro-Mediterranean Region. Water and Environment, Sustainable Energy, ICTs and Marine are the cluster areas that are being given priority.

5.1.3 Absorptive capacity of knowledge users

Processes enhancing SME participation in R&D

Maltese enterprises from industry and services report among the lowest level of innovation activity in EU27: data from the Community Innovation Survey (CIS) indicate that innovation activity stood at 21% in 2007 compared to 42% of the EU27 average. Moreover as indicated in Section 5.1.1., cooperation with research entities is low (Eurostat, 2007a).

Malta's business sector is dominated by medium to low-tech SMEs and micro-enterprises that were faced in recent years with the need to restructure in order to

better compete in international markets. The low level of R&D in SMEs cannot only be linked to structural factors (such as limited financial and human resource capacity) but also to social factors and namely the lack of a mindset nurturing an innovation and research culture. Thus, a primary challenge for Malta was raising appropriate awareness on R&I that subsequently evolved towards assisting enterprise in undertaking R&I projects through technology transfer and collaborative initiatives.

Malta Enterprise (ME) operates as many as 34 schemes to support enterprise and so far only a limited number have *directly* addressed R&D development (such as the R&D tax credit scheme). Through its IRC and BTN Networks, ME offers mentoring services for innovative start-ups or potentially innovative start-ups on innovation management techniques and business plan development as well as one-to-one coaching services to start-ups and novice entrepreneurs with innovative ideas and business ventures.

The new Enterprise Act (2007) is expected to spur R&D and innovation in enterprise, with proposed interventions including additional tax credits supporting enterprise engaged in industry-led R&D, support for the engagement of qualified personnel to assist SMEs on specific R&I projects, and provision of ERDF-financing for RDI projects amongst others. The Aid Schemes are in the process of being drafted and will be supported by the Cohesion Policy's Operational Programme I – Priority axis on Knowledge and Innovation.

Availability of a highly qualified labour force

The TrendChart reviews for Malta (2005-2008) have pointed at the strategic importance of investing in an SET human resource base not simply to compensate for Malta's poor performance in terms of S&T graduates but more significantly as a means of supporting a knowledge-intensive labour market. As indicated in Section 2.1.4 of this report, the percentage of scientists and engineers in the total labour force – 3.9% (2006) - is below the estimated 4.8% EU27 average[26], reflecting the negative trend in S&T graduates[27].

Policy responses have been timely and span across a number of levels of the education chain. Apart from measures supporting post-graduate specialisation (MGSS-PG Scheme), policy-makers are embarking on the implementation of a national science popularisation/communication strategy that aims to tackle the shortage of S&T careers from the early school years through to secondary education.

There has been the successful introduction of programmes that address entrepreneurial education at secondary and tertiary levels. Two examples include the Discover Enterprise scheme run by Malta Enterprise that provides financial support and mentoring services in entrepreneurship to post-secondary institutions and an entrepreneurial skills building project for undergraduate students in the Bachelor of Science course.

5.2 Assessment of strengths and weaknesses

Cross-sectoral knowledge circulation needs to be strengthened further through the putting in place of dedicated instruments that encourage knowledge flow and

[26] Eurostat News Release 34/2008 EU27 R&D spending stable at 1.84%GDP in 2006 10th March 2008
[27] EIS 2006 and 2007 Indicators for new S&T graduates at 3.6 and 3.4 respectively.

exploitation especially by enterprise. The knowledge absorption capacity of local enterprise remains restricted by the fact that this sector is dominated by small and medium-sized and micro-enterprises wherein R&I activity is low as also demand for R&I from academia is negligible.

Main strengths	Main weaknesses
• Various initiatives in place to promote knowledge circulation e.g. National funding programme; business technology network; • Good track record of international collaboration such as through the EU's Framework Programme for R&D and other international programmes (UNEP, FAO); • Schemes to facilitate participation of local research community (including enterprise) in international research programmes.	• academia-industry mobility programmes are not well developed; • low absorptive capacity of SMEs wherein R&I activities are low.

5.3 Analysis of recent policy changes

Operational Programme I of the Cohesion Policy 2007-2013 foresees support for strengthening business-academia links and thus improving knowledge circulation such as through the setting up of platforms of strategic importance.

In order to attract more careers in science and technology and more generally instil a culture for entrepreneurship, a national science popularisation strategy was drafted in 2007 by the Malta Council for Science & Technology in collaboration with the Education Ministry and key players from academia, the teachers association, the media etc. MCST is presently following up the implementation of this strategy through a dialogue with relevant stakeholders and there a plans to implement part of it by seeking support from the European Social Fund.

Malta Enterprise launched an Exploratory Award scheme that assists SMEs in writing proposals for submission to the EU's Framework Programme for R&D and Competitiveness Innovation Programme (CIP) amongst others. The scheme consists of grants for sustaining eligible costs related to proposal preparation (including personnel costs and consortium-building activities). More generally, incentive schemes are being designed to increase the absorptive capacity of private sector for undertaking research initiatives (through new Enterprise Aid Schemes 2008).

With regard to international circulation of knowledge and researcher mobility, the recent Amendment to the Immigration Act (Legal Notice102 of 2008) is seen to facilitate the admittance of third country researchers to Malta allowing for issuance of a residence permit for a period of one year (renewable), and providing for tax and social security benefits.

Challenge	Main Policy Responses
Knowledge circulation between university, PRO and business sectors	National R&I funding programme re-oriented towards public-private collaboration;
Absorptive capacity of knowledge users	Programmes of entrepreneurial education; tackling shortage of S&T careers through scholarship schemes and science popularisation strategy.
Profiting from accesss to international knowledge	Schemes to assist enterprise participate in EU level R&D programmes; Third country Researcher Mobility Act 2008.

5.4 Assessment of policy opportunities and risks

A policy opportunity lies in implementing a nation-wide science popularisation strategy that will serve not simply to attract more S&T careers but also to generally instil a culture for entrepreneurship across the education chain; the latter could serve to create further opportunities for knowledge demand and circulation.

Inter-sectoral R&D cooperation and R&D personnel circulation, at regional and European levels, can be further encouraged through the setting up of clusters in niche areas (with a focus on those areas of importance in the Euro-Med region). The new Enterprise Act that promotes cluster development, together with initiatives such as Euro-Mediti are seen to facilitate this.

Main policy opportunities	Main policy-related risks
• Operational Programmes implementing the Cohesion Policy 2007-2013 provide for support to knowledge circulation such as through consolidating business-academia links and setting up platforms of strategic importance; • A national science popularisation strategy has the potential to stimulate careers in S&T; • New Enterprise Act is to stimulate cluster development;	• Nurturing R&D “in a vacuum” without providing necessary incentive measures and schemes for circulation of knowledge among key players (industry-academia-public sector).

5.5 Summary of the role of the ERA dimension

Malta’s national R&I strategy places emphasis on opening of the ERA to the world such as through the exportation of locally generated R&I to the Mediterranean region (the EuroMedITI initiative) and the promotion of researcher mobility beyond the European Union such as the recently approved regulations on the status of researchers from third countries.

Further incentives are needed in order to attract top researchers from the EU to the University of Malta; one option for example could be that of exploiting the higher remunerative packages applicable through international collaboration in Framework Programme (FP) projects. The salary structure at the university is currently under review as academic staff is insisting on an upgraded salary package that reflects more closely the salary scales at EU level. One must bear in mind however that current salaries are based on and benchmarked against the national salary system. Moreover, the current reform in the higher education sector is introducing a Quality

Assurance Framework that is placing heightened emphasis on improvements in staff performance against salary increases.

The national R&I funding programme is open to participation of international organisations but does not support their funding and foreign entities cannot act as coordinators of nationally-funded projects.

The Malta National Reform Programme Annual Progress Report 2006 mentions the importance of facilitating the setting up of foreign business start-ups by introducing fast-track procedures within government departments and entities relating to industry in order to facilitate communications and shorten and improve the timeframes for business start-ups.

6 - Overall assessment and conclusions

6.1 Strengths and weaknesses of research system and governance

This Section of the report presents a synthesis of strengths and weaknesses in the Maltese research system across the four domains analysed.

The national research system has undergone rapid changes and progress in developing more joined-up (i.e. coordinated) approaches to research policy. The Research & Innovation (R&I) Strategy, launched in 2006, calls for shared competencies for R&I among public entities, with the Malta Council for Science & Technology (MCST) having an oversight role in coordinating policies and measures among the key players in the public and private sectors. The Strategy presents a very broad set of recommendations intended to guide policy initiatives and investments with a bias towards business-oriented research.

Coupled with these changes in governance, there has been an increased deployment of public funds for research through competitive grants of the national R&I funding programme and initiatives co-financed by structural funds. These investments, together with a good track record of participation in EU's Framework Programme for Research & Development (FP), have served to boost R&I activity. Nonetheless, the lack of a culture for research (and innovation) and the still limited investments in R&I coming from the public and private sectors are acting as bottlenecks to a thriving research and innovation system.

A key driver of knowledge demand is the government's vision to orient research and innovation in four sectors that offer potential for economic growth (ICT, Energy & Environment, Health-Biotech, and High Value-Added Manufacturing). Also, the use of foresight in policy processes is helping identify drivers of knowledge demand (e.g. in the higher education sector and innovation in enterprise). It has stimulated a bottom-up approach in defining knowledge demands and orienting research and innovation needs by engaging with relevant actors from the public and private sectors.

In a context where resources are limited, a critical aspect for Malta lies in building research capacity in niche sectors, through setting up platforms of strategic importance, with adequate human resources. The current low level of S&T graduates and researchers could actually limit this growth where the education system will not

be able to supply adequate skills and in adequate supply in these areas (such as ICT and pharmaceuticals). The current reform of the Higher Education System is addressing issues of skills mismatches and timely provision of skills.

There is limited leverage on the private sector contribution to the gross R&D spend and a lack of structured mechanisms for capturing knowledge demand from the private sector. On the other hand, private-public collaboration is being encouraged through the national R&I funding programme.

Since the private sector is mainly dominated by small and medium sized and micro-enterprises, with minimal R&D activity, there is limited absorptive capacity of this sector for R&I activity. The low level of indigenous R&D is being addressed by the new Enterprise Aid Schemes (2008), co-financed by the European Regional Development Fund, that will support industry-led research and development and research and innovation initiatives within SMEs with a wider mix of grants and fiscal measures.

A perceived weakness is the absence of sustained monitoring and evaluation of research programmes and instruments, the extent of their take-up by the research system and emerging lacunas that are not being addressed as a result.

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	• Research and innovation were given a higher profile when responsibility for R&I was taken over by the Office of the Prime Minister in 2005. • The National Strategic Plan for Research & Innovation 2007-2010 sets for the first time targets for boosting the country's R&I investments in defined priority areas.
	Securing long term investment in research	• Long-term investments in research are mainly those tied to European funding (Structural Funds); for the period 2007-2013 research and innovation projects are being funded through the priority axis on Knowledge & Innovation of the Cohesion Policy. • Ministries and public agencies receive their annual budgets as block funding from the central government so that generally there are no multi-annual funding cycles/programmes. The National R&I funding programme follows a yearly budget cycle. • Malta has a good track record of participation in EU's FP6 and has attracted €3.26m in the first year of FP7.
	Dealing with barriers to private R&D investment	• Although business sector investment in R&D has risen from 0.08% to 0.42% of GDP over the period 2004-2007, this is still low in comparison with the EU average. • A new package of incentives was launched in 2008 by Malta Enterprise to promote international competitiveness, innovation, research and e-business development. These schemes are supported through structural funds. • Initiatives are underway to generate demand for R&I through public procurement for research and innovation.
	Providing qualified human resources	• The national landscape is characterised by a low percentage of S&T graduates and researchers, with the additional concern of a brain drain of graduates.

Domain	Challenge	Assessment of strengths and weaknesses
Knowledge demand	Identifying the drivers of knowledge demand	• The National Foresight Project and other future-oriented exercises, provide key input into the updating of the RTDI Strategy and helped flag niche sectors in which to target public research investments.
	Co-ordination and channelling knowledge demands	• Mechanisms for coordinating knowledge demand between different sectors of the research system are not well developed.
	Monitoring of demand fulfilment	• The evaluation of policies and programmes and their impacts is still in an embryonic phase.
Knowledge production	Ensuring quality and excellence of knowledge production	• International peer-review of the public research funding programme ensures quality of knowledge production and transparency.
	Ensuring exploitability of knowledge	• Malta has low levels of patent applications and licences compared to the EU25 average and needs to build more momentum towards defining an IPR strategy.
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	• The national R&I funding programme facilitates collaboration between academia and the business industry sector. Insufficient intersectoral researcher mobility.
	Profiting from international knowledge	• Malta has a good track record of international collaboration such as through the EU's FP, COST and other international programmes (UNEP, FAO). The highest success rate of participation in FP involves primarily academia with SMEs lagging behind so far.
	Enhancing absorptive capacity of knowledge users	• There is an evident disparity in the private sector: large multinational affiliates undertaking R&I probably account for the largest share of BERD; whilst the more numerous SMEs, that are often family-run micro-enterprises report minimal R&D activity.

6.2 Policy dynamics, opportunities and risks from the perspective of the Lisbon agenda

In the face of Malta's limitations in terms of scale and critical mass, a policy opportunity lies in developing a sector-specific approach to identify and define research requirements and investments in niche areas. The MCST is undertaking a priority-setting exercise in 2008 for the health sector; a consultative process has been launched in order to formulate a health research strategy. A second initiative on green manufacturing is also under consideration.

These initiatives, together with the recent thrust to promote innovative public procurement, also aim to create an impetus for boosting private sector demand for R&I; though they must be accompanied by an adequate framework promoting inter-sectoral collaboration and researcher mobility.

The reform of the higher education system, together with the re-orientation of the University's long-term strategy, creates opportunities for fine-tuning skills supply with industrial needs.

The main policy opportunities and policy-related risks are summarised in the table below.

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	• Increased resources for research deployed through Structural Funds especially in the second wave of funding 2007-2013. • The National Strategic R&I Plan provides a framework for long-term investments in qualified human resources. • The newly approved legislation determining the conditions for admittance of third country researchers should help attract researchers and research collaboration to Malta. • A number of public entities are to allocate 0.25% of their budget for R&I.	• There is no distinct research policy and innovation policy – with the risk that a lack of coordination of policy initiatives and measures, leads to ineffective deployment of resources.
Knowledge demand	• The setting up of Platforms of Strategic Importance in priority areas for better integration of knowledge demands into the national research system; • An emerging opportunity lies in stimulating the demand for innovation-oriented public procurement. • As one of the principal knowledge producing institutions, the University of Malta has the potential to steer its strategy around societal, environmental and economic needs of the country, thus making its research more relevant to national needs.	• Lack of a formal setting for evaluation and systematic monitoring of policy measures and programmes constrains further development and evolution of policy initiatives addressing specific weak areas. • There is a need for more bottom-up approaches to addressing knowledge demand;
Knowledge production	• The re-orientation of the university's long-term strategy, currently underway, to more closely reflect economic and demographic changes; • Attracting careers in science and technology.	• Limited penetration and diffusion of knowledge in the absence of adequate policy support system e.g. in the form of Intellectual Property, and public procurement Frameworks as well as adequate infrastructures.
Knowledge circulation	• Operational Programmes implementing the Cohesion Policy 2007-2013 provide for support to knowledge circulation such as through consolidating business-academia links and setting up platforms of strategic importance in priority sectors; • A national science popularisation strategy has the potential to stimulate careers in S&T;	• Nurturing R&D "in a vacuum" without providing necessary incentive measures and schemes for circulation of knowledge among key players (industry-academia-public sector).

6.3 System and policy dynamics from the perspective of the ERA

There is a limited penetration of the ERA dimension at the country level, with a restricted ongoing policy dialogue on the ERA and its implications, such as that initiated within the social affairs and Foreign and European affairs parliamentary committees. This national debate is framed around integrating the ERA concept with the achievement of the Lisbon Strategy and its goals and it also hails for further integration of third countries in the ERA dimension (Azzopardi, 2008).

At a policy level, the ERA concept is broadly embedded in the National Strategic Plan for Research and Innovation 2007-2010 though many of the recommendations and proposed initiatives contained in the Plan do not make direct reference to the ERA.

Malta's engagement with the ERA is in fact constrained by barriers that stem from the contextual reality of the national research system. Specifically, the elements of particular concern relate to the mobility of researchers where Malta already faces a brain drain; and the limited national resources deployed for R&I, that come mainly through structural funds and the national R&I funding programme.

The ERA initiatives currently being implemented reflect the above reality. Malta is attempting to steer its national research funding programme towards increased international collaboration by opening up the programme to participation by foreign institutions though this participation is limited to involvement in consortia with no funding made available. Malta has participated in two Era-Nets on trans-national foresight initiatives (Forsociety) and marine research programme coordination (MarinERA) and it is a long-term objective to participate more fully in joint research programmes.

With regard to researcher mobility, the recent introduction in 2008 of new legislation for inward researcher mobility from third countries intends to curb the legal and practical barriers hampering mobility; Malta is also on the European Mobility Portal grid. The development of the EuroMediti initiative is seen as a means for generating sufficient critical mass for R&I and North-South technology and knowledge transfer, by addressing a Euro-Med market.

It is only recently that structural funds have been ring-fenced to support research and innovation-related measures, including those contained in the National Strategic R&I Plan. Such funds are being deployed for strengthening research infrastructures, typically at the university of Malta, human capacity building (through scholarship schemes) and more recently R&D support for enterprise (through a new package of Aid Schemes). Businesses, especially SMEs are increasingly benefiting from support to participate in the EU Programmes such as through the FP Exploratory Award that assists in proposal writing, the Innovation Relay Centre for Technology Transfer and the Enterprise Europe Network and Eureka. In order to create a pull-through in the research and innovation system, demand-side R&I measures are being introduced including innovation public procurement and a simpler regulatory and administrative regime for attracting innovative business activity to Malta.

Whilst acknowledging that Malta has made significant progress in stimulating joined-up and systematic approaches to research and innovation policy and initiatives, it is still in a catch-up phase, where the limited financial and human capital are restraining the growth of the research system and its potential to attract more effective international collaboration. The Open Method of Coordination (OMC) provides an important learning process through CREST, but needs to be extended further to provide real support for policy development.

Initiatives such as the TrendChart and ERAWATCH Research Inventory, as well as the Policy Mix and Inno-Appraisal projects are contributing valuable knowledge on the national research landscape and its evolutionary patterns though there is still need for external support for a broad review of the national system of research and innovation, including a dedicated evaluation of the impacts of FP participation and national programmes and measures. To date, the evaluation culture is limited to the external peer review of projects under the national R&I Funding Programme.

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List of Abbreviations

BERD	Business Expenditure on Research & Innovation
CIP	Competitiveness Innovation Programme
CIS	Community Innovation Survey
EIS	European Innovation Scoreboard
EPC	European Patents Convention
ERA	European Research Area
ERDF	European Regional Development Fund
ERM	Exchange Rate Mechanism
EU	European Union
FP	Framework Programme for Research and Technological Development
GBOARD	Government Appropriations or Outlays on Research & Development
GDP	Gross Domestic Product
ICT	Information Communication Technology
IPR	Intellectual Property Rights
MARIS	Malta Regional Innovation Strategy

MGSS-PG	Malta Government Scholarship Scheme – Post Graduate
MCST	Malta Council for Science & Technology
ME	Malta Enterprise
NRP	National Reform Programme
OMC	Open Method of Coordination
OP	Operational Programme
OPM	Office of the Prime Minister
R&I	Research and Innovation
RIS	Regional Innovation Strategy
RDI	Research Development & Innovation
RTDI	Research, Technological Development & Innovation
SET	Science, Engineering and Technology
SMEs	Small and Medium-sized Enterprises
STRATA	Strategic Analysis of Specific Policy Issues – Science & Technology
UoM	University of Malta

European Commission

EUR 23766 EN/12

Joint Research Centre – Institute for Prospective Technological Studies
Directorate General Research

Title: ERAWATCH Country Report 2008 - An assessment of research system and policies: Malta
Authors: Lisa Pace
Luxembourg: Office for Official Publications of the European Communities
2009
EUR – Scientific and Technical Research series – ISSN 1018-5593
ISBN 978-92-79-11615-5
DOI 10.2791/76764

Abstract

The main objective of ERAWATCH country reports 2008 is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries. The reports are produced for each EU Member State to support the mutual learning process and the monitoring of Member States' efforts by DG Research in the context of the Lisbon Strategy and the European Research Area. In order to do so, the system analysis focuses on key processes relevant for system performance. Four policy-relevant domains of the research system are distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The reports are based on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.
This report encompasses an analysis of the research system and policies in Malta.

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LF-NL-23766-EN-C

ISBN 978-92-79-11615-5

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