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Innovation studies

Innovation Staff Recruitment Programme Feasibility Study

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Nils Gabrielsson, Tarmo Kalvet, Kimmo Halme

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Authors:

Nils Gabrielsson *holds a master's degree in civil/environmental engineering from the Royal Institute of Technology in Stockholm. Since 2001 Nils is the managing director of inno Scandinavia, a daughter-company within the inno-group. Since joining inno in 1998 Nils has developed a wide knowledge regarding Swedish and European R&D-systems as well as national and regional innovation processes, especially through the participation and management of several Swedish RITTS projects and follow up initiative such as the trans-regional innovations projects. He is also an expert in the working methods of industrial collaborative research and has been responsible for the development of a methodology for performance evaluation of the Swedish research institutes. Nils' main competence is the development of models for collaboration activities between industry and R&D-institutions. Further, he is an advisor to different Swedish research and innovation-supporting organisations such as VINNOVA, Stockholm Science City (owned by the major research- and higher-education institutions in Stockholm) and The Knowledge Foundation.*

Tarmo Kalvet *has graduated from the University of Tartu with MPA in Public Administration and was also enrolled in the PhD program 2002-2007. He has also studied in the Global Network for Economics of Learning, Innovation and Competence Building Systems (GLOBELICS) and Cambridge Advanced Program on Rethinking Development Economics (CAPORDE). Since joining PRAXIS Center for Policy Studies in 2001 he has led the innovation research programme and has participated in many respective studies. PRAXIS has contributed to all stages of policy cycle, including problem definition and agenda setting, construction of policy alternatives and policy formulation, policy design, policy implementation, monitoring and evaluation. Before joining PRAXIS Center for Policy Studies in 2001, he has worked for Archimedes Foundation as researcher for various ICT-related research projects. Tarmo is also a staff member of the one-year Masters program in Technology Governance, a technology-focused special graduate degree, placed at the Institute of Humanities and Social Sciences, Tallinn University of Technology.*

Kimmo Halme *holds a Licentiate in Technology - degree in international business strategy and MSc in industrial management from Helsinki University of Technology. Kimmo is Managing Director of Advansis Oy and has been working as consultant since 2003, after the founding of the company with Tarmo Lemola. Prior to that, he was working for the Science and Technology Policy Council of Finland and for the European Commission. Kimmo has an extensive experience in innovation policy planning and implementation at international, national and regional levels from nearly 20 years and from several countries, focusing largely on programme, institution and policy evaluations, on the planning and development of innovation policy instruments, as well as on advisory assignments for international organisations and governments.*

Foreword

Up to the present our economic success has been achieved due to the excellent utilisation of our competitive edges that enable companies to operate successfully without the extensive R&D and innovation expenditures in the domestic market. Unfavourable demographic trends, changes in economic structure and increase in labour costs exhausting one of the previously main competitive edges have brought Estonia to the next „transition period" where consistent R&D and innovation generative human capital have become essential to achieving the international competitiveness of economy.

There is need for knowledge, skills and competence for realizing the excellent ideas and thoughts in companies. Due to the small size of Estonian companies and relatively weak collaboration between academia and industry, the aforementioned features have quite frequently become an influential obstacle in the company development. Innovation takes place through people and the economic competitiveness depends on the application of the human capital. Therefore, in addition to other various human capital development support measures, the government plans to implement a new measure to increase the innovation capability of companies by facilitating the involvement of highly qualified people in the company.

In purpose to increase the innovation capability of companies, to improve the management skills of innovation projects and to increase the collaboration between academia and industry, the implementation of mobility scheme has been included as a new activity in the operational programme of research and development and innovation strategy 2007–2013 „Knowledge-based Estonia" and in the operational programme of „Estonian Enterprise Policy 2007–2013".

The aim of the current study was to assess the need for public sector intervention in favouring mobility and to design the recruitment support scheme for Estonia in order to increase in-house innovation capacity of companies through recruitment of researchers, engineers, designers, innovation managers, marketing specialists etc. The present study will provide possible tools and valuable input for policymakers to design the new mobility support measures. Hopefully it will give a positive impulse to the performance of Estonian companies, as our economic competitiveness and sustainability primarily depend on the ability to create social capital and utilise it properly.

Division of Technology and Innovation
Ministry of Economic Affairs and Communications

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Definitions and abbreviations

Definitions

Innovation	The transformation of a new or existing knowledge in a new marketable product, service or process*
Higher education	Higher education is education provided by universities, vocational universities (community colleges, liberal arts colleges, and technical colleges, etc.) and other collegial institutions that award academic degrees, such as career colleges.
Tertiary education	Post-secondary or tertiary education, also referred to as third-stage, third level education, or higher education, is the non-compulsory educational level following the completion of a school providing a secondary education, such as a high school, secondary school, or gymnasium. Tertiary education is normally taken to include undergraduate and postgraduate education, as well as vocational education and training. Tertiary education generally results in the receipt of certificates, diplomas, or academic degrees.
Skilled people	Skilled people are people with at least tertiary education. In the context of the present study highly skilled people are defined as people with at least tertiary education in fields relevant to innovation.**
Mobility and recruitment measures	A mobility or recruitment measure is a publicly co-funded policy measure directly or indirectly aiming at increasing companies' innovation capability through the uptake of highly skilled people. Measures can be divided into direct and indirect measures.
Direct mobility and recruitment measures	These are policy instruments for which the explicit and primary goal is to enhance the science-industry human capital mobility, such as subsidies for joint PhD or financial support to companies to hire public researchers in the business sector, while maintaining links with research organisations.
Indirect mobility and recruitment measures	Indirect measures consist of joint structures involving companies and research organisations (and other actors) –often referred to as 'competence centres'.
Framework measures (individual-oriented measures)	Measures include e.g. income tax reductions, work permit fast track, spouse work permit, etc.
Spin-offs	Firm established by members of an R&D institution or institution of professional higher education, the main activity of which is to commercialise the knowledge or intellectual property created by the R&D institution or institution of professional higher education.
Start-ups	New firms established especially to develop or commercialise an invention licensed from a public research organisation but without staff participation.

Abbreviations

R&D	Research and Development
BERD	Business Expenditure on R&D
FP6	EU Sixth Framework Programme for Research and Technological Development (2002–2006)
GERD	Government expenditure on R&D
HEI	Higher Education Institutions
HERD	Higher Education Expenditure on R&D
MKM	Ministry of Economic Affairs and Communications
PRO	Public Research Organisation
PSRE	Public Sector Research Establishment
S&E	Science and Engineering
HRSTE	Human Resource in Science and Technology
CIS	Community Innovation Survey
SME	Small and Medium Sized Enterprises

* *Definition adopted from DG Regio*
** *Such as engineers, innovation managers, industrial researchers, design specialists*

Lühikokkuvõte

Eesti majandus on läbinud ühe arengutsükli, mille tulemusena on käivitatud palju tugeva turupotentsiaaliga ettevõtteid, kellel on head eeldused edasiseks arenguks. Vaatamata majanduses toimunud positiivsetele arengutele domineerivad endiselt traditsioonilisi majandusharusid esindavad ettevõtted, kelle käive ja kasumlikkus töötaja kohta jäävad märkimisväärselt maha vastavatest näitajatest arenenud maades. Ettevõtete edu baseerumine eelkõige odaval tööjõul ja ressurssidel on olnud siiamaani üheks põhjuseks, miks erasektori investeeringud teadus- ja arendustegevusse ning innovatsiooni on väga väikesed ja suurel hulgal Eesti ettevõtjatel puuduvad kogemused uute innovaatiliste toodete, teenuste ja tehnoloogiate arendamisel.

Eesti teadus- ja arendustegevuse strateegia 2002–2006 „Teadmistepõhine Eesti" raames on võetud kasutusele hulk meetmeid olukorra parandamiseks. Keskseks eesmärgiks on suurendada avaliku sektori investeeringuid teadus- ja arendustegevusse, maksimeerides samaaegselt erasektori kaasatust, edendada rahvusvahelist koostööd ja täiustada rahvuslikku innovatsioonisüsteemi.

Siiani on pööratud suhteliselt vähe tähelepanu poliitikameetmetele, mis oleksid suunatud innovatsiooniga tegelevate töötajate kaasamisele ettevõtetesse kui ühele olulisele võimalusele tõsta ettevõtete innovatsioonivõimekust ja soodustada teadmistesiiret. Rahvusvaheliselt on antud teema saanud aga suure tähelepanu osaliseks, kuna traditsioonilised meetmed ettevõtete ja teadusasutuste koostöö arendamiseks ei too tihti kaasa oodatud tulemusi[1]. Viimase kümnendi jooksul on paljud Euroopa riigid rakendanud erinevaid toetusskeeme mobiilsuse soodustamiseks. Sageli on need suunatud teadlaste või doktorantide mobiilsusele, kuid esineb ka üldisemaid toetusskeeme kvalifitseeritud töötajate mobiilsuse suurendamiseks. Antud toetusskeemide analüüsist võib teha üldise järelduse, et vastavad skeemid paistavad toimivat rahuldavalt tööstuse seisukohast, kuid neil on sageli raskusi väikese ja keskmise suurusega ettevõteteni jõudmisega. Toetuste andmine kvalifitseeritud tööjõu püsiva iseloomuga mobiilsuse soodustamiseks ei ole levinud, tõenäoliselt seetõttu, et selliste meetmetega kaasneb oht tööjõuturgu moonutada.

Eestis võivad mobiilsust soodustava skeemi rakendamisel ilmneda tagasilöögid seoses valitseva üldise tööjõupuudusega aga ka asjaoluga, et Eestis domineerivad väga madalate innovatsioonialaste oskustega ettevõtted. „Keele" ja töötavade erinevus ettevõtete ja teadussektori vahel ning ettevõtete nõudluse puudumine teadus- ja arendustegevuse järele kujutavad endast takistavat faktorit. Teisest küljest puuduvad Eesti innovatsioonipoliitika tööriistakastist tõhusad meetmed kvalifitseeritud töötajate mobiilsuse soodustamiseks, eriti ettevõtete hulgas, kellel on olemas kasvupotentsiaal, kuid ebapiisavad innovatsioonialased oskused.

Eelöeldut arvestades tegi Eesti Majandus- ja Kommunikatsiooniministeerium meeskonnale, mis koosneb innogroup'i kuuluvast inno Scandinavia AB-st (Rootsi), Poliitikauuringute Keskusest PRAXIS (Eesti) ja Advansis Oy-st (Soome), ülesandeks viia läbi eeluuring toetusmeetmele, mis soodustaks innovatsiooniga tegelevate töötajate kaasamist Eesti ettevõtetesse ning toetaks mobiilsust teaduseasutuste ja ettevõtete vahel. Eeluuringu eesmärgiks oli:

- Anda ülevaade toetusskeemi käivitamise kontekstist ja hinnata toetusskeemi põhjendatust sellest kontekstist tulenevalt.
- Suurendada teadmisi teistes riikides rakendatud toetusskeemidest, mis oleksid Eesti kontekstis suurima tõenäosusega tõhusad ja efektiivsed.
- Hinnata võimaliku toetusskeemi võimalikke kulusid ja sellega kaasnevat kasu.

Eeluuringul on kuus peatükki: 1) sissejuhatus, 2) teoreetiline raamistik, 3) hetkeolukord Eestis, 4) järeldused sobivate mobiilsust toetavate skeemide osas, 5) väljapakutud skeemide detailsed kirjeldused ja 6) *ex ante* analüüs, mis sisaldab ettepanekuid hindamise raamistiku jaoks.

Peatükk, mis käsitleb inimressursi mobiilsuse teoreetilist raamistikku, toob välja riikide üha suureneva tähelepanu pööramise kvalifitseeritud tööjõule ja aina suureneva võitluse kvalifitseeritud töötajate järele globaalselt. Inimressursi mobiilsuse käsitlus tugineb arusaamal, et traditsiooniline tehnoloogiasiire, kus teadmised antakse saatja poolt edasi passiivsele vastuvõtjale kodifitseeritud kujul, ei ole efektiivne, kuna vastuvõtja pole võimeline seda informatsiooni ise lahti kodeerima. Poliitikameetmed, mis keskenduvad teadmiste siirdele inimressursi mobiilsuse kaudu, võiksid seetõttu olla sobivaks lahenduseks, kuid teatud kitsendavate tingimuste puhul võivad nendega kaasneda tugevad ebasoodsad mõjud. Inimressursi mobiilsuse käsitlus teeb vahet kahel mobiilsust suurendaval poliitikameetmel – otsesel ja kaudsel. Neist esimene keskendub otsesele rahalisele toetusele

[1] *European Commission (2003): Evaluation of the Trend Chart Policy Benchmarking Workshops, 2001–2002, Trendchart.*

teadusasutuste ja ettevõtete vaheliste suhete edendamiseks, teine aga ettevõtete ja teadusasutuste vahelistele ühisstruktuuridele, kus töötajate mobiilsus on kõigest üks komponent.[2]

Peatükk lõppeb viitega Rootsi uuringule, mis osutab väga kõrgele kasvutempole ettevõtetes, kes kaasavad ettevõtetesse innovatsiooni alal pädevaid töötajaid, ent samas rõhutab ka erinevate ettevõtete erinevaid vajadusi. Suuremad firmad vajavad kõrge kvalifikatsiooniga tööjõudu, nagu näiteks teadlasi, väike- ja keskmise suurusega ettevõtted vajavad aga kõrgharidusega insenere, ent mitte tingimata teadustöö taustaga. Seetõttu on jätkusuutliku majanduskasvu soodustamiseks ning nii väikese- ja keskmise suurusega kui ka suuremate ettevõtete innovatsioonivõimekuse tõstmiseks vaja välja töötada paindlikud ja laiapõhjalised poliitikameetmed.

Eesti olukorda käsitlev peatükk annab detailse ülevaate Eestis valitsevast olukorrast, mis puudutab kvalifitseeritud tööjõu kättesaadavust, ligipääsu ja nõudlust selle järele – nii praeguses situatsioonis kui ka tulevikus. Peatükk sisaldab infot Eesti ettevõtete teadus- ja arendustegevuse intensiivsuse kohta, tuues välja summaarsed kulutused teadus- ja arendustegevusele ning täistööaja ekvivalendi. Eesti väiksusele ning erasektori piiratud teadus- ja arendustegevuse intensiivsusele viitab teadus- ja arendustegevuse kulutusi omavate ettevõtete vähesus: erinevate sektorite ja ettevõttetüüpide vahelisest ülevaatest selgub, et Eesti Statistikaameti andmetel on teadus- ja arendustegevusega tegelevaid ettevõtteid kokku 357 (2005). 129 neist kuuluvad töötlevasse tööstusesse, kusjuures 44 tegelevad elektri- ja optikaseadmete tootmisega. Nende 111 ettevõtte seas, kellel on teadus- ja arendustegevuse (T&A) kulutused suuremad kui 10% käibest, domineerivad põhitegevusena teadus- ja arendustegevusega tegelevad ettevõtted (27) ja IT-firmad (24). Ettevõtete arv, kelle T&A kulutused jäävad vahemikku 1–10% käibest, on 88; suurimad allharud on siin keemia- (12), elektroonika- (11) ja metallitööstus (9). Paljud ettevõtted, kes on raporteerinud T&A kulutusi, on väga väikesed – 43% neist annab tööd vähem kui 10 inimesele.

Samas peatükis antakse ülevaade ka teadus- ja arendustööga tegelevate inimeste kättesaadavusest ehk teadlaste ja inseneride pakkumise poolest. Järeldatakse, et Eestis valitseb vastava kvalifikatsiooniga inimeste puudus ning olukord muutub veelgi halvemaks Eesti teadlaste ja inseneride ebasoodsa ealise struktuuri tõttu, aga ka Eesti ettevõtete teadus- ja arendustegevuse alaste tegevuste kiire kasvu tõttu. Mitmesugused empiirilised uuringu näitavad, et Eesti ettevõtetel on suuri probleeme sobiva personali leidmisega; 2000 ettevõtja hulgas läbi viidud ulatuslik uuring kinnitas, et 2005. a pidas 70% ettevõtetest kvalifitseeritud töötajate leidmist keeruliseks (Saar Poll 2005). Ent see vajadus pole kõigis sektorites ühesugune. Kuna praegused teadus- ja arendustegevuse ning innovatsioonipoliitika meetmed on suures osas keskendunud ülikoolidele ja teadusmahukatele ettevõtetele, on äärmiselt oluline tõdeda, et kuigi paljude Eesti firmade arendusvõimekus on piiratud ning teadus- ja arendustegevus puudub, võivad nad kasu saada toote-, protsessi-, organisatooni- või turunduslikest uuendustest, et tõsta oma konkurentsivõimet. Uuring pakub välja järgmise lihtsa firmade tüpoloogia, iseloomustamaks nende vajadust kvalifitseeritud töötajate järele:

	Tüüp	*Vajadus*
a.	Maailmaklassi tasemel või sellele lähedal olevad teadusmahukad ettevõtted	Vanemteadurid (tipptasemel); turundusspetsialistid (turundusspetsialistidel peavad tavaliselt olema tugevad tehnilised teadmised teadusmahukatest toodetest – seega vajalik kahekordse profiili olemasolu)
b.	Rahvusvaheliselt konkurentsivõimelised tugeva arendustegevuse võimekusega ning vähese uurimistöö võimekusega ettevõtted	Rahvusvahelise kogemusega juhid, kes omavad toote ja tehnoloogia juhtimise alast kompetentsi
c.	Konkurentsivõimelised (kasvavad) ettevõtted, kellel on piiratud arendustegevuse võimekus ning puudub uurimistegevus	Rahvusvahelise kogemusega juhid, insenerid, disainerid, innovatsioonijuhid, rahvusvahelise müügi asjatundjad, muud spetsialistid
d.	Mittekasvavad ettevõtted	Puudub

Vaatamata praegustele haridussüsteemi tugevdamisele suunatud pingutustele, on vajalikud täiendavad meetmed, et rahuldada kasvav vajadus kvalifitseeritud spetsialistide järele. Uuring püüab hinnata nõudlust teadus- ja arendustöötajate ning inseneride järele tulevikus. Seda nõudlust saab hinnata kas poliitiliste eesmärkide põhjal (nt teadlaste ja inseneride arvu suhe tööjõusse peaks olema võrdne Saksamaa tasemega) või arengutendentside põhjal, mille on kujundanud viimaste aastate tööstussektori tegelikud kulutused teadus- ja arendustegevusele tööstuses. Uuringus on ära toodud erinevad tuleviku nõudluse arvutamise võimalused. Saavutamaks Eestis samasugune teadlaste ja inseneride intensiivsus kui näiteks Rootsis (u 5%), peaks teadlaste ja inseneride arv

[2] *European Commission (2001): European Trend Chart on Innovation, Policy Benchmarking Workshop. Favouring Industry-Science Relationships through Human Capital Mobility.*

tõusma 17 000-ni. Aastal 2005 oli ülikooli lõpetanud teadlaste ja inseneride arv u. 5800. Eeldades, et igal aastal läheb pensionile umbes 3 000–4 000 inimest, tähendab see, et ilma tööjõudu impordita kulub sellise teadlaste ja inseneride arvu taseme saavutamiseks 7–8 aastat.

Eesti olukorda kirjeldavale peatükile järgnev peatükk sisaldab diskussiooni avaliku sektori sekkumise põhjendatuse (*rationale*) kohta. Jõutakse järeldusele, et arvestades praegu Eestis valitsevat olukorda ja arengu kitsaskohti, on kvalifitseeritud tööjõu mobiilsust ja kaasamist soodustava toetusskeemi käivitamine riigi poolt põhjendatud. Tuginedes rahvusvahelistele kogemustele ja heale praktikale, tõstab peatükk esile terve rea selliste toetusskeemide edutegureid ning tuvastab sarnaste eesmärkidega programme ja algatusi Eestis. Tuginedes inimressursi allikatele ja kompetentsi vajadustele, pakutakse välja kolm eri tüüpi toetusskeemi. Need on järgmised:

- Toetus teadustöö kogemusega inimeste (järeldoktorid, doktorid) kaasamiseks ettevõtetesse
- Toetus rahvusvahelise kogemusega inimeste kaasamiseks ettevõtetesse
- Toetus spetsiifilistes teemades kogemust omavate inimeste kaasamiseks ettevõtetesse

Väljatoodud toetusskeeme on soovitav käsitleda kui ühe programmi eri variante ning neid tuleks juhtida sama organisatsioonilise raamistiku piires. Erinevate toetusskeemide iseloomustused on toodud alljärgnevas tabelis:

Skeemi tüüp/tunnus	*Doktorantide ja järeldoktorite kaasamine*	*Rahvusvahelise kogemusega ekspertide kaasamine*	*Teemapõhiste spetsialistide värbamine*
Sihtgrupid	Maailmaklassi tasemel või sellele lähedal olevad teadusmahukad ettevõtted	Rahvusvaheliselt konkurentsivõimelised tugeva arendus tegevuse võimekusega ning vähese uurimistöö võimekusega ettevõtted	Konkurentsivõimelised (kasvavad) ettevõtted, kellel on piiratud arendustegevuse võimekus ning puudub uurimistegevus
Eesmärk	Suurendada ettevõtte teadus- ja arendustegevuse alast kompetentsi ja tugevdada kontakte teadusasutustega	Aidata väike- ja keskmise suurusega ettevõtetel kaasata kõrge kvalifikatsiooniga töötajaid välismaalt	Vähendada väikeste ja keskmise suurusega ettevõtete takistusi spetsialistide kaasamiseks innovatsiooniprojektidesse
Sihtgrupi suurus	125–150 ettevõtet	250–300 ettevõtet	1 500 ettevõtet
Allikas	Ülikoolid ja teised teadusasutused Eestis ja välismaal töötavad eestlased	Välismaa firmad ja institutsioonid, välismaal	Akadeemilised institutsioonid, konsultatsioonifirmad
Stiimulid	50% palgakuludest. Eritoetus väiksematele ettevõtetele.	50% palgakuludest, mis kolme aasta jooksul väheneb. Atraktiivsuspaketid.	Kuni 35% palgakuludest 12 kuu jooksul. Projektipõhine taotlemine.
Eeldatav arv	10 kuni 40 inimest aastas	10 kuni 30 inimest aastas	25 kuni 85 inimest aastas
Orienteeruv eelarve (v.a TA)	0,36–2,16 milj. eurot aastas	0,5–4,8 milj. eurot aastas	0,44–1,5 milj. eurot aastas

Viiendas peatükis on ära toodud eeltoodud toetusskeemide üksikasjalik kirjeldus. Nimetatud peatükk käsitleb ka lähemalt toetusskeemide ellurakendamist, eeskätt erinevate organisatsioonide kohustusi, ning annab ülevaate võimalikust taotlemisprotsessist. Kuues peatükk tutvustab hindamise raamistikku keskendudes mõjunäitajatele. *Ex-ante* hindamine, mis moodustab samuti ühe osa kuuendast peatükist, sisaldab ettepanekuid toetusskeemi edukuse näitajate osas, samuti vajalike rahaliste vahendite mahtu, mis toetusskeemi rakendamiseks kulub. Hinnangulised rahalised vahendid on kokkuvõtlikult esitatud alljärgnevas tabelis:

Skeemitüüp/ tunnus	*Doktorite ja järeldoktorite kaasamine*	*Rahvusvahelise kogemusega ekspertide kaasamine*	*Teemapõhiste spetsialistide kaasamine*	*Atraktiivsus-toetus*	*Kokku*
2007	180 000	500 000	490 000	50 000	1 220 000
2008	540 000	1 400 000	880 000	115 000	2 935 000
2009	1 260 000	2 600 000	1 660 000	230 000	5 750 000
2010	1 800 000	3 300 000	1 660 000	290 000	7 050 000
2011	2 160 000	3 600 000	1 660 000	320 000	7 740 000

Lisaks eeltoodule on toetusskeemi rakendamiseks vaja ka tehnilise abi ressursse, mille suurus küündib iga toetusskeemi osa puhul 125 000 euroni aastas.

Executive Summary

The Estonian economy has passed one developmental cycle, by the end of which many companies that have strong market potentials and good prospects for further development have been started. In spite of these positive developments, however, the economy is still dominated by companies representing traditional branches of economy whose turnover and profitability per employee lag well behind the corresponding figures of developed countries. Due to the fact that companies have been able to prosper relying on cheap labour and other resources, private investments in R&D and innovation activities are very low and a large part of Estonian entrepreneurs lack experiences in developing new innovative products, services and technologies.

Within the framework of the Estonian Research and Development Strategy 2002–2006 "Knowledge-based Estonia" a number of measures have been launched to improve the situation. Central goals are to increase public sector investments in R&D simultaneously maximising the involvement of the private sector, to foster international co-operation and to enhance the national innovation system.

So far little attention has been given to policy measures addressing the recruitment of innovation staff in enterprises as an essential part in raising innovation capacities and increasing knowledge transfer. Internationally, however, the issue has received a great deal of attention as traditional instruments to promote industry-science relations often show disappointing results.[3] During the past decade many European member states have launched different types of mobility promoting schemes. Often these address the mobility of researchers or PhD-students but also more general mobility of skilled people-schemes can be found. A general observation from the evaluation of programmes is that they seem to be working satisfactorily from the viewpoint of industry but that they often have difficulties reaching SMEs. Financial incentives to foster skilled people mobility on more permanent basis is not common, probably due to the inherit risk of such measures of distorting the labour market.

In Estonia both of the given potential drawbacks may occur due to the general shortage of labour the country experiences but also due to the dominance of companies with very low innovation skills. The difference in language and work practices and a simple lack of demand for R&D on the side of industry constitute a blocking factor. On the other hand, the Estonian innovation policy tool-box is lacking powerful measures to promote mobility and uptake of skilled people, in particular among companies with growth potential but insufficient innovation skills. Therefore, a team comprising inno Scandinavia AB (Sweden) as a representative of inno-group, PRAXIS Centre for Policy Studies (Estonia) and Advansis Oy (Finland) have been assigned by the Ministry of Economic Affairs and Communications for Estonia to carry out a feasibility study regarding a policy scheme favouring recruitment of innovation staff in enterprises and science-industry mobility. The objectives of the feasibility study are:

- To increase the understanding of the context in which the mobility and recruitment scheme shall be launched.
- To increase the knowledge of scheme types that are best suited to be efficient and effective in the Estonian context
- To raise knowledge about the potential costs and benefits of a future scheme.

The feasibility study covers six chapters: 1) introduction, 2) a theoretical framework, 3) the present situation in Estonia, 4) conclusions on suitable mobility supporting measures, 5) detailed descriptions of suggested measures and 6) an Ex-ante evaluation including suggestions for an evaluation framework.

The chapter describing the theoretical framework regarding human resources mobility points out the increasing focus nations pay to skilled workforce and the increasing competition for skilled people globally. The concept of human resource mobility recognizing that knowledge transfer from a sender to a passive receiver, i.e. codified knowledge is transferred from science to industry, is misleading, as the receiver will not be able to decode the information. Policies focusing on the transfer of human resources might therefore be an appropriate solution but with potentially strong adverse effects under certain restrictions. The approach on human resource mobility distinguishes between two policy measures to increase mobility, direct and indirect schemes. The former focuses on direct subsidies to research-industry relationships while the latter focuses on joint structures between companies and research organisations, where personnel mobility is only one component.[4]

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[3] *European Commission (2003): Evaluation of the Trend Chart Policy Benchmarking Workshops, 2001–2002, Trendchart.*
[4] *European Commission (2001): European Trend Chart on Innovation, Policy Benchmarking Workshop. Favouring Industry-Science Relationships through Human Capital Mobility.*

The chapter concludes with the reference to a Swedish study showing very high growth rates of companies employing staff skilled in innovation but also emphasises the different needs of different companies. Larger firms are in need of highly qualified resources such as scientists and researchers, SMEs are in need of skilled workers i.e. staff with tertiary education as engineers but not necessarily with research background. Therefore, to foster sustainable economic growth and increase the innovative capacities for SMEs as well as larger enterprises, flexible and inclusive policies need to be developed.

The chapter on the situation in Estonia provides a detailed and partially quantified picture of the situation in Estonia regarding availability of, access to and demand of skilled workforce – now and in the future. It provides details on the R&D-intensity of Estonian companies regarding total R&D-expenditure and the number of Full Time Equivalents (FTE). Estonian smallness and limited R&D intensity of private sector is indicated by the small number of companies with business expenditures on R&D: A characterisation of differences between sectors and types of companies is given showing that there are altogether 357 companies conducting R&D according to the Statistical Office of Estonia (2005). 129 of them belong to the manufacturing sector: 44 in the manufacture of electrical and optical equipment, there are 111 companies with BERD/turnover higher than 10% of turnover, dominated by dedicated R&D companies (27) and IT companies (24). The number of companies with BERD/turnover 1–10% is 88; the largest sub-sectors are chemical (12), electronics (11) and metal (9) industries. Many companies reporting BERD are very small – 43% employ less than 10 people.

In the same chapter also the situation regarding availability of people in science, engineering and research is highlighted. It is concluded that there is a lack of people in science and engineering and that the situation is bound to get worse due to the unfavourable age structure of Estonian researchers, scientists and engineers but also because of the rapid increase in R&D efforts of Estonian companies. Various empirical evidence confirm that Estonian enterprises have major problems in finding suitable personnel; an extensive study among 2000 entrepreneurs confirmed that 70% of enterprises found finding skilled workers complicated in 2005 (Saar Poll 2005). The need is not identical in all sectors, though. Whereas current science, technology and innovation policy measures have mostly focused on universities and research-intensive companies, it is crucial to recognise that many competitive and growing firms in Estonia have limited development and no research capacity, but can take advantage of product, process, and organisational and/or marketing innovations in order to increase their competitiveness. The study suggests the following simple typology of firms for characterising their need for skilled people:

Type	*Need*
World-class or close to world-class research-intensive companies	Senior (top level) researchers; marketing specialists (marketing specialists usually need to have technical knowledge about the very research-intensive products – so a double profile is probably needed)
Internationally competitive companies with strong development and some research capacity	Internationally experienced managers, people with product and technology management competence
Competitive (growing firms) with limited development and no research capacity	Internationally experienced managers, engineers, designers, innovation managers, international sales, other specialists
Non-growth companies	n/a

Strong efforts are currently under way to strengthen the educational system but complementary measures are necessary in order to satisfy the demand for people. The study makes an attempt to estimate the future demand for scientists, researchers and engineers. The demand can be estimated either based on political targets (e.g. the ratio of science and engineering (S&E) work force to total force should be equal to that of Germany) or on the trends set by actual industry R&D-spending in recent years. Different calculations are provided in the study. One result is that in order to reach the same intensity of S&E workforce in Estonia as, for example, in Sweden (approx. 5%) a further 17,000 people must in work in S&E-professions. The number of graduates in S&E was approx. 5,800 in 2005. Assuming a yearly retirement of some 3,000–4,000 persons, it means that it will take 7–8 years before the given level of S&E-workforce is achieved without importing work force.

The chapter after the description of the Estonian situation contains a discussion on the rationale for public intervention through policy measures. It concludes that, considering the present situation and bottlenecks for growth in Estonia, a scheme promoting the mobility and recruitment of skilled people is motivated. The chapter further highlights a number of success factors of such schemes based on international experiences and good practice and identifies existing Estonian schemes and initiatives with related aims. Based on the sources of people and the type of skills sought, three different types of support measures are suggested. These are:

- Support to Recruitment of research-trained personnel
- Support to Recruitment of international expertise
- Support to Recruitment of specific purpose specialists

It is suggested that the given support initiatives are considered to be different variants of the same scheme and that they are managed within the same organisational umbrella. The characteristics of the different schemes are presented in the table below:

Scheme type / element	*Recruitment of research-trained staff*	*Recruitment of international expertise*	*Recruitment of specific purpose specialists*
Target groups	World-class or close to world-class, research-intensive companies	Internationally competitive with limited research but strong development capacity	Competitive (growing firms) with limited development and no research capacity
Objective	To upgrade company R&D skills and strengthen contacts to research	Helping SMEs to find and hire highly skilled people from abroad	Lowering the barrier for SMEs to hire specialists in projects
Target group size	Estimated target group size: 125–150 companies	Estimated target group size: 250–300 companies	Estimated target group size: 1.500 companies
Source of skills	Higher education and research institutions in Estonia and abroad	Foreign companies, institutions, returning expatriates	Academic institutions, expert companies
Incentives	50% of salary costs. Special support for smaller companies.	50% of salary costs, decreasing for three years. Attraction packages.	Up to 35% of salary costs for 12 months. Project-related application.
Expected output	From 10 to 40 persons per year	From 10 to 30 persons per year	From 25 to 85 persons per year
Tentative budget (excl TA)	0.36–2.16 mill. Euro/year	0.5–4.8 mill. Euro/year	0.44–1.5 mill. Euro/year

A detailed description of the schemes is provided in Chapter 5. The given chapter also covers in some detail the implementation of the scheme, in particular responsibilities of different organisations, and also outlines the application process. Chapter 6 presents the evaluation framework focusing on impact indicators. The Ex-ante evaluation, which also forms a part of Chapter 6, provides suggestions for operational success indicators and a quantification of necessary financial resources to be allocated to the measures. The estimated financial resources are summarised in the table below:

Scheme type / element	*Recruitment of research-trained personnel*	*Recruitment of international expertise*	*Recruitment of specific purpose specialists*	*Attraction support*	*Total*
2007	180 000	500 000	490 000	50 000	1 220 000
2008	540 000	1 400 000	880 000	115 000	2 935 000
2009	1 260 000	2 600 000	1 660 000	230 000	5 750 000
2010	1 800 000	3 300 000	1 660 000	290 000	7 050 000
2011	2 160 000	3 600 000	1 660 000	320 000	7 740 000

In addition to the given resources it is estimated that there is a need for technical assistance resources to each of the schemes amounting to 125.000 Euro per year.

1 Introduction

1.1 The study

A team comprising inno Scandinavia AB (Sweden) as a representative of inno-group, PRAXIS Centre for Policy Studies (Estonia) and Advansis Oy (Finland) has been assigned by the Ministry of Economic Affairs and Communications for Estonia (MKM) to carry out a feasibility study regarding a policy scheme favouring recruitment of innovation staff in enterprises and science-industry mobility. The objectives of the feasibility study are:

- To increase the understanding of the context in which the mobility and recruitment scheme shall be launched;
- To increase the knowledge of the scheme types that are best suited to be efficient and effective in the Estonian context;
- To raise knowledge about the potential costs and benefits of a future scheme.

The objectives shall be reached taking under consideration global good practice related to the given topic and through the integration of Estonian stakeholder organisations in the process.

1.2 Work carried out

The present report outlines a set of measures (schemes) for promoting recruitment and mobility that we believe has a strong potential to address the needs of Estonian industry for skilled people. The scheme outlines are based on the results of a thorough desk research, interviews with international recruitment and mobility scheme managers and on interviews with Estonian stakeholders.

The desk research has covered a wide range of relevant reports addressing both the situation in Estonia and internationally. The references can be found in Appendix 4.

Interviews have been carried out with some 19 Estonian stakeholders (list in Appendix 3). These include representatives of companies, academic institutions and Enterprise Estonia. Also, interviews have been conducted with managers of mobility/recruitment schemes in other countries.

International good practice relevant to the study has been identified and analysed. Initially a draft paper was designed outlining different types of mobility/recruitment measures. In the course of the study the scope of the good practice examples included has come to focus on repatriate schemes and the schemes sourcing skilled people internationally as well as on the recruitment of skilled workers by SMEs.

2 Theoretical framework

Sustainable economic growth is regarded as the key to prosperity and human well-being. Economic research provides two kinds of models that explain which factors influence economic growth and respectively, what policy implications may be drawn from the model: 1) the exogenous model based on findings of Solow-Swan (1956), also known as neoclassic models and 2) the endogenous models by Mankiw, Romer and Weil (1992) or Aghion and Howitt (1997). The important finding that human capital and innovation are the driving forces behind economic growth, besides other factors, is the basic output of endogenous growth theory.

The recognition of the importance of human resources stresses the fact that availability of and access to skilled people is crucial to the competitiveness of companies and thereby in end-effect to nations. For this reason, countries commit significant resources to graduate education and compete intensely to attract top scientists and researchers. The worldwide competition for skilled workers has increased in recent years through various socio-economic effects such as the ageing population of developed societies (large proportions of the labour workforce retire within the next decade)[5] or declining birth rates.

Empirical evidence suggests that the global demand for skilled people has led to an increase in migration. For example a study undertaken by Open Doors (2004) states that the number of foreign scholars employed by US universities rose over 40% between 1993 and 2003 from about 60,000 to 84,000, the majority of which were in the engineering and natural sciences. Nonetheless, as of today America is aware that they run into strong competition for international students, who will later become a potential resource for future scholars, from countries as United Kingdom, where international student enrolment rates grew by 29 percent between 1999 and 2005, or Japan with an increase of 108 percent for that time frame.[6] As competing countries have implemented various strategies to recruit international students and researchers, including using national marketing strategies, aligning immigration policies with recruiting goals or creating regional education hubs, and besides above stated socio-economic effects, the fight for high-qualified and scarce personnel will become much more intense within the next decade.

2.1 Promoting Industry-Science relationships through human resources mobility

Following the concept of National Systems of Innovation (NSI)[7]national policies strive to close the gap between research and industry by focusing on an interactive mode of diffusion of knowledge among actors of the system. This perception of innovation and factors driving innovation departs from the general, endogenous theory of growth by Grossman and Helpman (1991) or Aghion and Howitt (1990). The endogenous growth theory presumes that efforts in research and development lead to innovation and commercialisation and subsequently better economic performance. The NSI approach states that innovation is an interactive process in which its key actors, e.g. firms, interact with manifold other actors in their environment (research organisations, customers, regulators) influencing this innovation process. Innovation is therefore understood as a very complex process with intricate causal links. Policy instruments are thus designed to support knowledge flows between individual actors.

The main barrier between research and industry seems to be the language of both worlds. Therefore, various channels to promote the given relationship have been established, among the most popular in recent years is human resource mobility. The concept of human resource mobility recognizes that knowledge transfer from a sender to a passive receiver, i.e., codified knowledge is transferred from science to industry, is misleading, as the receiver will not be able to decode the information. Policies focusing on the transfer of human resources might therefore be an appropriate solution but with potentially strong adverse effects under certain restrictions. The approach on human resource mobility distinguishes between two policy measures to increase mobility, direct and indirect schemes. The former focuses on direct subsidies to research-industry relationships while the latter concentrates on joint structures between companies and research organisations, where personnel mobility is only one component.[8] Further, it has to be acknowledged that industry-science relations are only pieces of the puzzle of promoting innovation.

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5 *Oliveira Martins J., F. Gonand, P. Antolin, C. de la Maisonneuve and K.-Y. Yoo (2005): The Impact of Ageing on Demand, Factor Markets and Growth, OECD Economics Department Working Papers, No. 420, OECD, Paris.*

6 *Open Doors (2006): Students on the Move: The Future of International Students in the United States. ACE Issue Brief.*

7 *The NSI approach helps to understand how innovation evolves and what the elements and framework conditions are that determine and affect innovation and economic development. [M. Lankhuizen R. Klein Woolthuis (2003): The National Systems of Innovation Approach and Innovation by SMEs, Netherlands]*

8 *European Commission (2001): European Trend Chart on Innovation, Policy Benchmarking Workshop. Favouring Industry-Science Relationships through Human Capital Mobility.*

Results from empirical studies concerning the given issue do not provide a clear picture on how effective mobility policies are, as effects of programmes are complex and non-uniform. Workshops undertaken by the European Union[9] point at benefits and learning arising from the implementation of mobility schemes as:

- The mobility of ideas seems to be at least as interesting as physical mobility of people.
- Human resource mobility schemes can be seen as instruments to facilitate communicative interaction between researchers from both science and industry. Yet the impact on the establishment of dynamic long-term relationships between science and industry seems limited. Neither direct nor indirect human mobility schemes provide all-embracing solutions to bridge the Industry-Science gap.
- Learning-oriented mobility of human resources is the key objective. In this respect the human resource mobility schemes seem more appropriate than the traditional schemes that focus on the transfer of technology.

Nonetheless, adverse effects resulting from mobility schemes might occur if there are certain constraints regarding contributing factors, e.g. the danger of drying up the science base by promoting the uptake of young researchers by industry. Another important constraint of mobility schemes might be the applicability to different company sizes, as mobility schemes already implemented in many European countries state the concern that they are not able to reach SMEs with those schemes, which is in line with the theoretical framework stating that absorption capacity is an indispensable condition for successful knowledge transfer. This leads over to the next issue that any policy addressing human resource mobility is especially relevant for larger firms and high technology firms but not necessarily for Small and Medium Sized companies.

2.2 The importance of human resources for SMEs

SMEs play an extensive role in sustaining growth and employment in economy. SMEs make up the majority of European firms both in absolute and relative terms. In 2003, across Europe[10], there were more than 19 million SMEs and almost 6 million in the new Member States and Candidate Countries[11]; in both cases they accounted for 99% of total number of enterprises. A study by Florio and Ozzimo (2006) shows that SMEs have the largest share of total national employment in Europe, similarly Schmidt (1997) points out that SMEs play an extensive role within innovation events. According to figures provided by the Statistical Office of Estonia, 99% of Estonian companies are SMEs and they account for 77% of total employment (2005) in the business sector. Further, SME's share of value added created in business sector in 2005 was 75% and their share of exports amounted to 83% in the same year.

As described above, technological progress respectively innovations are assumed to be drivers of economic growth and prosperity. Therefore, it is indispensable to understand the mechanisms of the innovation process from a politico-economic point of view. The following parameters could be identified as crucial by theory[12]:

- Resources needed to produce technological progress,
- Access to the given resources,
- The efficient assignment of resources,
- The question of how technological process can be described and how the diffusion takes place,
- Factors that hinder or support the formation and diffusion of technological progress.

Based on the parameters, a linear model on how to create innovation was adapted within the first decades following the Second World War. This model lead to the conclusion that only large enterprises would be able to afford and push technological progress, which was in line with the Schumpeterian growth framework. Today the Schumpeterian framework is being revised by researchers with particular emphasis on the dynamic "creative destruction" process, leading to a broader understanding of mechanisms and consequences of technological progress. Thus, the scientific world diverged from the linear approach, which viewed innovation as an outcome of R&D efforts of large enterprises, and instead it came to favour a perception of innovation-based complex networking of different actors, producing, spreading and adopting different kind of knowledge. This new complex approach also recognizes different kinds of innovation stages, innovation and imitation, the latter often carried out by SMEs. A further difference between large and small enterprises, noticed by the new approach, is that activities underpinning innovation differ significantly from each other. To illustrate, investment in R&D plays only a minor role for SMEs. A study by Schmidt (1997) also reveals that R&D in SMEs is less systematic and discontinuous and that knowledge generation mainly stems from knowledge management

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9 *European Commission (2003): Evaluation of the Trend Chart Policy Benchmarking Workshops, 2001-2002, Trendchart.*
10 *15 old Member States of the European Union, the three countries of European Economic Area (Norway, Liechtenstein and Iceland) and Switzerland.*
11 *Data refer to private enterprises in non-primary sectors.*
12 *Schmidt, E. (1997): Innovation im Mittelstand: Theoretische und empirische Aspekte, RWI, Essen.*

which is determined by relations to customers and competitors. Barriers to innovation, identified by SMEs, often include financial constraints or constraints related to in-house management of competences (qualified staff). Problems associated with access to valuable market information and technologies and missing networking- and co-operation structures play only a minor role for SMEs, but are within the main concerns for larger enterprises.

The given picture of SMEs is supported by a recent Swedish study[13], which, based on data from 1997 to 2003, showed that small companies hiring an engineer (first and only one) increased their productivity by 290% and their turnover by over 500% during the period. At the same time the number of employees increased by 190%. The given effect was much smaller for companies already having at least one engineer when hiring a new one. Companies not having an engineer during the period at all perceived a small increase in the number of employees and turnover, but a negative growth of productivity.

The concluding remarks from the given theoretical approach towards the role and variables influencing SMEs ability to manage innovation processes does not exclude policies favouring the mobility of human resource management as stated by the latter chapter. Rather, it points at differences in the educational standards of the mobile human resources. As larger firms are in need of highly qualified resources such as scientist and researchers, SMEs are in need of skilled workers i.e. staff with tertiary education as engineers but not necessarily research background. Therefore, to foster sustainable economic growth, increasing the innovative capacities for SMEs as well as larger enterprises, flexible and inclusive policies need to be developed.

2.3 Overview of mobility/recruitment policy measures

Scheme Type	*Objectives*	*Field of Application*	*Best Practise*	*Examples of results*	*Supporting instruments*	*Responsibilities*
Repatriate schemes	■ Make use of expatriates, often with high-educational levels; ■ Support stock of high-skilled on temporary basis from outside;	■ Sustainable growth policy; ■ Education policy;	■ South Africa-SANSA ■ UN-TOKTEN ■ Belgium-MIDA	■ **SANSA** has more than 2,200 members (2003) in 60 countries; ■ **Pakistan-TOKTEN:** Since 2003, 834 consultancies have been carried out ■ **MIDA:** 50 direct transfers in 2001/02;	■ **SANSA:** database connected to NEXUS database ■ **Pakistan-TOKTEN:** financial support and Daily Subsistence Allowance (UN) ■ **MIDA:** financial support for time abroad and technical equipment provided;	■ **SANSA:** founded by university, handed over to National Research Foundation (public); ■ **Pakistan-TOKTEN:** cooperation between national governments and UN ■ **MIDA:** cooperation between Belgian government, International Organization of Migration (IOM) and participating states governments;

[13] *Ramböll Management AB (2006): „När kunskap ger resultat – värdet av ingenjörer i mindre företag ".*

Scheme Type	*Objectives*	*Field of Application*	*Best Practise*	*Examples of results*	*Supporting instruments*	*Responsibilities*
Researcher mobility schemes	■ Enhance innovative capacities of large enterprises; ■ Create link between industry-science	■ Wage subsidy schemes via Education policy or Fiscal Growth policy;	■ Denmark-Industrial PhD ■ France-CIFRE ■ USA-H1B visa is a non-immigrant visa	■ **Denmark:** 1988–2004 422 projects were accepted ■ **France:** 1500 projects get approved, annually ■ **H1B:** yearly numbers/ CAP for 2006: 65000 people;	■ Financial incentives are paid to collaborating research centres; overall subsidy is given to company-transferred into researcher loan;	■ **Denmark:** Ministry of Science, Technology and Innovation, Department of Science & Innovation ■ **France:** Managed by ANVAR ■ **H1B:** Department of Homeland Security (DHS) H1B base incorporated handles application;
Recruitment of skilled people schemes	■ Facilitate innovative capacities of enterprises (focus on SMEs)	■ Wage subsidy schemes to increase management and innovative resources;	■ KIM (NL) ■ KTP (UK)	■ **(KIM)** 794 projects were started, 670 completed between 1998–2002 ■ **(KTP)** Estimated that on average, every million invested in KTP results in 77 new jobs created, and training for 263 members of staff,	(KTP) Regional offices support both companies and individuals	■ **(KIM)** Installed by Ministry of Economic Affairs, carried out by Syntens (foundation) ■ **(KTP)** Managed by Department of Trade and Industry

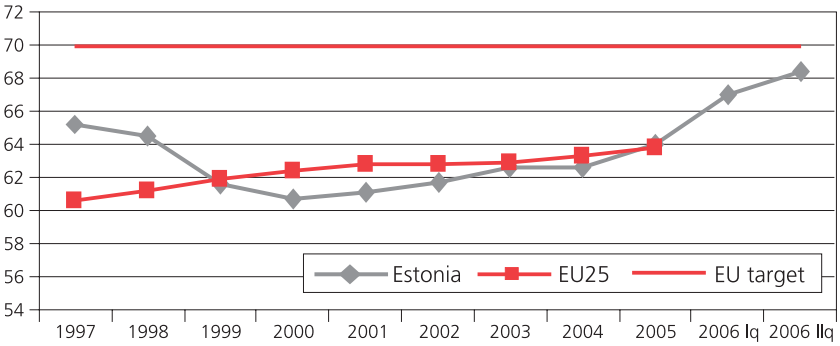
3 The Estonian context

3.1 Estonian Labour Market developments

Estonia has experienced strong economic growth since 2000. In 2005 the annual growth rate was 10.5% and in Q4 2006 it accelerated to 11.2% making Estonia one of the fastest growing economies in the EU. Such rapid developments are also reflected by corresponding employment indicators.

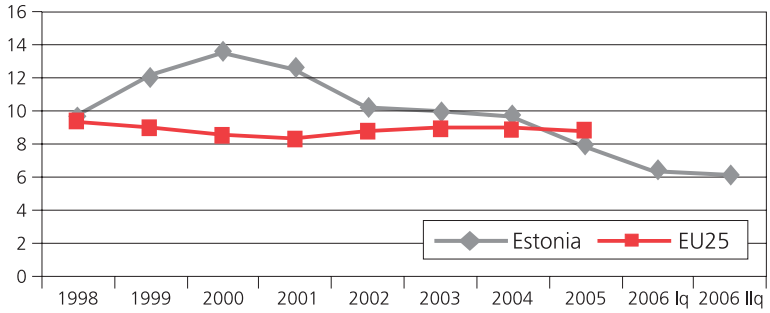
Since 2005 increase in employment rate may be observed: employment increased by 1.4 percent to 64% in 2005 (for ages 15–64) and exceeded slightly the respective indicator of the EU (Figure 1). This trend has also continued in the first half of 2006, when the employment rate reached 67% in the first quarter and to 68.4% in the second quarter, which is the highest quarterly level since 2000. In the light of the given developments Estonia might already reach the national employment target of 67.2% (as defined in National Reform Programme) before 2010. Also, these developments suggest that while achieving the EU employment target of 70% by 2010 seemed unrealistic in 2005, the situation looks more optimistic today.

Figure 1. Employment rate (15–64) in Estonia and EU



Source: Statistical Office of Estonia, Eurostat

Figure 2. Unemployment rate in Estonia and EU



Source: Statistical Office of Estonia, Eurostat

After the peak of 13.8% in 2000, unemployment rate has decreased to 7.9% in 2005 (Figure 2). This trend continued also in the first half of 2006, when the unemployment fell to 6.4% in the first quarter and 6.2% in the second quarter. In absolute terms there were 51.6 thousand unemployed according to the Labour Force Survey in 2005. The number of the unemployed fell to 37,000 in the 3rd quarter of 2006. Unemployment is still high for young people (15.9% in 2005) and for non-Estonians (15.2%) compared to 6.2% for Estonians.

Labour migration has also increased during last two and half years. Starting form May 2005 until the end of 2005 about 25,000 Estonians have moved to work abroad, the majority of them to Finland (about 7,000 with work permits and 7,000 posted workers). Second target country was UK with 5,000 and the third one Ireland with about 3,000 workers (Ministry of Social Affairs).

Another major challenge, somehow felt as rather distant, but impacting the education system already in near future, is related to the demographic situation in Estonia. Estonian population has constantly declined starting from early 1990's, but also the age structure of the population has clearly changed. The decrease in the number of children and increase in life expectancy have inevitably raised the share of older people in the population. Estonia

today is one of the fastest ageing countries in Europe. In 2006 the percentage of those over 60 was 22%, but in 2050 it will increase to 34% of the population (United Nations 2007).

Consequently, rapid economic growth has been accompanied with declining unemployment and inactivity. As a result a new phenomenon of labour shortage has emerged for Estonia. Sectoral distribution of labour shortage is different; it seems that the most affected sectors are construction, transportation, health care and ICT.

3.2 R&D intensity of the Estonian economy

When looking at the structure of the Estonian economy using Keith Pavitt's sectoral taxonomy of innovations (1984), which is a well-established identification of some regularities in the way in which technological change unfolds and affects economic activity, we can argue that majority of Estonian manufacturing enterprises belong to supplier-dominated or production-intensive sub-fields.

In supplier-dominated activities (such as agriculture, textiles, clothing, building, mining, forestry, commerce, and traditional manufacturing) most innovations come from suppliers of equipment and materials; firms that operate in these activities undertake generally little R&D and request few patents; main innovations are incremental cost-reducing process innovations embodied in intermediate and capital goods.

In production-intensive activities (such as scale-intensive industries including cement and glass manufacturing, metal refining, and transportation equipment, and specialized suppliers such as machinery production), R&D is conducted in the larger firms; it is centred on both product and process technologies; firms tend towards vertical integration and appropriability is linked to tacit knowledge, secrecy, and patents. While R&D based innovative acts in the supplier-dominated or production-intensive sectors are everywhere relatively low, this explains why Estonian enterprises are generally investing very little resources to research and development.

Indeed, empirical data shows that the Estonian research system is not strong in an international comparison. In 2005 total spending on R&D reached 0.9% of GDP; EU15 average was 1.9% and EU27 1.8%. Private spending on R&D was 0.36% of GDP in Estonia (2004); in EU15 it was 1.2% and EU27 1.0% (Eurostat 2007), although private spending has increased to 0.42% in 2005 (Statistical Office of Estonia).

The branches of Estonian industry whose sectoral value added as % of national GDP is the highest, are not R&D intensive. For example, when transport, storage and communication have a contribution of 10.6% to GDP (2005), its R&D intensity[14] is only 0.1; in the wholesale and retail trade and repair of motor vehicles the respective figures are 13.2 and 0.08. The most R&D intensive sectors in Estonia are computer and related activities, manufacture of electrical and optical equipment, chemical industry, and manufacture of transport equipment (Appendix 1.1).

These conclusions hold when looking at the R&D personnel (FTE) by sectors. Out of the 445 R&D FTE in the manufacturing industry (2004), 207 are employed in electronics and 91 in the chemical industry (Appendixes 1.2 and 1.3). When considering total R&D expenditures mainly the same picture may be observed, only financial intermediation, transport, storage and communications, and electricity, gas and water supply come up as well (Appendix 1.4). A sharp increase took place in private R&D expenditures in 2003 and has continued to rise strongly in 2004 and 2005 as well. Again, manufacture of electrical and optical equipment and computers and related activities were the most rapidly growing sectors; the share of these sectors exceeded one third of the total private R&D expenditures in 2004.

Observations concerning innovative sectors are also confirmed with the results of the survey on the companies with innovative activities (CIS4) (Appendices 1.5 and 1.6).

Estonian smallness and limited R&D intensity of private sector are also indicated by the small number of companies with business expenditures on R&D: There are altogether 357 companies conducting R&D according to the Statistical Office of Estonia (2005). 129 of them belong to the manufacturing sector: 44 in the manufacture of electrical and optical equipment, 18 in the chemical industry and 19 in the food industry. 210 belong to the services sector: 67 to the computer and related activities and 29 are dedicated R&D companies (overview of main sectors in Table 1; full data in Appendix 1.7).

[14] *Share of sectoral R&D in sectoral value added.*

Table 1. Companies reporting R&D expenditures, 2005

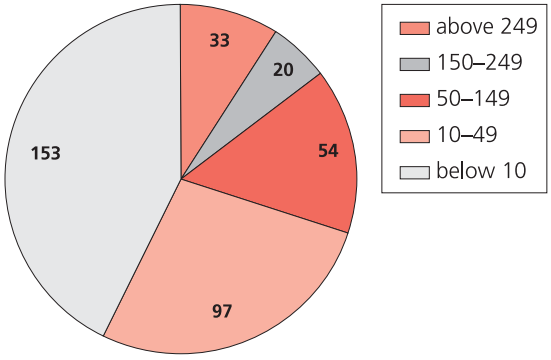
	Companies reporting BERD	*Employees above 249*	*150–249*	*50–149*	*10–49*	*below 10*
Total	**357**	**33**	**20**	**54**	**97**	**153**
Manufacturing	**129**	**21**	**12**	**34**	**34**	**28**
Manufacture of food products and beverages	19	7	3	6	3	0
Manufacture of coke, chemical products…	18	3	1	3	7	4
Manufacture of other non-metallic mineral products	9	2	1	2	4	0
Manufacture of basic metals…	14	0	2	6	6	0
Manufacture of electrical and optical equipment	44	2	2	7	9	24
Electricity, gas and water supply	**9**	**5**	**1**	**2**	**1**	**0**
Services	**210**	**4**	**6**	**18**	**58**	**124**
Wholesale and retail trade…	30	0	0	1	8	21
Transport, storage and communication	10	2	3	2	2	1
Financial intermediation	5	2	2	0	1	0
Computer and related activities	67	0	0	3	14	50
Research and development	29	0	0	0	8	21
Real estate, renting and business activities…	27	0	1	4	8	14

Source: Statistical Office of Estonia, 2007

There are 111 companies with BERD/turnover higher than 10% of turnover, dominated by dedicated R&D companies (27) and IT companies (24). The share of companies with BERD/turnover being 1–10% is 88; the largest sub-sectors are chemical (12), electronics (11) and metal (9) industries. 158 companies have the ratio less than 1% (for detailed data see Appendix 1.7).

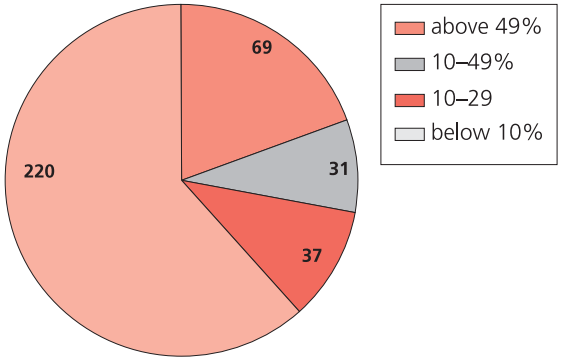
Many companies reporting BERD are very small – 43% employ less than 10 people (Figure 3). Of the 204 BERD reporting companies employing more than 10 people, 101 of them are in manufacturing (20 in the manufacture of electrical and optical equipment, 19 in the manufacture of food products and beverages) and 86 in the services sector (17 in the computer and related activities). 220 (out of 357 that report of BERD) have export/turnover ratio below 10%. Those with the ratio above 49% are 69 (Figure 4, see also Appendix 1.7).

Figure 3. Number of employees in companies reporting of BERD



Source: Statistical Office of Estonia, 2007

Figure 4. Export/turnover ratio in companies reporting of BERD



Source: Statistical Office of Estonia, 2007

According to Archimedes Foundation the number of applications submitted to the European Community Framework Programme for Research, Technological Development and Demonstration (FP6, 2002–2006) by Estonian companies was altogether 132 (58 in information society technologies, 16 in biotech, but also 9 in energy and 7 in environment fields, for example). FP6 funding was granted to 51 project proposals that were submitted by 43 companies (some companies participated in multiple projects).

Table 2. FP6 funded projects with Estonian participants by research priority

Information society technologies	17
Horizontal research activities involving SMEs	13
Sustainable development, global change and ecosystems	6
Life sciences, genomics and biotechnology for health	4
Nanotechnologies and nanosciences, knowledge-based multifunctional materials and new production processes and devices	3
Research and innovation	3
Science and society	3
Citizens and governance in a knowledge-based society	1
Human resources and mobility	1
Total number of projects:	51

Source: Archimedes Foundation, 2007

3.3 People in science, engineering and research

Compared to all EU states the degree of the Estonian population with tertiary education is high: 31.4% compared to EU25 average of 21.9. However, the degree of people in science and engineering is low compared to advanced countries as shown by the table below:

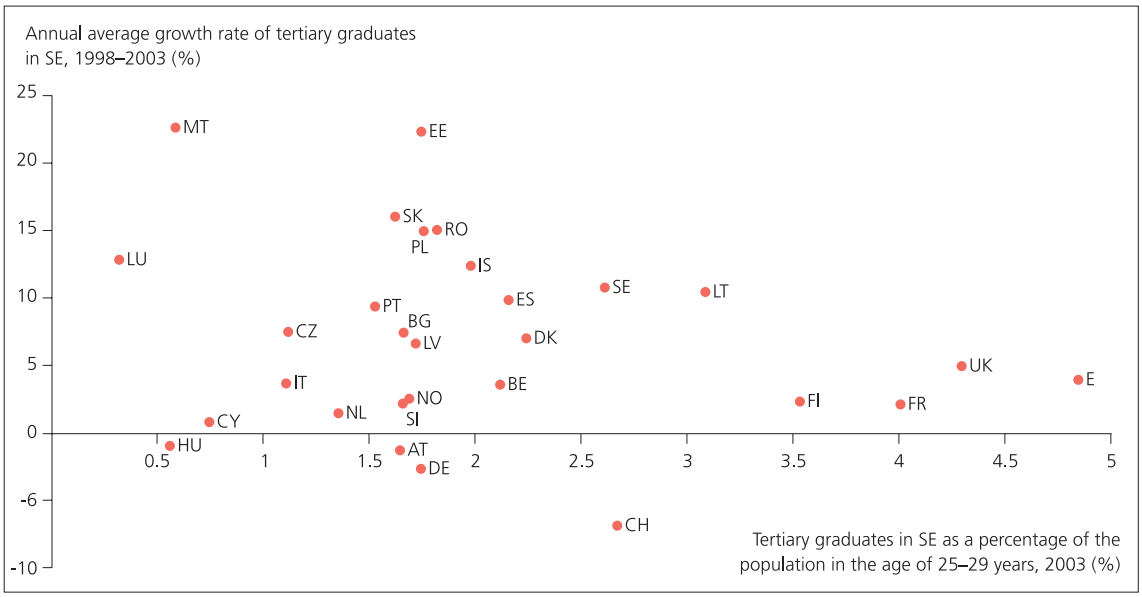
Table 3. Total and S&E workforce in Estonia, Sweden, Ireland and Germany

Country	*Total labour workforce (2004)*	*Total S&E work force (2004)*	*S&E workers as % of workforce (2004)*
Estonia	659,100	17,000	2.6
Sweden	4,512,000	270,000	6.0
Ireland	2,014,000	141,000	7.0
Germany	43,320,000	2,063,000	4.8

Source: Labour Force Statistics by OECD (2004)

Estonia is also behind EU25-average when it comes to the output of graduates in science and engineering subjects. However, as illustrated by the following figure, a good catching-up process from an initial very low position seems to be under way.

Figure 5. Share of tertiary graduates in science and engineering (SE) as a % of the population aged 25–29, 2003, AAGR of tertiary graduates in SE between 1998–2003, in EU-25 and other selected countries



Source: Eurostat Database

Admittance to science and engineering has increased over the last five years in Estonia (Table 4).

Table 4. Enrolment, admittance and graduates in S&E[15] in Estonia, 2000–2005

		2000	2001	2002	2003	2004	2005
Integrated bachelor and master courses	Enrolment	–	–	486	740	996	1286
	Admittance	–	–	378	381	405	430
	Graduates	–	–	13	10	10	6
Master courses	Enrolment	897	1086	1238	1390	1486	2189
	Admittance	421	470	533	586	549	1242
	Graduates	150	186	248	256	262	335
Doctoral courses	Enrolment	496	543	598	688	752	834
	Admittance	127	115	140	165	176	195
	Graduates	42	31	38	49	66	63

Source: Statistical Office of Estonia, 2007

Admittance to social sciences and humanities dominate; admittance to engineering was 56 (in 2005), physical sciences 51, life sciences 38 (in 2005), computer sciences (34) (Appendix 1.8). Among the graduates (118 in 2005) there were 15 graduates from engineering (19), 15 from life sciences and 5 from computer sciences (Appendix 1.9).

The Estonian work force engaged in R&D is still quite modest. The table below shows the Full Time Equivalents (FTE) spent on R&D by industry in Estonia, Sweden and Germany.

[15] *Science and engineering includes the following fields of education: life sciences, physical sciences, mathematics and statistics, computing, engineering and engineering trades, manufacturing and production, architecture and building. Integrated bachelor and master courses include only architecture and building.*

Table 5. R&D personnel in FTE in industry and in work force

Country	*R&D FTE in industry*	*FTE per 10.000 of work force*
Estonia (2004)	1.084	159
Sweden (2003)	49.000	1.086
Germany (2003)	330.000	762

Source: Statistical Office of Estonia and VINNOVA 2003

However, personnel engaged in R&D in business sector has grown more than twice over 1998–2004 and almost four times in the manufacturing sector, although it is primarily contributable to the low level of 1998 (when the R&D personnel in FTE was only 104 in manufacturing in total). Two fields of activities – manufacture of electrical and optical equipment and computer and related activities– have contributed to the growth the most (for detailed distribution of R&D personnel see Appendices 1.2 and 1.3).

Estonia faces an unfavourable situation regarding the age structure of HRSTE – 42% of the work force is between 45 and 64 years old.[16] This holds particularly true for academic institutions.

3.4 Shortage of skilled labour is a bottleneck for growth

Legislators, senior officials and managers account for 13% of employed persons, professionals 27% and increase may be observed over the years. Clerks and service workers account for 18%, skilled workers for 32% and elementary occupations 10% (Table 6).

Table 6. Employed persons, occupation and year

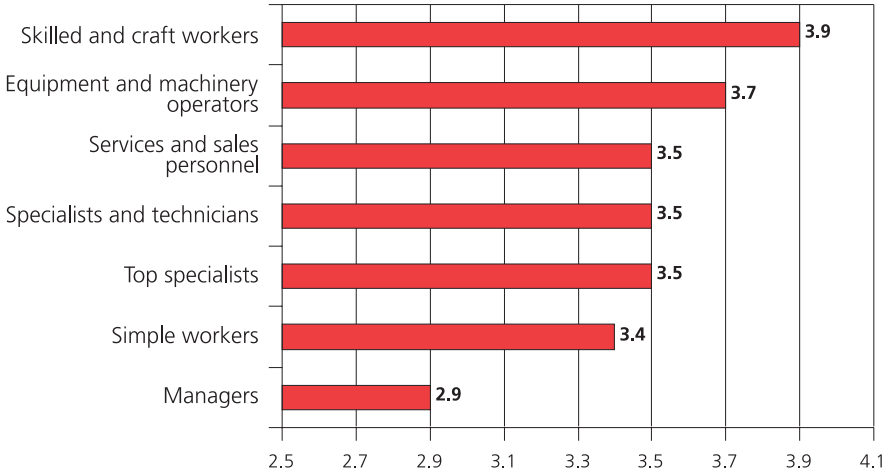
	1997	*2000*	*2003*	*2006*
Occupations total	617,2	572,5	594,3	646,3
Legislators, senior officials and managers	84,6	72,4	69,8	83
Professionals	69	75,7	82,6	94,8
physical, mathematical and engineering science professionals	10,8	16,3	17,1	20,8
life science and health professionals	6,5	8,7	7,4	10,1
teaching professionals	26	24,8	33,7	33,6
other professionals	25,6	25,9	24,4	30,3
Technicians and associate professionals	82,5	80,3	71,7	79,1
physical and engineering science associate professionals	16,8	20,9	11,3	13,2
life science and health associate professionals	14,8	11,9	15,8	10
teaching associate professionals	6,7	4,6	2,2	1,4
other associate professionals	44,3	42,9	42,4	54,5
Clerks	28,4	27	30,2	32,8
Service workers and shop and market sales workers	67	62,1	76,3	81,2
Skilled agricultural and fishery workers	28,3	21,3	15	11,7
Craft and related trades workers	105,8	90,7	93,6	100,4
Plant and machine operators and assemblers	80,9	79	83	94
Elementary occupations	68,4	62,5	68,4	65,1

Source: Statistical Office of Estonia, 2007

Various empirical evidence identified during desk research as well as interviews carried out during the project confirm that Estonian enterprises have major problems in finding suitable personnel; an extensive study among 2000 entrepreneurs confirmed that 70% of enterprises regarded finding skilled workers complicated as of 2005 (Saar Poll 2005).

[16] *Statistics in Focus, Science and Technology, Eurostat.*

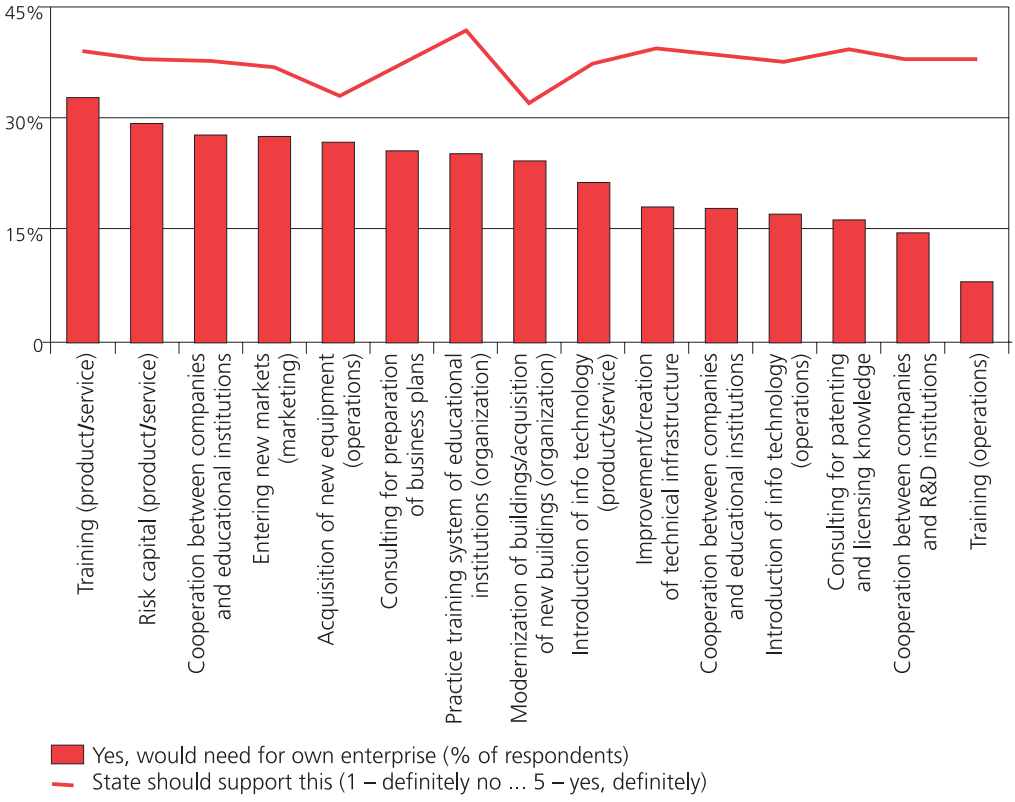
Figure 6. Finding employees (1 – very simple, 5 – very difficult)



Source: Saar Poll 2005, 34.

Another survey, conducted among 810 low-, middle- and high-technology manufacturers, resource-based industrial companies, and companies providing knowledge-based services in May-June of 2005 concluded that the primary development obstacle was the financing of innovations, then finding sufficient labour, as well as insufficient access to markets. If we compare the measures where the involvement of the state is most anticipated, then a large number of entrepreneurs have specified the weakness of the practice training system and the need to develop respective measures (Figure 7).

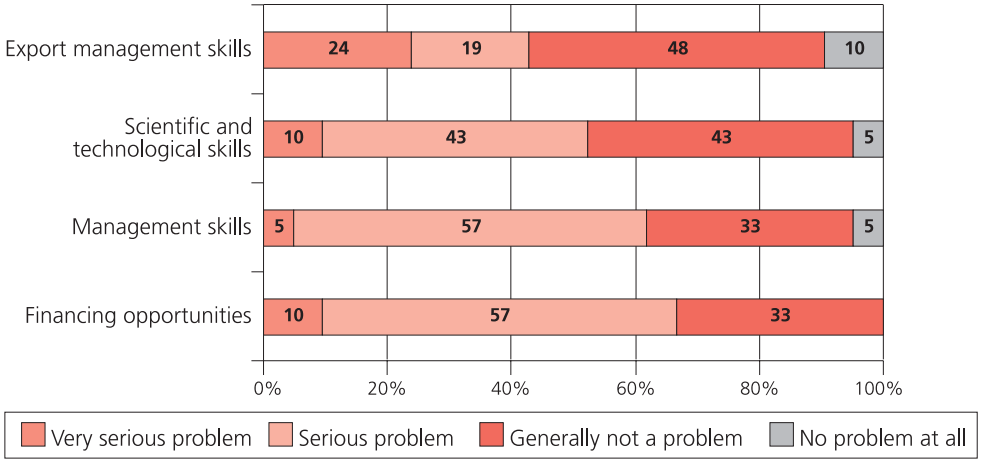
Figure 7. Highest-rated and desired support measures



Source: Jürgenson et al. 2005, 12

The problem is also crucial among companies that are undertaking R&D. In an impact evaluation of the R&D financing programme run by Enterprise Estonia, projects that were granted with funding in 2001–2004 were studied. The beneficiaries were asked about the main factors which inhibited the successful conduct of the project. The lack of management, scientific and technological skills was revealed (Figure 8).

Figure 8. Factors hindering successful implementation of the projects[17]



Source: Jürgenson, forthcoming 2007.

There are also many sector studies that have come to similar results. For example, more than half of the companies in ICT sector have mentioned that they cannot find the sort of people they would like to employ in the labour market. The problems include the lack of experience and the required level and motivation of employees (PW Partners 2002; see also Kalvet et al. 2002).

The shortage of a qualified labour force is exacerbated even more with some top specialists and skilled workers leaving for abroad (see 3.1).

There are various factors that have caused such a situation, e.g. lack of graduates of science and engineering (e.g. the share of graduates of science and engineering among youth aged 20–29 was 8.9 in 2004; compared to 23.1 in Ireland, 13.6 in EU15, and 12.7 in EU25), problems with curricula and minor focus on apprenticeships during studies (see Kattel and Kalvet 2006 for in-depth discussion on ICT education), etc. Such problems are now well known and steps to reinforce educational and research system are being undertaken.

3.5 Classification of companies and need for Mobility Support Measures

Considering the task at hand (elaboration of the mobility scheme) we have proposed the following division of Estonian companies based on the desk research and interviews carried out as well as considering previously applied methodological approaches (e.g. staircase model applied by MKM):

Table 7. Distribution of companies according to R&D&I performance

Type	*Comments and estimated size*
a. World-class or close to world-class, research-intensive companies	There are some 50 world class research intensive companies (type a) in Estonia. Such an assessment was made by various experts. Also, according to data from Archimedes Foundation there are 43 companies that have successfully co-ordinated or partnered in FP6 projects over 2002–2006. Type (a) companies belong mostly to the following sectors: information and communication technology, electronics, biotechnology, energy, environment, nanotechnologies (see table 2), but also to the chemical industry in general (according to Appendix 1.2).

[17] *Preliminary data.*

Type	*Comments and estimated size*
b. Internationally competitive companies with limited research but strong development capacity	Based on the estimation of different experts to expect the number of internationally competitive with limited research but strong development companies (type b) to be 150–200. Indeed, according to the Statistical Office the number of companies that have more then 9 employees and report of R&D costs is 204. According to CIS4 there are 39 companies with R&D costs between 5–10% of turnover and an additional 99 companies with R&D costs up to 5% of turnover that are co-operating with R&D institutions. From another perspective: there were 89 companies that submitted application for FP6 funding, but were not successful (Archimedes Foundation). Type (b) companies belong mostly to the following sectors: information and communication technology (incl. financial intermediation), electronics, chemical industry, manufacture of transport equipment, dairy industry, manufacture of metal as well as non-metallic mineral products (see also Chapter 3.2).
c. Competitive (growing firms) with limited development and no research capacity	We assume the number of competitive growing companies that have some development capacities, to be some 1,500. According to CIS4 the number of exporting innovative companies with more than 10 employees (2002–2004) is 1342. In addition, there are companies that are currently focused on the Estonian market, but about to break through to the world market; thus, we have enlarged the group by some 150 companies. Type (c) companies as innovative and exporting companies may be found in all economic sectors (Appendixes 1.5 and 1.6). For detailed overview of innovation performance of various economic sectors see CIS4 report on Estonia by Viia et al. 2007.
Non-growth companies	n/a

Current science, technology and innovation policy measures have mostly focused on universities and research-intensive companies, but it is of utmost importance to admit that many competitive and growing firms in Estonia have limited development and no research capacity, but can take advantage of product, process, organisational and/or marketing innovations in order to increase their crucial success in export markets. Such companies are currently in a development phase where they are looking for possibilities to move on into activities with higher added value and availability of skilled labour would allow them to rapidly move ahead in areas where they already have certain competence for development activities.

Based on interviews carried out during the project and following the typologies of companies the following rough skill needs have been identified:

Table 8. Need for additional competencies according to company types

Type	*Need*
a. World-class or close to world-class, research-intensive companies	Senior (top level) researchers; marketing specialists (marketing specialists usually have to have technical knowledge about the very research-intensive products – so a double profile is probably needed
b. Internationally competitive companies with strong development and some research capacity	Internationally experienced managers, people with product and technology management competence
c. Competitive (growing firms) with limited development and no research capacity	Internationally experienced managers, engineers, designers, innovation managers, international sales, other specialists
d. Non-growth companies	n/a

Fresh graduates cannot take such places as people who have acquired higher education – they need in-job training from a couple of months to a year before they meet the requirements and interests of companies.

As innovation and particularly R&D activities are risky and costly, there are many companies that cannot bear such risks, especially if there are possibilities to earn profits more easily pursuing activities that do not comprise much innovation, let alone R&D. It is of public interest, though, that companies be more innovative.

Although there are some mobility support schemes in Estonia (summary in Chapter 3.6), these are mainly directed towards supporting academic mobility or implementation of very R&D intensive projects (thus supporting mainly type (a) companies).

Introducing measures especially for type (b) and type (c) companies has been proposed earlier as well. For example, in 2002 the feasibility study "Establishing the basis for the elaboration of the Estonian design policy measures" suggested to launch a so-called "icebreaker program" to offer financial support to companies that for the first time buy professional design services from approved Estonian designers. Also, the analysis of the design and implementation of the Estonian RTDI policy (carried out by Technopolis in 2005) included a proposal for innovation policy measures for Estonia in 2007–2013 and emphasized the need for more human capital mobility. The study also offered a very preliminary description for the support measure, divided into two categories: 1) Recruitment of researchers in enterprises (required: industrial engineering or university degree in science); 2) Recruitment of innovation managers in enterprises (required: third level educational degree or certificate in technology, innovation or quality management, industrial design or an equivalent qualification).

3.6 An estimation of the future need for skilled people

It has already been established that Estonia is facing a serious labour market problem. Growing vacancies are strongly interrelated both with the age structure of generations as well as labour emigration. It is obvious that the population decrease both through demographic situation as well as labour emigration has resulted in serious labour shortage, especially what concerns specialists and skilled workers. This has been recognized as the main problem for the future labour policies to solve in Estonia. Many companies are in need of implementing new innovations and this will be accompanied by changes in the labour structure – more specialists and skilled workers are needed and less unskilled labour (in the current situation all kinds of labour force are needed, some companies are ready to employ unskilled people and train them by their own resources). Now the question arises – can the number of needed skilled workers be quantified? In the following section an attempt is made to quantify also the need of Estonian industry for skilled people in the coming years.

3.6.1 Labour demand prognosis

Recent research of the Estonian Ministry of Economics and Communication "Labour demand prognosis until 2012" points out the estimated numbers of the labour demand in economic sectors until 2012. It has estimated that there will be over 625.000 people in the age of 15–64 active in the labour market, which makes 26.000 new working places in 2012 compared to 2004 (average of 2003-2005). Among those the largest increase will take place among specialists (increase 19.200) and skilled workers (increase of approx. 7.000). Yearly it would mean about 3.800 new working places. In addition, in next years in average 11 000 employees will retire and therefore the yearly labour need will be about 14.5 thousand. At the same time, the labour force will be decreased by 44 000 people in 2012.

The prognosis also say that among all the sectors the overwhelming supply of working places will happen in production sector, where foreign specialists and skilled workers could be needed in the manufacture of basic metals and fabricated metal products; manufacture of machinery and equipment, and manufacture of transport equipment.

3.6.2 Science and engineers and researchers

R&D-fulltime equivalents (FTE) in Estonian manufacturing industry increased by 34% from 2001 to 2004. In absolute numbers there were 1.084 FTE in 2004. Manufacturers of electrical and optical equipment contributed to almost all of the given increase. In the service sector the increase was 155%. Here the sub-sector "Computer and related activities" contributed to most of the increase. In both cases the largest increase could be noticed from 2003 to 2004.

Figure 9. R&D FTE in manufacturing sector

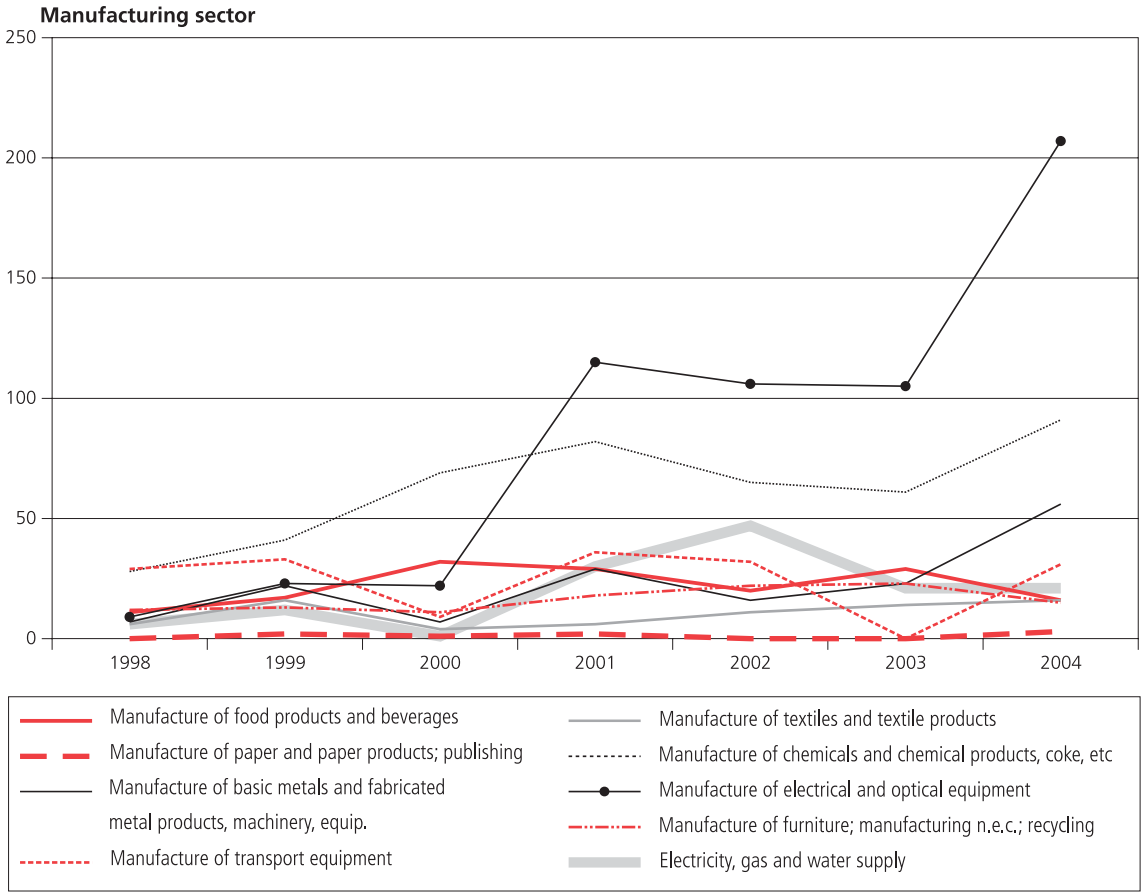
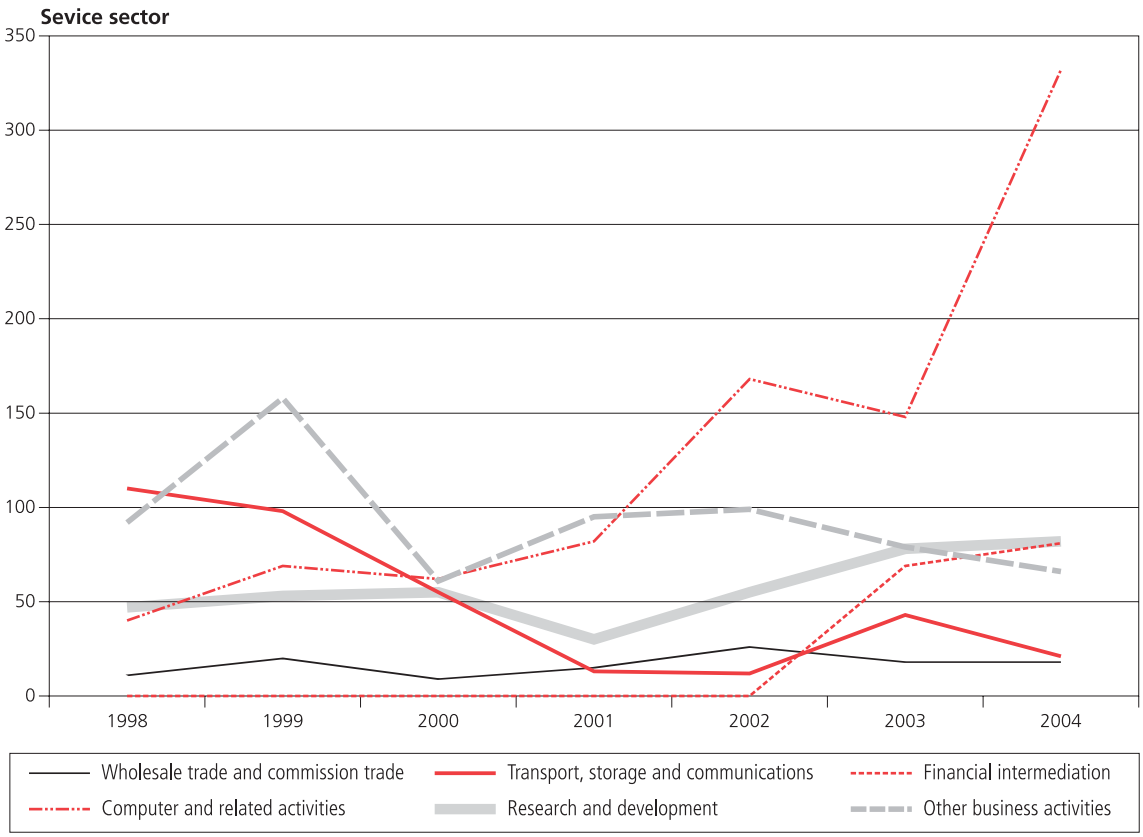


Figure 10. R&D FTE in service sector



It should be noted, however, that the volume of R&D carried out is still very low. There are only 159 R&D FTE per 10.000 of work force in Estonia compared to 1.085 in Sweden and 760 in Germany. The ratio of R&D FTE per person working in S&E is also low, 6% compared to 18% in Sweden and 16% in Germany. The number of companies undertaking R&D has also increased, from 141 in 2000 to 357 in 2005 and there is a rapid increase in their R&D intensity as well as illustrated by the table below.

Table 9. Development of companies carrying out R&D

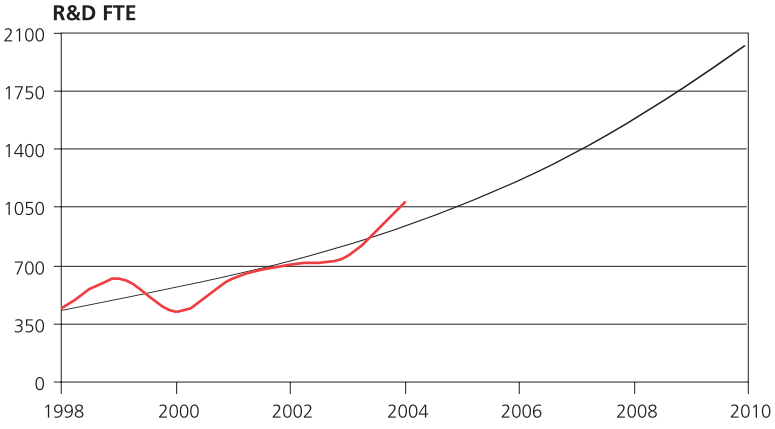
	Export/Turnover					Employees					BERD/turnover				
	Companies reporting BERD	*above 49%*	*30–49%*	*10–29%*	*below 10%*	*above 249*	*150–249*	*50–149*	*10–49*	*below 10*	*above 10%*	*5–10%*	*3–4%*	*1–2%*	*below 1%*
2005	357	69	31	37	220	33	20	54	97	153	111	16	21	51	158
2004	262	61	22	24	155	26	15	47	71	103	73	22	13	43	111
2003	236	43	16	22	155	25	19	44	47	101	54	16	17	34	115
2002	214	50	14	20	130	19	16	28	56	95	72	17	12	35	78
2001	202	43	25	18	116	25	12	37	49	79	67	18	10	43	64
2000	141	43	10	22	66	25	11	36	48	21	29	14	13	34	51

Source: Statistical Office of Estonia

Using time series to estimate the future need for S&E-people is an uncertain method, as there seem to be fluctuations in companies' R&D efforts over the years. Due to the small sample the large increases can be significantly influenced e.g. by a large investment by a foreign company, but also interpretations of R&D expenditures.

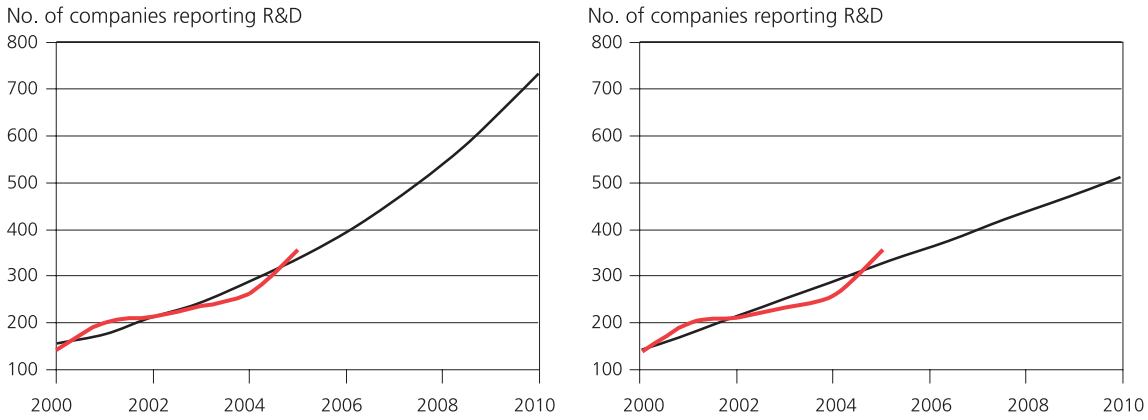
Nevertheless, available statistics indicate a strong increase in the demand for S&E-competence. A rough estimate could be that the 2004 number of approx.1,084 FTE will double in five years. One way of coming to this estimation is to assume an exponential development of the number of R&D FTE the coming years. This development is illustrated by the diagram below:

Figure 11. R&D FTE in manufacturing sector



Another approach to make an estimation of the need for R&D people is to assume that the ratio of R&D FTE and number of companies that report R&D activities will remain constant. Using the data available from 2004 this ratio is (1,084/262) 4.1 FTE per company reporting R&D activities. Applying a linear or exponential trend (as illustrated below) to the development of the number of companies reporting R&D activities the past years the need for R&D-people in 2010 is approximately 2,100 with linear development and 2,900 with exponential development.

Figure 12 & Figure 13. Estimation of the need for R&D FTE



However, these figures must be seen as an absolute minimum as research activities are likely to rise in the coming years.

In order to reach the same intensity of S&E workforce in Estonia as in e.g. Sweden (approx. 5%) a further 17,000 people must work in S&E-professions. The number of graduates in S&E was approx. 5,800 in 2005. Assuming a yearly retirement of some 3,000–4,000 persons it means that it will take 7–8 years before this level of S&E-workforce is achieved without importing work force. According to the objectives of the *Knowledge-Based Estonia 2007–2013,* the increase must be even higher: According to the Strategy Estonian total R&D expenditures are expected to increase to 3.0% by 2014; the share of enterprises (BERD) 1.6%. By 2014 the share of R&D (researchers and engineers) personnel is expected to rise to 8 per 1,000 employees.

It should also be pointed out that even if the number of new S&E-graduates develops in a satisfactory manner this will not solve the problem of availability of experienced people in the short run. The proportion of the population in Estonia with Science and Engineering education is biased towards the ages 45–64.[18] The yearly net contribution of some 2.000 S&E-persons is therefore not perfectly matching the needs of the industry. Assuming that the 3.000–4.000 persons retiring can not be replaced completely by new graduates it will cause a lack of people that can easily amount to 2.000 persons per year during a 5–7 year period.

[18] *Statistics in focus, SCIENCE AND TECHNOLOGY 11/2006 (Eurostat)*

4 Discussion and conclusions

The present chapter discusses, based on the theoretical framework of Chapter 2 and on the analysis of the Estonian situation given in Chapter 3, the policy rationale for public intervention in the given area in Estonia. The discussion, in turn, provides the basis for a set of implications regarding the design of a recruitment and mobility scheme for Estonia.

4.1 Is there a policy rationale for a mobility/recruitment scheme in Estonia?

Assuming that the assumption holds true that skills are crucial to enable innovation, Estonia seems to be facing two problems that prevent the country from utilising its full economic potential:

- Industry demands more skilled people than the Estonian educational and vocational system is able to produce.
- Parts of the Estonian industry lack motivation to employ skilled people who could help boost innovation.

Now the question arises if these problems are of such nature that they motivate policy intervention. In general the policy rationale for intervening in private sector innovation processes through mobility/recruitment schemes can find support both in neoclassical theory and in the Systems of Innovation (SI) approach. It is far beyond the ambitions and scope of this study to elaborate on innovation policy theory but the fundamental arguments for why policy intervention is motivated will be presented nevertheless.

The first problem is a typical system problem or system failure (as opposed to market failure, which typically concerns individual organisations). To use the vocabulary of SI-policy theory the Estonian educational system seems to be facing what is termed "Infrastructure provision and investment problems" as well as "Transition problems" and "Network problems" meaning in short that:[19]

- Historically, investment in higher education and vocational training has been too small (Infrastructure provision and investment problems)
- Investments have been made in areas not always favourable of innovation and market-orientation.
- Linkages between organisations of the innovation system (such as companies and R&D-institutions) have been and probably still are too weak to allow efficient knowledge transfer.

In terms of rationale for policy intervention the second issue can be motivated relying on neoclassical market failure arguments such as:

- Companies do not employ staff with innovation skills because they are uncertain about the outcomes of what this type of staff can contribute with.
- Companies are reluctant to employ innovation staff because they are uncertain of how to protect the outputs of the innovation process.
- Companies are unwilling to make the initial necessary investments in order to produce innovations.

However, this reluctance can also be attributed to system problems such as weak capability of companies to adapt to new situations such as global competition, changing market demands, etc. A crucial point, which is out of scope of this study but nevertheless should be mentioned, is regulatory-related problems (such as red tape) that seem to discourage Estonian companies from employing in particular foreign experts.[20]

On a more pragmatic level the justification of public intervention in areas related to innovation can be tested by applying the following questions to the given "issue" (here the fact that Estonian industry needs skilled people in order to continue growing):

- How important is it to Estonia or Estonians that the problem is solved in a short time frame?
- Will the problem solve itself in a short time frame?
- Could public intervention make a difference at reasonable efforts?
- Can other policy measures solve the problem in a more effective and efficient manner?
- Can public support be maintained until the situation improves?
- Would it be possible to assess the contribution of public support to solving the problem?

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[19] *Some of these systemic problems mentioned in the literature include (Norgren and Haucknes, 1999: Smith 2000; Woolthuis, Lankhuizen et al. 2005):*

[20] *The study" Conditions of Entry and Residence of Third Country Highly-Skilled Workers in the EU. SMALL SCALE STUDY III. ESTONIAN MIGRATION FOUNDATION. TALLINN OCTOBER 2006" points out that in particular extensive red tape in issuing work permits hampers the employment of foreign experts.*

In Chapter 3 we have shown that large parts of Estonian industry consider the lack of skilled people a bottleneck for growth. This holds true for as good as all types of companies – from low to high tech. Consequently, it seems to be of strong national interest that industry's access to skilled people is improved.

Recent efforts in strengthening the education system will improve the availability of people with a science and engineering background in 4–6 years time. At the same time, however, the age distribution of Estonians implies that a significant degree of retirements will take place in the coming 10-year period. The consequence will be a work force with quite a lot of people with limited experience and a large cohort on the doorstep of retirement. The problem of availability of experienced people will therefore not be solved within at least a ten-year period or probably longer. A consequence of this is that even if other measures are necessary to counter the problem, recruitment schemes aiming at increasing availability of skilled people seem inevitable to Estonia, at least in the short run.

In the European perspective there is quite a lot of experience in recruitment and mobility schemes, in particular focusing on the mobility of researchers and graduate students. Although both bad and good practice may be found, the general conclusion must be that such schemes work quite well, i.e. additionality[21] is high, although they are relatively heavy to administer and deliver. At this point it should be pointed out, however, that a recruitment and mobility scheme is a rather advanced intervention tool suitable for:

- companies that have the capability to absorb the skills provided by the new staff member and,
- companies that are committed to strategic development and innovation.

A general experience made is that larger companies tend to make more use of mobility schemes than SMEs do. This can be explained largely by the higher absorptive capacity of larger companies and by the fact that most mobility schemes in place emphasise recruitment of researchers. Consequently a key risk for any mobility-promoting scheme is that it may be difficult to involve smaller companies, which normally is the primary target group. A short list of success factors for mobility and recruitment schemes would be:[22]

- Unbureaucratic programme management, in particular regarding application procedures, cost reporting and reimbursement regulations.
- Strong technical assistance, including in-process support to applicants during the entire cycle of activities, from application to final report. Please refer in particular to the experiences of the Danish industrial PhD-programme and CIFRE (France).
- Strong visibility of the programme. To reach all target groups the programme must be marketed in a proactive way.
- Strong networks. Mobility and recruitment schemes are characterised by a match-making activities. The programme management organisation must have access to strong networks, both domestically and internationally, in order to facilitate the given match-making.

In Estonia there are a number of on-going policy measures in areas related to mobility and recruitment. The most important ones are listed in section 4.2. In section 6.5 an attempt is also made to estimate potential synergy effects of a new recruitment/mobility scheme and existing schemes. In short it may be concluded that on-going measures do not address the full range of mobility as outlined by the terms of reference of the present study. Existing measures primarily target mobility (also internationally) of researchers between research-institutions or indirectly by subsidising companies' costs for R&D-projects (which may include external staff costs). There are no schemes directly supporting the mobility/recruitment of skilled people and in particularly not mobility from abroad to Estonia.[23]

Another question is if there are more appropriate mechanisms for promoting the recruitment of highly skilled staff. A different path could be to offer all companies employing skilled people tax-related subsidies such as double deduction possibilities for employment costs. However, such instruments seem to be less suitable for Estonia. For a start wage subsidy is probably a more powerful tool, in particular since such intervention also positively influences the cash flow of companies. For SMEs struggling with low profit margins this may be a decisive factor for employing or not.

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[21] *Meaning that the companies would not have recruited without the scheme support. Please refer to Appendix 2 for more information about good practice measures.*

[22] *Please refer to appendix 2 for more in-depth information on international good practice schemes*

[23] *For more details please refer to ESTONIAN MIGRATION FOUNDATION. EUROPEAN MIGRATION NETWORK. Conditions of Entry and Residence of Third Country Highly-Skilled Workers in the EU. SMALL SCALE STUDY III. Tallinn October 2006.*

Typically, public policy measures are time limited. The time frame should be set in such a way that the objectives of the measure could be achieved. For measures aiming at mobility and recruitment there could be different objectives (please refer to Chapter 2 for a more elaborate discussion on objectives). In the case of an Estonian scheme the objective should be to enhance the availability of skilled people to Estonian industry as well as to provide a final incentive for companies committed to innovation and change. The time frame for achieving this objective is at least five years. A scheme funded by the structural funds programme of 2007–2013 therefore offers a sound basis.

Regarding the issue of measuring outputs of a mobility/recruitment scheme in terms of company competitiveness this is a well known problem related to the fact that it is very difficult to isolate e.g. an increase in profit or turnover to the contribution of one staff member. In general it may be possible that one innovation manager can have enough power to activate innovation activities and processes in the firm but how to assess this? It is possible if companies involved in the schemes are questioned on a continuous basis, e.g. annually or biannually. In Chapter 4 a comprehensive evaluation framework including indicators is described.

Table 10. Existing instruments in Estonia to support mobility

Programme	*Essence*	*Eligible to participate*	*Mobility aspect*	*Managed by*	*Budget (2004–2006, MEUR)*
R&D financing programme	**Support scheme for market oriented R&D projects.**	**Companies, R&D institutes**	**Possibility to employ research staff (incl. PhD students) for R&D projects.**	**Enterprise Estonia**	**16.0**
Competence Centres	**Funding of staff and investments in machinery and equipment for industrially relevant R&D projects.**	**Companies, R&D institutions**	**Mobility between R&D institutions and business sector is one of the sub-objectives.**	**Enterprise Estonia**	**6.4**
SPINNO	**Creating spin-off companies.**	**R&D institutions, institutions of higher education**	**From research to private sector.**	**Enterprise Estonia**	**3.9**
ESF measure 1.1	Among other issues, doctoral schools and hiring of foreign lecturers is supported.	Educational institutions	Supports academic mobility.	Innove	
R&D financing programme	Support scheme for market oriented R&D projects.	Companies, R&D institutes	Possibility to employ research staff (incl. PhD students) for R&D projects.	Enterprise Estonia	16.0
Competence Centres	Funding of staff and investments in machinery and equipment for industrially relevant R&D projects.	Companies, R&D institutions	Mobility between R&D institutions and business sector is one of the sub-objectives.	Enterprise Estonia	6.4
ESF measure 1.1	Among other issues, doctoral schools and hiring of foreign lecturers is supported.	Educational institutions	Supports academic mobility.	Innove	
Kristjan Jaak	Supports international mobility of researchers.	Master and doctoral students as well as lecturers.	Mobility is the core of the programme but it includes only academic mobility.	Archimedes Foundation	0.03 (2004)
Tallinn City Apprenticeship scheme	Favours mobility between vocational schools and enterprises.	Educational institutions (enterprises as partners).	Focus is on vocational schools and skilled and craft workers.	Tallinn City Government	
NordProLink – Nordic Professional Links	Short-term apprenticeship in Nordic SMEs.	Employees of SMEs	The impact of the programme is rather educational for employees of SMEs.	Nordic Council of Ministers	
Internship Exchange	The Internship Exchange of the ITC is designed to match the ITC student's educational goals with hosting organisations needs.	IT College students and ICT companies.	Mobility aspect is strong but its impact is limited as it concerns only the field of ICT.	IT College	1.2 (2006)
Nordplus Neighbour	Mobility and network programme. Its objective is to develop networks between educational institutions, research institutions and non-governmental organisations in the field of education and lifelong learning.	Educational institutions, research institutions and NGOs in the field of education and lifelong learning.	Mobility of all stakeholders in the field of education.	Nordic Council of Ministers	

[24] *Programs aiming at mobility as main goal and having companies as direct beneficiary are marked in bold.*

4.3 Which of the available policy measures are appropriate for Estonia?

Recruitment and mobility policy measures can be categorised as according to different factors of which the most important are:

- The prioritised goal of the measure
- The source of people targeted by the measure
- The type of company targeted by the measure

Goals can be of two fundamental categories. 1) Labour market-oriented, e.g. increase employment, 2) Growth-oriented, e.g. increase competitiveness of companies by strengthening the internal knowledge base. These measures usually target so-called skilled people.

The source of people can be either international or domestic. Measures (such as mobility and recruitment schemes) that source people domestically usually work only in labour markets with a general surplus of work force or a surplus in specific domains such as public research.

Companies targeted by measures are normally SMEs as large companies are considered to be able to solve recruitment on their own. However, companies' growth potential and knowledge-absorption capacity is also important, in particular when it comes to growth-oriented measures and recruitment of skilled people.

Here follow the conclusions regarding some common types of mobility/recruitment measures that are in use today and their relevance to Estonia. The primary focus is on growth-oriented measures.

4.3.1 Skilled workers migration schemes

Context and key challenges

Systematic approaches to skilled worker migration can primarily be found in countries with a high immigration pressure such as the US, UK, Canada and Australia. Here, migration schemes targeting skilled people have been in place for quite some years now. Fast growing economies such as Ireland and Singapore have introduced measures more recently and in a few of the new European member states the introduction of measures is discussed.

The normal "mechanism" of a migration scheme is to offer a fast track to work permit for people that fulfil certain skill levels. Some schemes also offer additional advantages such as work permit for spouse and the possibility of permanent citizenship.

Relevance to Estonia

Migration schemes for skilled people are highly relevant and important for Estonia but probably more in a mid- to long-term perspective than for achieving fast results in terms of inflow of skilled people. On the one hand every skilled migrant is welcome and there is definitely a need to modernise migration policy. On the other hand it is unlikely that even a pro-active migration policy and strong efforts in international marketing would increase significantly and rapidly the number of foreigners seeking working permit in Estonia. An exemption to this assumption may be skilled people from Russia or NIS-countries as can be people from other new EU-member states.

Regardless of the time horizon and the origin of potential immigrants Estonia needs to up-grade its migration policy. Several of the people interviewed complained about the difficulty of employing non-Estonians and expressed a belief that migration policy is protecting a labour market that does not need protection at present time. In particular the lack of skilled workers is a strong argument for relieving migration rules at least for people fulfilling certain skill levels.

Conclusion: Migration schemes are not the core of this study but a modernisation of Estonian migration policy to specifically address the issue of skilled worker deficit is necessary.

4.3.2 Repatriate schemes

Context and key challenges

Repatriate schemes aim at bringing back, on short term or permanent basis, people who due to some reason have left the country (expatriates). Normally such schemes are aimed at skilled people who are expected to contribute to growth and prosperity through their experiences, networks and knowledge.

Typically concerted repatriate measures are taken by developing countries and there are also major initiatives of the United Nations and countries with colonial history. The repatriate scheme builds on the emotional and cultural ties of the expatriate to his native country and normally offers some kind of service package when this person returns to the home country to work. A package can include e.g. wage subsidies for the company, spouse employment, health care services etc.

Relevance to Estonia

Although the new European members are better positioned than the typical states deploying repatriate measure this instrument should be highly relevant to Estonia in its effort to increase the availability of skilled people in the medium-term perspective. An estimation provided by the Estonian Ministry of Social Affairs gives at hand that in the period May to December 2005 about 25.000 Estonians were working abroad on a longer term or even permanent basis. Most of them can be found in Finland and in the UK but also in Ireland, Sweden and Norway. This constitutes around 2,6% of the total labour force. A rough estimation is that 30–40% of these are skilled workers whose competence would be valuable contribution to Estonian companies.[25] A few cases of repatriation can also be observed in very strong Estonian sectors such as biotechnology. These examples prove that repatriation is possible and indicates that a systematic approach has good chances of being successful.

Conclusion: A repatriation scheme equipped with financial resources of the structural funds programmes could be a valuable instrument for attracting skilled people (back) to Estonia.

4.3.3 Researcher mobility schemes

Context and key challenges

The recognition of science for technological breakthroughs providing the fundaments for marketable innovations is a corner stone in modern growth policy. At the same time science and industry often represent two separate worlds. Traditionally, the policy answer has been intermediary organisations transferring technologies from research institutions to companies, mostly in a linear way and with debatable success. In recent years the approach has shifted towards trying to enhance a more direct interaction between science and industry by supporting mobility of researchers (public and/or private). This makes sense because human resources are the most important instrument for innovation, and mobility of personnel is an important way to foster inter-organisational learning. However, this is a rather new policy field and statistical data proving success is scarce. One thing suggested by the literature is that any policy addressing human resource mobility is especially relevant for larger firms and for high technology firms.

During the past 5–8 years many European states have launched measures promoting science-industry mobility, e.g. through direct means such as industry PhD-programmes or indirect e.g. through competence centres.

Relevance to Estonia

In general there is certainly a need to raise the level of research competence in Estonian industry, which clearly under-spend when it comes to investments in research and development. The key reasons for this were described in section 3.2. Changing the given situation is a delicate, long-term task that demands a wide range of different policy measures of which mobility of research-trained people is one.

[25] *There is, to our knowledge, no verifiable data regarding the educational- or skill level of Estonian expatriates. However, approximately one-third of the Estonian work force has a tertiary education and there is no reason to believe that expatriates are less educated than the average Estonian.*

There are a number of initiatives aiming at strengthening science-industry linkages through people, both directly and indirectly. Examples are the Competence Centre Programme, SPINNO, ESF measure 1.1, etc.[26] Furthermore, Enterprise Estonia runs programmes that support companies' collaboration with research institutions by offering reimbursement of costs for researchers. To our knowledge there is no scheme that supports more permanent mobility of researchers to industry. Such a scheme would make sense if it targeted younger researchers (before they advance too far on an academic career) since companies are reluctant to pay full costs for inexperienced researchers with limited industrial experience – here a support scheme could provide a necessary incentive.

"Companies are interested in research competence but not in 25-year-old PhDs"
(Director of a Competence Centre)

On the other hand, the number of companies with a capacity to absorb research competence is still relatively limited.[27] According to CIS4 (see Chapter 3) we are speaking about some 200–250 companies nation-wide.

Any measure promoting mobility of researchers from science to industry must take this fact under consideration in order to avoid weakening the research base. This could be achieved if there are complementary investments in the R&D-base and if a researcher mobility scheme contributes to additional PhD-positions and not just shift existing ones from academic institutions to industry.

Conclusion: A scheme directly promoting science-industry mobility, e.g. by industrial PhD-positions, should be launched only if such PhD-positions are in addition to the existing ones and preferably in combination with further investments in the research-base.

4.3.4 Recruitment of skilled people schemes

Context and key challenges

Direct measures aiming at strengthening companies' willingness and resources to employ skilled workers (coming from non-research institutions but regardless of if they are sourced internationally or domestically) for the purpose of boosting innovation capabilities are rare in the European innovation policy. The exception is made in case there is a need to support the labour market in times of high unemployment (see below Labour market schemes). The reason for this is the fear that such a public intervention will distort a free labour market. There are also good grounds to doubt the sustainability of positive effects of such schemes in companies when the subsidy is stopped – will the company be able to continue paying the wage?

On the other hand, there are situations where there is a policy rationale for such schemes. This could be e.g. smaller companies looking to employ specific purpose experts for a limited time period and for well defined projects such as the introduction of new product/service development processes, the change of organisational set-up, company strategy development, etc.

Relevance to Estonia

As shown in Chapter 3 there is definitely a strong demand for skilled people below the level of researchers in Estonian industry. In fact the main bulk of companies with development potential will be much more attracted by a scheme that provides support in employing skilled workers than researchers. The problem is how to avoid distorting the labour market. As long as people can be sourced from outside Estonia the problem is less imminent (but still existing). If the scheme allows companies to source from within Estonia there is a risk that it will drain some companies of competence while giving it to others, which might be less competitive in the market. In worst cases this could have a serious negative impact on Estonian industry.

Conclusion: A skilled people recruitment scheme could enable innovative Estonian companies to recruit top-class people but care must be taken to prevent distortion of the labour market.

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[26] *For more examples please refer to Chapter 3*

[27] *Meaning that companies need a certain level of development resources, equipment and competence in order to fully profit from research collaboration.*

4.3.5 Labour market schemes

Labour market schemes are typically put in place to support weak labour markets in times of high unemployment. The primary aim of such schemes is not to reinforce competitiveness of companies but to get people employed. A wage subsidy to the employing company is the usual financial instrument used.

In general the skill level of people is of secondary importance for this type of scheme but there are also schemes targeting skilled workers such as unemployed academics. Again, however, such schemes are normally used in cases of labour force surplus and therefore of less relevance to Estonia today.

Conclusion: No need to implement labour market schemes targeting skilled workers in Estonia today

4.4 Implications and success factors for an Estonian mobility and recruitment scheme

In general the idea of launching a recruitment and mobility scheme is welcomed by all interviewees. However, a number of issues and concerns on high as well as low level of abstraction were raised. Detailed comments[28] will be addressed through the design of the specific schemes. Below more fundamental aspects that any scheme needs to take under consideration are listed:

1. A recruitment and mobility scheme may not distort a free labour market

Estonia faces work force deficit. This does not mean that there is no unemployment at all. However, unemployment is low and of structural character. In other words, the volume of "free" work force of skilled people to utilise is very limited. This is in stark contrast to the situation in e.g. Germany where unemployment is relatively high also among highly educated people.

The key implications for the scheme to be designed are that the financial instruments put in place must not disturb the free labour market. Recruitment of people domestically would primarily be a reshuffling of people where one company loses and the other wins. A net-contribution of skilled people is necessary.

"Mobility is good if people come to us and bad if people leave us"
(Managing director of an Estonian IT-company)

2. One size does not fit all – there is a need for a portfolio of measures

In a growing economy most companies and organisations look to employ. However, the skills wanted differ significantly depending on how advanced companies are with regards to innovation and development.

Key implications for the recruitment scheme are that there is a need to design different approaches (in particular regarding the source of people) in order to effectively address the needs of the different types of companies.

3. From nothing comes nothing – A set of different measures aiming at increasing the availability of highly skilled people is necessary

a. Estonia needs to reinforce its educational and research system
Even if the future recruitment scheme is successful in attracting foreign specialists and in promoting a more intense flow of research-trained people from research and higher education institutions to industry, the fundamental problem of labour shortage must be addressed as well. This should be done on two levels:
- By strengthening academic education as well as vocational training in areas relevant to Estonian industry.
- By investing more public resources in research. This is a crucial measure also to the recruitment scheme since the average age of scientists in academic institutions is high and the re-growth of younger people is weak too. A recruitment scheme addressing the mobility of researchers may drain the research system of scarce resources.

[28] *E.g. how to avoid that funds are used for purposes not intended by the scheme. A key issue may be how to assess the actual skill of a person.*

b. Estonia needs to reinforce its vocational training system
Without going into details the present study did intercept several negative comments from companies regarding quality and contents of the vocational training offer available. In particular low industrial relevance is considered a problem.

c. Estonia needs to address the domestic sector brain drain, i.e. skilled people working in other fields than their real expertise. However this is the task of the educational and research system.
This unwanted labour market mobility is not automatically bad but it does indicate a mismatch of education and demand from companies leading to sub-optimal usage of resources invested in education.

4. The success of a mobility/recruitment scheme is depending on solid support- and accompanying measures

International good practice shows that the success of direct policy measures is dependent on the professionalism of the support offered to companies and individuals of the scheme's target group. E.g. it is futile to design and launch a repatriate scheme if there is no one promoting it outside Estonia.

The organisation managing the scheme must therefore have:
- The necessary resources to provide sufficient volume of support
- The necessary competence to offer the right quality of support
- The necessary networks, mandate and acceptance in order to deliver the support.

5 Scheme descriptions

Based on the sources of people and the type of skills sought, three different types of support measures are considered suitable to help Estonia in competing in the global race for talent. These are:

- Support to Recruitment of research-trained personnel
- Support to Recruitment of international expertise
- Support to Recruitment of specific purpose specialists

We suggest that these support initiatives are considered to be different variants of the same scheme and that they are managed within the same organisational umbrella. By doing so there is a chance to profit from synergy effects, in particular regarding applications procedures and technical assistance to applicants.

In the following, each scheme is presented with a similar structure. First part is describing the scheme framework: its rationale and the addressed challenge, the scheme target and focus areas, expected results or impact. The second part elaborates operational aspects and how the scheme implementation could be organised. The third part estimates the financial aspects related to schemes as well as monitoring and evaluation aspects.[29] After the scheme description two sections on organisational issues and application procedures follow.

5.1 Type 1 Scheme – Recruitment of research-trained personnel

5.1.1 Framework

Rationale and overview	There is a need to strengthen the links between science and industry in Estonia. In particular it is necessary to: ■ Increase the industry relevance of public research ■ Increase the employability of younger researchers in industry ■ Increase companies' capability to utilise researchers and research results ■ Create lasting relations between companies and R&D-institutions For this purpose the so-called Industry PhD-scheme should be designed. The scheme makes resources and infrastructure available to companies for employing a PhD-student. The student is supervised by an academic supervisor and there should be a contract between the company and the R&D-institutions regulating the utilisation of equipment and the sharing of IPR. The source of people is primarily higher education and research institutions, both Estonian and foreign. The scheme should mainly contribute to the strengthening of PhD-student education in Estonia, not to a transition of academic PhD-positions to industry.
Scheme objective and expected results	To upgrade technological capacities of enterprises and to maintain contact to research laboratory by subsidising mid-term part-time employment of research personnel by companies. Based on the estimations made earlier in this report the target group size is assumed to be 125–150 companies at present time (all type (a) companies and half of the type (b) companies). With reference to similar schemes implemented in other European states the objective should be to activate 10–20% of the total target group in the scheme every year. Assuming that the target group will double within two years the expected "deal flow" of this measure should be as follows: 2007: 10 contracts 2008: 20 contracts 2009: 40 contracts

[29] *Financial and funding estimates are based on a very simple model. The scheme is assumed to cover primarily wages costs (wage subsidy schemes) to a ceiling amount not exceeding 50% of the normal market wage of the skill category in question. The total cost is the number of cases per year times the subsidy. Of course the cost model must be further refined and also include the administrative costs of the scheme.*

Risk assessment and management / Key challenges	■ Could be regarded as brain-drain instrument by research institutions ■ May be a limited number of applications, at least initially ■ Universities may not be able to produce required experts to meet the demand in specific fields. This risk can be managed by focusing also on PhD-candidates from foreign universities. ■ Companies do not have competences to make good use of the research-trained personnel ■ The results end up isolated cases and do not have effect on the industry relevance of public research in general

5.1.2 Implementation

Application	The company applies for co-funding based on a project description presented in a standardised application form. The relation to the research institution must be described in detail. Calls for applications should be continuous with evaluations each or every second month.
Selection criteria	■ Strong absorption capacity within company. This probably means that there is already a (R&D)-unit within the company. ■ Threshold level of investments in R&D, 3–5% of turnover ■ Dedicated industrial mentor (strong CV, time committed to the project) ■ Contract between company and R&D-institution regulating the utilisation of equipment and sharing of IPR ■ International scope/potential of the thesis ■ Added value for the Estonian R&D-base, i.e. the industrial funding should lead to additional PhDs, not to that funding is enlarged for already enrolled PhDs.
Promotional activities	Promotional activities will be very important in order to raise a satisfactory number of applications. The management group should design a marketing plan that could include e.g. home page services, information events and industry brokerage seminars for candidates, databases of companies and PhD-aspirants, study trips, written material, etc. Promotional activities should also be directed towards selected foreign universities. The management groups should also be active in assisting companies in formulating PhD-thesis and in helping in particular SMEs in negotiations with R&D-institutions. The management group should also assist both sides in IPR-related issues.

5.1.3 Administration and monitoring

Tentative scheme budget and time frame	The budget for co-funding PhD-positions is based on the assumption that each PhD costs 30.000 Euro per year and that an additional 20% of this cost is reserved for expenses such as travels, publication costs, conference fees and other costs necessary for the work proposed. Based on this the budget for co-funding PhDs are as follows: 2007: 180.000 Euro 2008: 540.000 Euro 2009: 1.260.000 Euro
Budget for technical assistance	In accordance with the recommendations to provide strong technical assistance we suggest that two to three persons work full-time on managing this measure. The distribution of staffing could be as follows: Enterprise Estonia: 1 full time equivalent External Estonian Expert: 1 full time equivalent International expert: 0,5 full time equivalent The yearly budget for external experts should be in the range of 100.000–150.000 Euro per year. The international expert would contribute to identifying experts abroad and to assist in negotiating with them.

Financial incentives and eligible costs	50% of companies' direct personnel costs + possibly other costs such as travel and accommodation are reimbursable. Wage cost reimbursement should be limited to a "normal" PhD salary plus additional direct wage costs (presumably totalling 20.000–30.000 Euro per year) + 10% deviation in specific cases. It should also be possible to reimburse foreign PhD-students. Here costs can be estimated to approx 40.000–45.000 Euro per year. It is assumed that the number of foreign PhDs will be rather limited and thereby cause no consequence for the total scheme budget. Co-funding is provided for three years with a decreasing funding rate for companies with more than 100 employees. Companies with less than 100 employees could be offered soft loans to counter negative liquidity effects and/or to help boost accompanying investments in research equipment.
Impact, effects and indicators	Main effects: increased use of research trained personnel in the targeted companies and the industry in general, increased collaboration between companies and public research institutions Main impact: increased innovation orientation of enterprises, increased industry relevance of public research Impact indicators: number of participating PhDs hired permanently at the end of the contract, number of firms with increased expertise in conducting in-house R&D, share of R&D personnel in the target group of enterprises, share of R&D expenditure in the target group of enterprises, number of PhDs in target group of enterprises Operational indicators: successful organisational setup, number of contracts with PhD students, number of projects perceived as successful by enterprises

5.2 Type 2 Scheme – Recruitment of international expertise

5.2.1 Framework

Rationale and overview	Estonian companies lack several skill categories that could be retrieved from abroad if the working conditions offered would be attractive enough. To these categories belong e.g. senior industrial researchers, senior managers, engineering specialists and international sales managers. There is a fierce global competition for such competences, though and Estonia may not be the first choice for this kind of "knowledge mercenaries". To reach success it will therefore be important to carefully design a scheme that supports companies in attracting highly skilled people from abroad. Within this context expatriate Estonians may prove to be a both promising and important target group, but also foreign companies and international research institutions or public sector institutions are important sources of people.
Scheme objective and expected results	Raising the competitive edge of Estonian companies by enabling them to employ on a medium to long-term basis internationally acknowledged specialists. Based on the estimations made earlier in this report the target group size is assumed to be 250–300 companies at present time (half of type (a), all type (b) companies, 5% of type (c) companies). It is expected that the support provided by the given measure contributes to the following "deals" in the respective year: 2007: 10 cases 2008: 20 cases, 2009: 30 cases

Risk assessment and management / Key challenges	■ May distort the labour market due to the offering of above-market wages to certain employees; ■ May be limited number of cases, at least initially; ■ Other support measures do not support that the expert stays in Estonia (social relationships, employment prospects for spouses etc). There is a significant need for supporting services, e.g. for finding candidates and for developing "attraction packages"; ■ External changes in factors such as politics, legislation or reputation (e.g. lack of tolerance) negate the efforts of the scheme; ■ A possibility of "over-education" in certain fields prevents the possibility of finding enough jobs that correspond to education of highly skilled people in Estonia.

5.2.2 Implementation

Application	The company applies for co-funding based on a project description presented in a standardised application form. The core part of the application is a detailed business plan showing the projected development to the company and how the new skills will contribute to this. The application should include at least a Memorandum of Understanding from the foreign specialist in question. Calls for applications should be continuous with evaluations each or every second month.
Selection criteria	■ Strong business plan showing how the new expertise will contribute to the growth and profitability of the company ■ Certain level of internationalisation, e.g. measured in export ratio or strong ambitions to go international ■ Threshold level of investments in R&D, e.g. 1–3% of turnover ■ Certain financial stability in terms of turn-over and profits
Promotional activities	The management group should design a marketing plan that could include e.g. homepage services, seminars, databases of companies and people, study trips, written material, etc. As the given scheme targets international experts, international promotional activities will be important. This work could be carried out e.g. in co-operation with embassies, international chambers of commerce and trade, etc.

5.2.3 Administration and monitoring

Tentative scheme budget and time frame	Since the range of both skills and nationalities concerned by this measure is very wide it is impossible to estimate a mean cost of the individual agreements that will be concluded. Instead we suggest that the eligible costs should be estimated based on the business plans of the individual applications. The support provided to applicants will consequently be mirroring the estimated impacts of the people hired. Indicative co-funding budget could be as follows: 2007: 500.000 Euro 2008: 1.400.000 Euro 2009: 2.600.000 Euro Further budget is foreseen for "attraction packages" as according to section 6.
Budget for technical assistance	In accordance with the recommendations to provide strong technical assistance we suggest that two to three persons work full time on managing this measure. As for the other measures the distribution of staffing could be as follows: Enterprise Estonia: 1 full time equivalent External Estonian Expert: 1 full time equivalent International expert: 0,5 full time equivalent The yearly budget for external experts should be in the range of 100.000–150.000 Euro per year.

Financial incentives and eligible costs	Co-funding is provided to cover direct personnel costs for a period of three years with a decreasing funding rate as follows: Year 1: 50% Year 2: 40% Year 3: 30% Gradually decreasing funding will put pressure on the company to realise the potentials of the expert. The funding period of three years will also give the company sufficient time to evaluate the contributions of the expert to the company. The scheme should cover the respective percentage of the companies' wage costs. In addition the scheme should also cover the respective percentage of cost for offering "attraction packages". Such packages could comprise e.g.: solutions for husbands/wives going along, children's day care, pension funds, health care solutions, assistance in finding housing etc.[30]
Impact, effects and indicators	Main effects: Increased immigration flows of experts to Estonia, increase in number of highly educated people working in sectors that corresponds to their education; Main impact: decreased shortage of skilled internationally experienced people in Estonian companies; Impact indictors: decreased shortage of international experts in the target group of enterprises (this will be measured through questionnaires to companies) immigration flows of highly educated workforce (managers, engineers), immigration flows of qualified scientists, share of R&D expenditure in the target group of enterprises, annual growth rate of target enterprises; Operational indicators: successful organisational setup, number of contracts with international experts, number of projects perceived as successful by enterprises.

5.3 Type 3 Scheme – Recruitment of specific purpose specialists

5.3.1 Framework

Rationale and overview	In particular SMEs in traditional sectors face difficulties in freeing up time for more future-oriented development work. Furthermore, existing resources for new product and service development are usually scarce or non-existing. Lack of management skill and networks also hampers the realisation of factual growth potential. In many cases all that is needed, however, is to facilitate companies' access to external competences through some well designed incentives and companies will be able to realise their potential without further assistance. For such cases with well-defined purposes and project plans, in particular smaller companies may be motivated to apply subsidies in getting access to so-called specific purpose specialists. Specific purpose specialists could be e.g.: ■ Design engineers ■ Business mentors ■ Graduate students of innovation management This scheme type differs from the previous ones through its focus on short-term employments and well-defined scope of the assignments. To assist companies in defining the assignments it is suggested that companies can apply for funding of a 2-day review/audit carried out by an external expert. The expert shall help in defining key needs and structure an application but **not** write it. Potential sources of people are consultancy companies (Estonian and foreign), academic and research institutions and individuals, possibly retired specialists.

[30] *We have not found suitable benchmarks from other countries but suggest that attraction costs are also reimbursed to 50% and that such cost should not exceed 7% of the total support.*

Scheme objective and expected results	Promoting SME's ability to upgrade innovation capability by subsidising the employment of specific purpose specialist on a short-term-basis < 1 year. The estimated target group size is 1,500 companies (all type (c) companies). It is expected that the support provided will lead to the following number of assignments: 2007: 25 cases 2008: 45 cases 2009: 85 cases
Risk assessment and management / Key challenges	■ During a period of fast economic growth enterprises are oriented to short term profit seeking ■ Lack of suitable specialists ■ The assignments end up being separated from the core activities of the companies and do not have expected results in innovation culture of SMEs ■ The subsidised employment of specialists becomes a permanent way of action and may distort labour market

5.3.2 Implementation

Application	The company applies for co-funding based on a project description presented in a standardised application form. Calls for applications should be continuous with evaluations each or every second month.
Selection criteria	Support will be provided on the basis of a detailed project plan indicating the input from the skilled person in question, the expected outputs and economic benefits expected. Key selection criteria could be: ■ Strong growth ambition and potential of the company ■ Very well defined relation between specific competence employed and growth strategy of the company ■ Feasibility of the presented project plan
Promotional activities	The management group should design a marketing plan that could include e.g. homepage services, seminars, databases of companies and people, study trips, written material, etc. As this scheme targets international experts, international promotional activities will be important. This work could be carried out e.g. in co-operation with international partners.

5.3.3 Administration and monitoring

Tentative scheme budget and time frame	As for the international expert measure it is very difficult to estimate the mean cost for the contracts. However, assuming that an individual contract will not exceed total costs of 50.000 Euro the co-funding budget for the measure can be calculated as follows: 2007: 490.000 Euro 2008: 880.000 Euro 2009: 1.660.000 Euro
Budget for technical assistance	In accordance with the recommendations to provide strong technical assistance we suggest that two to three persons work full time on managing this measure. As for the other measures the distribution of staffing could be as follows: Enterprise Estonia: 1 full time equivalent External Estonian Expert: 1 full time equivalent International expert: 0,5 full time equivalent The yearly budget for external experts should be in the range of 100.000 –150.000 Euro per year.

Financial incentives and eligible cost	Co-funding is provided for a maximum of 12 months. Maximum public co-funding is 35%. Only SMEs are eligible for co-funding. The scheme should cover the companies' wage costs but only for people with relevant innovation-related competence.
Impact, effects and indicators	Main effects: increased use of external specialists in SMEs, increased product and service development activities in SMEs; Main impact: improved innovation capability of SMEs; Impact indictors: number of specialists hired at the end of the contract, number of links between SMEs and technology transfer structures, share of R&D expenditure in the target group of enterprises, number of new products, services or processes developed, share in turnover that comes from new products or services, increase in turnover and/or profitability; Operational indicators: successful organisational setup, number of contracts with external specialists, number of projects perceived as successful by enterprises.

5.4 Comparison of the scheme types

Table 11. Comparison of the scheme types

Scheme type/ element	*Type 1: Recruitment of research-trained personnel*	*Type 2: Recruitment of international expertise*	*Type 3: Recruitment of specific purpose specialists*
Target groups	World-class or close to world-class, research-intensive companies	Internationally competitive with limited research but strong development capacity	Competitive (growing firms) with limited development and no research capacity
Objective	To upgrade company R&D skills and strengthen contacts to research	Helping SMEs to find and hire highly skilled people from abroad	Lowering the barrier for SMEs to hire specialists in projects
Target group size	Estimated target group size: 125–150 companies	Estimated target group size: 250–300 companies	Estimated target group size: 1.500 companies
Source of skills	Higher education and research institutions in Estonia and abroad	Foreign companies, institutions, returning expatriates	Academic institutions, expert companies
Incentives	50% of salary costs. Special support for smaller companies.	50% of salary costs, decreasing for three years. Attraction packages.	Up to 35% of salary costs for 12 months. Project-related application.
Expected output	From 10 to 40 persons per year	From 10 to 30 persons per year	From 25 to 85 persons per year
Tentative budget (excl TA)	0.36–2.16 mill. Euro/year	0.5–4.8 mill. Euro/year	0.44–1.5 mill. Euro/year
Impact and indicators Key challenges	■ Impact indicators: participating PhDs hired permanently at the end of the contract, number of firms with increased expertise in conducting in-house R&D, number of PhDs in target group, share of R&D expenditure in the target group ■ Operational indicators: Successful organisational setup, number of contracts with PhD students, number of successful projects Could draw (too much) resources from research institutions. May be limited by applications.	■ Impact indicators: Decreased shortage of international experts in the target group of enterprises, emigration flows of highly educated workforce (managers, engineers), emigration flows of qualified scientists, share of R&D expenditure in the target group, annual turnover growth rate of target enterprises ■ Share of innovation costs ■ Increase in export turnover ■ Operational indicators: Successful organisational setup, number of contracts with international experts, number of successful projects May distort labour market by offering above-market wages. Limited in number. Requires significant effort.	■ Impact indicators: number of specialists hired at the end of the contract, number of links between SMEs and technology transfer structures, share of R&D personnel in the target group, share of R&D expenditure in the target group, share of innovation expenditure (based on CIS) in the target group. Annual growth rate of target enterprises. ■ Operational indicators: Successful organisational setup, number of contracts with external specialists, number of successful projects ■ May distort labour market by encouraging short-term contracts.

5.5 General organisational set-up

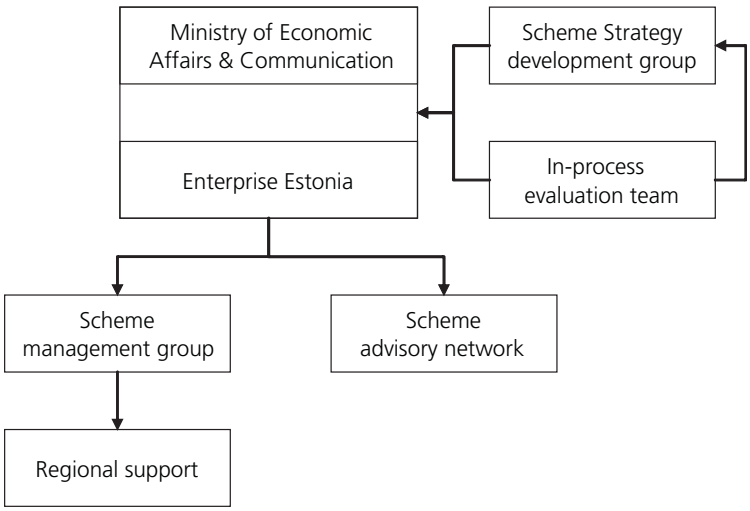
The general organisational set-up for delivering the schemes is described in some detail below. At the core of the organisation we find the Ministry of Economic Affairs and Communications and Enterprise Estonia. The Ministry will hold overall responsibility for the schemes, which in particular implies securing the legal basis and that the schemes comply with EU-regulations. The Ministry also have an important role regarding strategic development of the schemes. Strategic development should secure that the schemes address the needs of the target groups and Estonia in general. This also includes securing that the scheme(s) are complementary to other initiatives and with national as well as EU innovation policy in general. This task implies that the Ministry should closely follow the implementation of the schemes and take action to:

- Support exchange between Estonian organisations managing schemes with related purposes
- Supply the scheme managers with international good practices and networks

Enterprise Estonia's function is that of scheme managing organisation but it will also administrate the scheme and manage cash payments. Enterprise Estonia's task is to secure total quality in scheme management where the major goal is effective scheme delivery resulting in high quality applications. This task should be carried out taking into account the effects among companies, the achievement of quantitative targets but also qualitative aspects such as satisfaction of the target group with scheme management.

For this it is suggested that Enterprise Estonia is supported by different functions as illustrated by the figure below.

Figure 14. General scheme organisational set-up



With exception of the Ministry of Economic Affairs and Communications the tasks and responsibilities of the different functions are briefly outlined in the following.

- **Scheme Strategy development group:** This group comprises representatives from the Ministry of Economic Affairs and Communications, the Ministry of Social Affairs and the Ministry of Education and Research as well as from other relevant Estonian stakeholders. This group has an advisory function regarding the strategic development of the scheme and for proposing target levels and funding levels. It is expected to meet regularly with the scheme management group co-ordinated by Enterprise Estonia and with the in-process evaluators.
- **Scheme advisory network:** This should be a panel consisting of a network of some 6–8 experts (Estonian and foreign). The experts should be contracted on an individual basis by Enterprise Estonia for assisting in evaluating applications. Two experts (one from industry and one from academia) will be assigned to assess each application. The profiles of the experts will depend on the nature of the application. The experts make recommendations to Enterprise Estonia who take the final decision on funding. It is important to point out that the task of the panel is not to refuse applications but to help in fine-tuning as many proposals as possible into high-quality proposals.
- **Scheme management group:** This group should comprise at least three people but its size should be depending on the tasks it should fulfil. If all schemes outlined here will be put in place the group should be larger, comprising at least two persons per scheme. Enterprise Estonia should co-ordinate the group and parts of the staffing should come from Enterprise Estonia. Considering the scope and importance of

the tasks assigned to the group we recommend, however, that external experts be also involved to secure sufficient resources and expertise. The group is responsible for day-to-day business of the scheme, e.g. designing calls, advising and supporting applicants, promotional activities, administration, preparation of cases, etc.

- **Regional support:** This can be e.g. Enterprise Estonia's regional branch office and County Development Centres but also people at R&D-institutions, business associations, Chamber of Trade and Industry, National Contact Point for EU Framework Programmes etc that assist in raising awareness of the scheme and in generating applications.

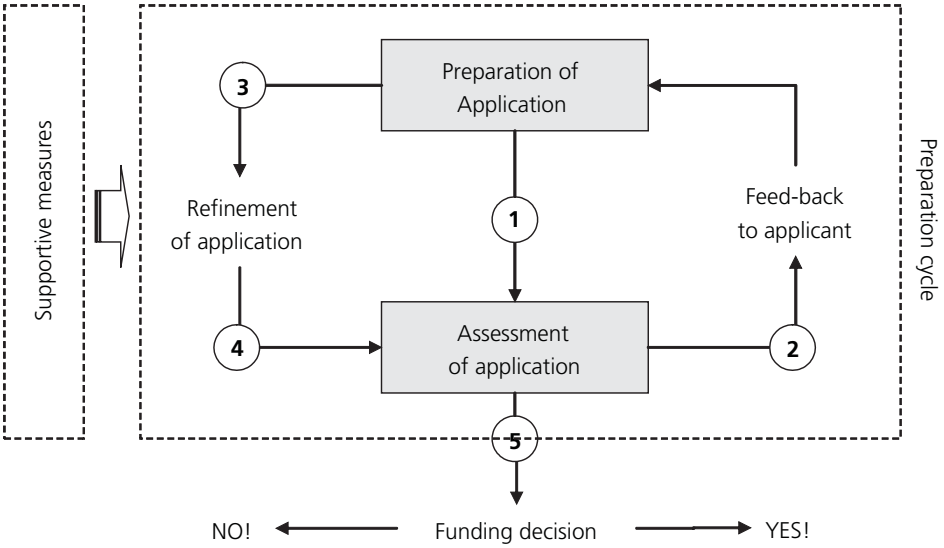
5.6 General application process

Regardless of the scheme, the applications process should be (in standard cases) as follows:

The company applies for co-funding based on a project description presented in a standardised application form. Calls for applications should be continuous with evaluations each or every second month. The application is assessed by the independent expert panel and unless there is reason to refuse the application without further dialogue with the applicant recommendations for improvements are made. The recommendations are submitted to the applicant and to the scheme management group. The applicant can choose to ask the management group for assistance (maximum two meetings plus telephone advice) or to improve the applications on its own.

The refined application is then reviewed for a second time by the expert panel that again, if necessary, may make recommendations for improvements. Should the applicant fail to pass the assessment also the second time the applications must be postponed for at least six months. The general application process is illustrated by the figure below.

Figure 15. Schematic application process



6 Evaluation framework and ex-ante estimation of targets and costs

"It is difficult for the policy makers to know ex-ante how the system will react to the policy. Policy makers need to experiment and allow some room for mistakes. For this reason, evaluation of policies is very important."[31]

6.1 Evaluation framework

The Terms of Reference of the study stipulates the provision of a set of base-line data to be used for estimating operational targets of the proposed schemes as well as for assessing impacts. However, due to the lack of appropriate data we suggest a different approach building on an initial investigation of the situation in each company that receives funding from the schemes.[32]

For each scheme type a set of impact indicators is proposed, which represent essential potential effects of staff recruitment. These indicators shall be measured at four different stages, initially (i.e. before the company recruit), after two years, after five years and after ten years. The evaluation intervals and types of evaluations are given in the second table of this section.

The target values of success impact indicators cannot be estimated at this point since the present situation with the indicators is not known. The impact is about to be evaluated separately with a qualitative assessment, where the indicator data are collected from target groups. Typical target levels of impact indicators should be relative to peer group i.e. the growth in the share of R&D expenditure in those firms that have participated in the schemes should be stronger than in the target group in general.

The mid term evaluation and the full evaluation assess the impact of the schemes during the operation of the schemes. The Final evaluation after 10 years seeks to assess a) how permanent the impact has been and b) if it has made a difference to general development.

Table 12. Overview of indicators per scheme type

Scheme type / element		
Type 1: Recruitment of research-trained personnel	*Type 2: Recruitment of international expertise*	*Type 3: Recruitment of specific purpose specialists*
1. Participating PhDs hired permanently at the end of the contract	1. Decreased shortage of international experts in the target group of enterprises[33]	1. Number of specialists hired at the end of the contract
2. Number of firms with increased expertise in conducting in-house R&D	2. Immigration flows of highly educated workforce (managers, engineers)	2. Number of links between SMEs and technology transfer structures
3. Number of PhDs in target group of enterprises	3. Immigration flows of qualified scientists	3. Share of innovation expenditure based on CIS
4. Share of R&D expenditure in the target group of enterprises	4. Share of R&D expenditure in the target group of enterprises	4. Share in turnover of new products and services
	5. Annual growth rate of target enterprises in terms of: ■ Turnover ■ Share of innovation costs ■ Increase in export turnover	5. Annual growth rate of target enterprises in: ■ Turnover ■ Growth in export rate

The core indicators that measure the impact more accurately are listed on the top.

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[31] *Up-coming paper: Rationales for public policy intervention in the innovation process: A systems of innovation approach. Chaminade and Edquist, Division of Innovation and CIRCLE, Lund University*

[32] *We also suggest running a pre-survey before launching the scheme. This investigation should be a straightforward internet-based survey run among the target group of companies to check their a) commitment to the described three schemes and b) estimate their current standing with regard to educated workforce, R&D investments and other indicators. Collecting the data would give a good reference base for later impact analyses. The same questions would then be repeated in the mid-term evaluation and complemented with qualitative analyses.*

[33] *To be measured by annual or bi-annual questionnaires*

Table 13. Overview of evaluation interval and approaches

Evaluation interval	*Type 1: Recruitment of research-trained personnel*	*Type 2: Recruitment of international expertise*	*Type 3: Recruitment of specific purpose specialists*
2 years	Mid-term assessment	Mid-term assessment	Mid-term assessment
5 years	Full evaluation	Full evaluation	Full evaluation
10 years	Final evaluation	Final evaluation	Final evaluation

6.2 Ex-ante evaluation

The Ex-ante evaluation covers three topics:

- An estimation of the target values of the success indicators in 2-, 5- and 10-year horizon,
- A quantification of the (annual) financial resources that are needed for achieving the target values;
- An estimation of the synergy that arises from implementation of the support measure in the system of other innovation support measures implemented by Enterprise Estonia.

The results of the Ex-ante evaluation is presented in the following:

6.2.1 Operational (success) indicators

The estimated success values for operational indicators are the success in meeting the expected results for the schemes. The schemes are expected to operate at least 5 years and after first three years they are expected to continue with suggested third year target levels. For indicative purposes estimations of 10-year cumulative targets are also given in the table below[34].

Table 14. Overview of success indicators

Scheme type / element	*Type 1: Recruitment of research-trained personnel*	*Type 2: Recruitment of international expertise*	*Type 3: Recruitment of specific purpose specialists*
Operational (success) indicators	Industry PhD-contracts	Specialist assignments	Specialist recruitment
2 years	30	30	70
5 years	150	120	325
10 years	350	210	750

6.2.2 Attraction packages

The issue of so-called attraction packages has been mentioned earlier. A general definition of attraction packages within the context of this study is a set of benefits or services offered to employees in addition to salary. International studies skilled workers are worried about and attracted by far more than only money. The table below lists some main motivations and barriers to mobility from the workers' view.[35]

[34] *The estimate is based on the assumption that after 3 years the annual amount of contracts and assignments stay at the same level.*

[35] *Pricewaterhouse Coopers "Managing mobility matters –a European perspective" 2002*

Table 15. Workers' barriers and motivations to mobility

Barriers	*Motivations*
Family (e.g. child education)	Improve income
Language skills	Improve living standard
Info on employment opportunities	Experience of life abroad
Recognition of qualifications	Develop skills
Spouse employment	New employment opportunities
Transferring pension	Enhance career opportunities
Suitable housing	Commitment to employer
Visa/work permit	
Different culture	

Consequently workers considering going abroad find the following to be the most desirable elements of a contract:

- benefits and social security
- pensions
- sickness benefits
- minimum remuneration
- holiday provision
- termination/notice periods.

For Estonian companies employing in particular foreign work force it is therefore important to consider e.g. pay scales, incentives and variable reward arrangements, share schemes, tax and social security treatment/efficiency, benefits, pensions/offshore pension arrangements and last but not least domestic/family arrangements. An important question for this study is whether the mobility/recruitment schemes proposed here should include attraction packages and if so in what way.

As attraction packages will look very different from case to case it is important to design offerings that suit all.[36] Consequently the starting point should be that the scope and scale of an attraction package is the responsibility of the company and employee candidate in question. There should therefore be no general subsidy for extra benefits such as children day-care or house keeping. Nevertheless it is suggested that a few percent of the total budget, at least for scheme type 2 and 3, is added to a special "Attraction fund". These resources can be used to support e.g. SMEs in special cases where the employee demands certain service that the company cannot arrange for. Further, it is suggested that the parts of the resources reserved for technical assistance to scheme management also cover service that will increase the willingness to work in Estonia. Such assistance can be e.g.:

- Spouse assistance programs
- Retaining a search firm/headhunting
- Work permit assistance
- Training
- Networking for professional development
- Lifestyle allowance
- Childcare provisions

[36] *Examples of benefits often included in long term assignments are Schooling, Host housing, Medical insurance, Hardship, Goods and services*

6.2.3 Quantification of necessary financial resources

After the first 2–3 years when the schemes have been successfully set up, the expected annual financial resources needed for achieving target values are approximately 4.85 million. After the fifth year the schemes should be evaluated and the subsidy levels adjusted. It is likely that the subsidy level can be reduced but since it is very difficult to predict the future level we renounce estimating the costs on a 10-year basis.

Table 16. Overview of accumulated costs for scheme implementation

Scheme type / element	*Type 1: Recruitment of research-trained personnel*	*Type 2: Recruitment of international expertise*	*Type 3: Recruitment of specific purpose specialists*	*Attraction support*	*Total*
Estimated accumulated annual financial resources needed to achieve target values (€)					
2007	180 000	500 000	490 000	50 000	1 220 000
2008	540 000	1 400 000	880 000	115 000	2 935 000
2009	1 260 000	2 600 000	1 660 000	230 000	5 750 000
2010	1 800 000	3 300 000	1 660 000	290 000	7 050 000
2011	2 160 000	3 600 000	1 660 000	320 000	7 740 000

These figures exclude fixed costs for technical support to the scheme implementation (one Enterprise Estonia coordinator, one Estonian expert and half-time international expert) amounting to 125 000 Euro per scheme type and year.[37]

6.2.4 Synergy effects

Within the scope of this study it is not possible to estimate potential financial synergies of the proposed schemes and already existing programmes. The ex-ante evaluation of such synergies therefore focuses on the potential reciprocal benefits that could arise out of overlapping contents and purposes of the programmes.

Taking the table in section 3.5 as a starting point the following table indicates the synergy potential (from high to low) for each related programme. Short comments elaborate on which synergies that could be expected. We suggest that further investigations are undertaken in those cases where significant synergy effects can be expected. We also suggest that the possibility of co-ordinating the application processes of the different programmes be considered. This should be relatively uncomplicated since Enterprise Estonia is co-ordinating most of the programmes where synergies may arise.

[37] *The estimation of recruitment costs is based on the following calculations: The cost of Type 1 PhD recruitment with travel costs etc is estimated to be 36,000 per year with 50% co-funding. The recruitment of international expertise is based on the calculation of average annual cost of 100,000 with decreasing co-funding during a three-year period of 50%, 40% and 30% respectively. The cost of attraction packages is included in the total cost. The cost recruiting of specific purpose specialists is estimated to be an average of 50-60,000 per year with 30-35% co-funding.*

Table 17. Overview of potential synergy effects form other schemes

Programme	*Essence*	*Mobility aspect*	*Synergy potential and content*
R&D financing programme	Support scheme for market oriented R&D projects. for R&D projects.	Possibility to employ research staff (incl. PhD students)	High This programme can be combined with the Type 1 scheme offering companies an additional possibility of employing research personnel.
Competence Centres	Funding of staff and investments in machinery and equipment for industrially relevant R&D projects.	Mobility between R&D institutions and business sector is one of the sub-objectives.	High The type 1 scheme should offer a very important additional component to the Competence Centre programme by making funding available for PhD-projects in industry.
SPINNO	R&D contracts and creation of spin-off companies.	Mobility may be induced through the R&D contracts	Medium to high SPINNO tech transfer units may be ambassadors for mobility schemes.
ESF measure 1.1	Among other issues, doctoral schools and hiring of foreign lecturers is supported.	Supports academic mobility.	Medium The doctoral schools should be combined with the Type 1 scheme offering research training to the industrial PhD-students and their mentors.
Kristjan Jaak	Supports international mobility of researchers.	Mobility is the core of the programme but it includes only academic mobility.	Medium Synergies are low in the programme's present form but synergies may occur if the programme can be marketed jointly with type 2 scheme.
Tallinn City Apprenticeship scheme	Favours mobility between vocational schools and enterprises.	Focus is on vocational schools and skilled and craft workers.	High There could be strong synergy effects of this programme and the Type 3 scheme.
NordProLink – Nordic Professional Links	Short-term apprenticeship in Nordic SMEs.	The impact of the pro-gramme is rather educational for employees of SMEs.	Low
Internship Exchange	The Internship Exchange of the ITC is designed to match the ITC student's educational goals with hosting organisations needs.	Mobility aspect is strong but its impact is limited as it concerns only the field of ICT.	Low The proposed mobility/recruitment scheme does not focus on undergraduate students.
Nordplus Neighbour	Mobility and network programme. Its objective is to develop networks between educational institutions, research institutions and non-governmental organisations in the field of education and lifelong learning.	Mobility of all stakeholders in the field of education.	Low No focus on industry

Appendix 1 | Statistical tables on Estonian Context

Appendix 1.1 | R&D intensities and sectoral value added to GDP, 2005

Field of activity	*NACE*	*Sectoral value added as % of national GDP (%, 2005)*	*R&D intensity (share of sectoral R&D in sectoral value added %, 2005)*	*Increase in R&D intensity (change in private R&D investment 2003–2005)*
Agriculture, hunting and forestry; fishing	NACE A; B	3.28	0.02	n/a
Manufacture of food products, beverages and tobacco	NACE 15	1.88	1.91	120.8
Manufacture of textiles and textile products	NACE 17–18	1.33	0.09	9.7
Manufacture of wood and products of wood	NACE 20	2.16	0.05	n/a
Manufacture of pulp, paper and paper products; publishing	NACE 21–22	1.19	n/a	n/a
Manufacture of coke, oil shale, nuclear fuel and chemical products	NACE 23–24	0.91	3.33	-21.3
Manufacture of other non-metallic mineral products	NACE 26	1.12	0.61	19.4
Manufacture of metal, metal products and machinery and equipment n.e.c.	NACE 27–29	2.32	0.72	228.2
Manufacture of electrical and optical equipment	NACE 30–33	1.61	4.71	144.5
Manufacture of transport equipment	NACE 34–35	0.66	3.11	n/a
Manufacture of furniture; manufacturing n.e.c.; recycling	NACE 36–37	1.21	0.44	-31.6
Electricity, gas and water supply	NACE 40–41	3.03	0.66	22.5
Construction	NACE 45	6.42	n/a	n/a
Wholesale and retail trade; repair of motor vehicles etc.	NACE 50–52	13.18	0.08	88.4
Transport, storage and communication	NACE 60–64	10.60	0.10	-56.0
Financial intermediation	NACE 65–67	3.33	1.69	17.4
Real estate; education; health; other service activities	NACE 70–71; 80; 85; 90–93	19.94	0.01	-76.0
Computer and related activities	NACE 72	0.83	11.37	316.4
Other business activities	NACE 74	5.01	0.60	-77.7

n/a – data are confidential
Source: Statistical Office of Estonia

The following fields have been left out in Appendix 1 because almost no R&D expenditures reported in these sectors: hotels and restaurants, manufacturing of leather and leather products. In case of rubber and plastic products data was not available.

Appendix 1.2 | R&D personnel (full-time equivalent), 1998–2004

Field of activity	*NACE*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*
Economic activities total		440	618	418	626	702	763	1,084
Mining and quarrying	10–14	n/a	0	0.0	0	0.0	n/a	n/a
Manufacturing		104	172	163	333	287	298	445
Manufacture of food products and beverages	15	11	17	32	29	20	29	16
Manufacture of textiles and textile products	17–18	6	16	4	6	11	14	16
Manufacture of paper and paper products; publishing	21–22	n/a	2	1	2	n/a	0	3
Manufacture of chemicals and chemical products, coke, refined petroleum products and nuclear fuel	23-24	28	41	69	82	65	61	91
Manufacture of other non-metallic mineral products	26	n/a	1	2	1	n/a	4	5
Manufacture of basic metals and fabricated metal products, machinery and equipment	27–29	7	22	7	29	16	23	56
Manufacture of electrical and optical equipment	30–33	9	23	22	115	106	105	207
Manufacture of transport equipment	34–35	29	33	9	36	32	n/a	31
Manufacture of furniture; manufacturing n.e.c.; recycling	36–37	12	13	11	18	22	23	15
Electricity, gas and water supply	40–41	6	12	1	30	47	21	21
Services								
Wholesale trade and commission trade	50–52	11	20	9	15	26	18	18
Transport, storage and communications	60–64	110	98	55	13	12	43	21
Financial intermediation	65–67	…	…	…	…	…	69	81
Computer and related activities	72	40	69	62	82	168	148	332
Research and development	73	47	53	55	30	55	78	82
Other business activities	74	92	158	61	95	99	79	66

n/a – data are confidential; … – data were not collected
Source: Statistical Office of Estonia

Appendix 1.3 | R&D personnel in business sector by level of education, 2004

Field of activity	*NACE*	*Total*	*Doctor's degree*		*Master's degree and higher education*		*Secondary education*		*Without secondary education*	
		No	*No*	*%*	*No*	*%*	*No*	*%*	*No*	*%*
Economic activities total		1,735	122	7.0	1,222	70.4	158	9.1	16	0.9
Mining and quarrying	10–14	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Manufacturing		668	49	7.3	545	81.6	69	10.3	5	0.7
Manufacture of food products and beverages	15	34	0	0.0	27	79.4	7	20.6	0	0.0
Manufacture of textiles and textile products	17–18	26	0	0.0	20	76.9	4	15.4	2	7.7
Tanning and dressing of leather	19	0	0	0.0	0	0.0	0	0.0	0	0.0
Manufacture of wood and products of wood	20	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Manufacture of paper and paper products; publishing	21–22	8	0	0.0	8	100.0	0	0.0	0	0.0
Manufacture of chemicals and chemical products, coke, refined petroleum products and nuclear fuel	23-24	117	16	13.7	94	80.3	7	6.0	0	0.0
Manufacture of rubber and plastics products	25	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Manufacture of other non-metallic mineral products	26	21	1	4.8	15	71.4	5	23.8	0	0.0
Manufacture of basic metals and fabricated metal products, machinery and equipment	27–29	103	5	4.9	92	89.3	5	4.9	1	1.0
Manufacture of electrical and optical equipment	30–33	291	25	8.6	229	78.7	35	12.0	2	0.7
Manufacture of transport equipment	34–35	37	1	2.7	34	91.9	2	5.4	0	0.0
Manufacture of furniture; manufacturing n.e.c.; recycling	36–37	25	0	0.0	22	88.0	3	12.0	0	0.0
Electricity, gas and water supply	40–41	42	1	2.4	38	90.5	2	4.8	0	0.0
Construction	45	0	0	0	0	0	0	0	0	0.0
Services										
Wholesale trade and commission trade	50–52	33	6	18.2	22	66.7	5	15.2	0	0.0
Hotels and restaurants	55	0	0	0	0	0	0	0	0	0.0
Transport, storage and communications	60–64	54	0	0.0	56	103.7	19	35.2	3	5.6
Financial intermediation	65–67	99	2	2.0	86	86.9	11	11.1	0	0.0
Computer and related activities	72	465	27	5.8	340	73.1	96	20.6	2	0.4
Research and development	73	124	21	16.9	91	73.4	12	9.7	0	0.0
Other business activities	74	216	14	6.5	180	83.3	22	10.2	0	0.0
Real estate; education; health; other service activities	70, 71, 75, 80, 85, 90–99	27	2	7.41	23	85.2	1	3.7	1	3.7

Source: Statistical Office of Estonia

Appendix 1.4 | Total R&D expenditures, 1998–2004

(thousands EUR)

Field of activity	*NACE*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*
Economic activities total		15.286	12956	11.588	20.409	20.296	26.958	37.010
Manufacturing		4.394	3.487	4363	10.070	10313	10.657	14710
Manufacture of food products and beverages	15	893	336	381	759	985	1.634	1.150
Manufacture of textiles and textile products	17–18	295	290	87	n/a	229	135	252
Manufacture of paper and paper products; publishing	21–22	n/a	n/a	n/a	n/a	n/a	0	155
Manufacture of chemicals and chemical products, coke, refined petroleum products and nuclear fuel	23-24	631	969	1.442	3.050	3.055	2.982	3.503
Manufacture of other non-metallic mineral products	26	n/a	165	n/a	353	484	457	732
Manufacture of basic metals and fabricated metal products, machinery and equipment	27–29	62	215	n/a	n/a	547	361	1.094
Manufacture of electrical and optical equipment	30–33	n/a	n/a	640	2.479	2.374	1.778	5.116
Manufacture of transport equipment	34–35	n/a	881	n/a	909	n/a	n/a	2.294
Manufacture of furniture; manufacturing n.e.c.; recycling	36–37	1.771	276	170	526	1.330	736	345
Electricity, gas and water supply	40–41	n/a	1.617	1.606	1.266	1.586	1.473	2.366
Services								
Wholesale trade and commission trade	50–52	n/a	542	660	996	565	471	432
Transport. storage and communications	60–64	1.598	2.003	1.282	565	709	2.121	3.259
Financial intermediation	65–67	…	…	…	…	…	4.217	4.311
Computer and related activities	72	n/a	1.186	1.569	n/a	2.673	1.822	7.040
Research and development	73	440	640	754	885	1.411	1.610	1.494
Other business activities	74	986	2.630	848	2.275	2.780	2.941	1.603

n/a – data are confidential; … – data were not collected
Source: Statistical Office of Estonia

Appendix 1.5 | Companies with innovative activities, 2002–2004

Field of activity	*All enterprises*	*Enterprises with innovative activities*	*Share of innovative enterprises*
Economic activities total	3,789	1844.1	48.7
Mining and quarrying	43	15.4	35.8
Manufacturing	1,917	923.7	48.2
Manufacture of food products and beverages	229	134.2	58.6
Manufacture of textiles and textile products	298	100.2	33.6
Tanning and dressing of leather	33	17.8	53.9
Manufacture of wood and products of wood	352	146	41.5
Manufacture of paper and paper products; publishing	149	85.4	57.3
Manufacture of chemicals and chemical products, coke, refined petroleum products and nuclear fuel	38	33.9	89.2
Manufacture of rubber and plastics products	81	45.6	56.3
Manufacture of other non-metallic mineral products	65	41.2	63.4
Manufacture of basic metals and fabricated metal products, machinery and equipment	327	129.9	39.7
Manufacture of electrical and optical equipment	97	64.6	66.6
Manufacture of transport equipment	61	31	50.8
Manufacture of furniture; manufacturing n.e.c.; recycling	187	94.1	50.3
Electricity, gas and water supply	**108**	**31.7**	**29.4**
Services	**1,721**	**873.3**	**50.7**
Wholesale trade and commission trade	803	504.7	62.9
Transport, storage and communications	641	209	32.6
Financial intermediation	53	39.6	74.7
Computer and related activities	83	60.9	73.4
Architectural and engineering activities	113	46.7	41.3
Technical testing and analysis	28	12.3	43.9

Source: CIS4

Appendix 1.6 | Innovative and exporting companies, 2002–2004

	CIS, total	*Innovative*	*Co-operating with R&D institutions*	*Innovative and exporting*
	%	%	%	%
Manufacture of food products and beverages	6.0	7.3	5.0	4.9
Manufacture of leather and leather products	0.9	1.0	1.2	1.3
Manufacture of wood and wood products	9.3	7.9	2.5	9.4
Manufacture of rubber and plastic products	2.1	2.5	2.0	3.0
Manufacture of other non-metallic mineral products	1.7	2.2	3.8	2.4
Manufacture of machinery and equipment n.e.c.	2.1	2.2	3.6	2.9
Wholesale trade and commission trade, except of motor vehicles and motorcycles	21.2	27.4	25.9	26.5
Computer and related activities	2.2	3.3	6.0	3.0
Other business activities	3.7	3.2	7.8	2.1
Mining and quarrying	1.1	0.8	1.8	0.4
Manufacture of textiles and textile products	7.9	5.4	0.6	6.8
Manufacture of pulp, paper and paper products; publishing and printing	3.9	4.6	3.2	3.7
Manufacture of coke, refined petroleum products and nuclear fuel; manufacture of chemicals, chemical products and man-made fibres	1.0	1.8	7.5	2.4
Manufacture of basic metals and fabricates metal products	6.6	4.8	3.4	5.7
Manufacture of electrical and optical equipment	2.6	3.5	4.6	4.5
Manufacture of transport equipment	1.6	1.7	1.8	2.2
Other manufacturing; recycling	4.9	5.1	2.0	6.7
Electricity, gas and water supply	2.9	1.7	7.6	0.2
Transport, storage and communication	16.9	11.3	5.9	10.5
Financial intermediation	1.4	2.1	3.9	1.3
Source: CIS4	100.00	100.00	100.00	100.00

Appendix 1.7 | Companies reporting R&D expenditures, 2005

		Export/Turnover				Employees					BERD/turnover				
	Companies reporting BERD	*above 49%*	*30–49%*	*10–29%*	*below 10%*	*above 249*	*150–249*	*50–149*	*10–49*	*below 10*	*above 10%*	*5–10%*	*3–4%*	*1–2%*	*below 1%*
Total	**357**	**69**	**31**	**37**	**220**	**33**	**20**	**54**	**97**	**153**	**111**	**16**	**21**	**51**	**158**
Agriculture, hunting, forestry, fishing	4	0	0	0	4	1	1	0	1	1	0	0	0	0	4
Mining and quarrying	3	1	0	0	2	1	0	0	2	0	0	0	1	2	0
Manufacturing	**129**	**52**	**14**	**14**	**49**	**21**	**12**	**34**	**34**	**28**	**24**	**10**	**14**	**35**	**46**
Manufacture of food products and beverages	19	2	1	6	10	7	3	6	3	0	1	1	1	6	10
Manufacture of textiles and textile products	3	3	0	0	0	1	1	1	0	0	0	0	0	3	0
Manufacture of leather and leather products	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manufacture of wood and wood products	4	3	0	1	0	2	0	2	0	0	0	0	0	1	3
Manufacture of coke, refined petroleum products and nuclear fuel; manufacture of chemicals, chemical products and man-made fibres	18	8	4	1	5	3	1	3	7	4	5	3	3	6	1
Manufacture of other non-metallic mineral products	9	1	2	2	4	2	1	2	4	0	0	0	2	3	4
Manufacture of basic metals and fabricates metal products	14	8	4	1	1	0	2	6	6	0	3	1	2	6	2
Manufacture of electrical and optical equipment	44	15	3	0	26	2	2	7	9	24	13	3	3	5	20
Manufacture of transport equipment	5	4	0	0	1	1	0	2	2	0	1	1	1	1	1
Other manufacturing	9	6	0	2	1	2	1	5	1	0	1	0	1	4	3
Electricity, gas and water supply	**9**	**0**	**0**	**1**	**8**	**5**	**1**	**2**	**1**	**0**	**0**	**0**	**1**	**1**	**7**
Services	**210**	**16**	**17**	**22**	**155**	**4**	**6**	**18**	**58**	**124**	**87**	**6**	**4**	**13**	**100**
Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household foods	30	0	0	6	24	0	0	1	8	21	2	0	1	1	26
Transport, storage and communication	10	2	1	1	6	2	3	2	2	1	2	1	0	4	3
Financial intermediation	5	0	0	0	5	2	2	0	1	0	0	0	0	0	5
Computer and related activities	67	4	12	6	45	0	0	3	14	50	24	2	1	1	39
Research and development	29	8	3	1	17	0	0	0	8	21	27	0	0	0	2
Other business activities	42	1	1	7	33	0	0	8	17	17	18	3	2	6	13
Real estate, renting and business activities (excl. Computer and related activities, R&D and other business activities)	27	1	0	1	25	0	1	4	8	14	14	0	0	1	12

Source: Statistical Office of Estonia

Appendix 1.8 | Admittance in doctoral courses, 2000–2005

	2000	*2001*	*2002*	*2003*	*2004*	*2005*
Fields of study total	370	281	329	354	428	440
Teacher training and education science	15	13	10	11	18	13
Arts	7	6	11	9	9	19
Humanities	26	36	35	42	70	67
Social and behavioural science	21	35	40	45	56	68
Journalism and information	2	2	3	3	5	4
Business and administration	16	17	21	11	21	17
Law	4	7	11	12	12	11
Life science	38	31	33	32	39	38
Physical sciences	34	26	32	36	43	51
Mathematics and statistics	7	5	5	7	7	9
Computer sciences	6	7	25	29	24	34
Engineering and engineering trades	32	39	33	49	49	56
Manufacturing and processing	0	0	0	0	0	0
Architecture and building	10	7	12	12	14	7
Agriculture, forestry and fishery	15	14	20	15	18	16
Veterinary	12	2	4	5	3	3
Health	117	20	21	21	22	17
Social services	3	3	3	3	4	1
Personnel services	2	2	2	3	8	5
Transport services	0	0	0	0	0	0
Environmental protection	3	9	8	9	6	4
Security services	0	0	0	0	0	0

Source: Statistical Office of Estonia

Appendix 1.9 | Graduates of Doctoral courses, 2000–2005

	2000	*2001*	*2002*	*2003*	*2004*	*2005*
Fields of study total	117	149	188	226	209	118
Teacher training and education science	0	0	0	2	6	2
Arts	0	0	0	1	2	2
Humanities	10	14	15	16	26	15
Social and behavioural science	4	4	5	10	4	8
Journalism and information	0	1	3	1	0	0
Business and administration	3	5	4	3	6	5
Law	0	4	2	2	3	4
Life science	14	4	12	7	27	15
Physical sciences	16	15	14	22	15	15
Mathematics and statistics	1	2	1	2	5	3
Computer sciences	5	1	4	1	3	5
Engineering and engineering trades	6	8	6	13	13	19
Manufacturing and processing	0	0	1	1	1	2
Architecture and building	0	1	0	3	2	4
Agriculture, forestry and fishery	5	2	5	6	1	7
Veterinary	1	0	0	2	4	0
Health	52	88	113	131	86	10
Social services	0	0	1	0	1	0
Personnel services	0	0	0	1	3	1
Transport services	0	0	0	0	0	0
Environmental protection	0	0	2	2	1	1
Security services	0	0	0	0	0	0

Source: Statistical Office of Estonia

Appendix 2 | Overview of good practice programmes

One way to overcome the shortage of researchers and the subsequent problems arising from this issue as insufficient research at universities and within R&D departments in companies would be to attract outside experts. Another way to overcome this shortage would be to make use of internal measures/ resources that would foster knowledge transfer and secure new generations of researchers. As stated by the study "Operational Programme for Human Resource Development" (2006), the Estonian R&D system suffers severe and chronic financial gaps so that for example R&D investments in Estonia per full-time researcher or engineer are more than seven times smaller than in the European Union. This lack of finance translates into low wages for PhD students, which often have to take a second job in order to be able to secure a low living standard and it prevents institutions from making investments in cutting-edge technology for R&D on an ongoing perspective. For this reason a set of best practices that address that issue will be introduced in the next section. We will talk on the one hand about "Industrial PhD" programs that aim to build personnel networks of knowledge between companies, domestic universities and research institutions. On the other hand, we will focus on programs that pay subsidies to SMEs that would hire a high-qualified worker, as e.g. an engineer or technician, in order to upgrade innovative and technological capacities within their operational businesses.

Mobility/recruitment of researchers programmes

The basic idea of this type of programmes is to permit postgraduate students to obtain a PhD-degree through employment as researcher in a private company to gain insight into the business related aspects of research and development. At the same time it is also enhancing research and development in the business sector with the knowledge of the PhD students. The underlying financial structure is based on the assumption that approximately half of the costs (salaries, research costs) are paid for by the company; the other half is financed by the local government. Within this context the graduate student works for and gets guidance from both the company and the university. The main objectives stated by the initiatives are to:

- Increase rates of expenditure on research and technological innovation in enterprises;
- Facilitate access of enterprises to skilled personnel;
- Ensuring that the future skills base in the region/sector/country will correspond to the innovation needs of enterprises;
- Provide adequate infrastructure to new technology based firms to facilitate their survival and growth; and
- Upgrading innovation related skills and diffusing new technologies in enterprises.

1. Industrial PhD Fellowship Program

The first program that will be introduced is called the "**Industrial PhD Fellowship Program"**. It was installed in the 1970s by Denmark. Since then the Danish government is supporting between 50–70 new industrial PhD fellowships each year. The company pays approximately half and the governments half of the costs. This program is also open to foreign PhD students, which is not a common feature. The program has an annual budget of approximately 5.4 Million Euros, but future development efforts are aimed at increasing the budget. It also aims to increase the participation of SMEs, reducing the concentration of companies in Copenhagen (i.e. spreading the benefits throughout the country) and promoting the use of the programs in all academic areas, such as engineering, health, social sciences and arts.

Initially the program managers had to overcome administrative difficulties to allow it to work within timescales that are acceptable to companies. However, they did not have any legal or political barriers to designing a transnational program and feedback from participants shows that:[38]

- There is an increased knowledge at the universities and improved networks and cooperation with businesses – this includes networks outside Denmark.
- The quality level of the PhD work is typically as good as or better than a regular PhD.
- Companies enhance competencies and develop new fields of world-class R&D.
- 44% of companies expected to see increased turnover as a result.
- Around half of the companies that have hosted Industrial PhD projects in the last six years claim that the project has resulted in one or more patents.
- PhD fellows enjoy and value their international experience, with it adding a perspective to their study that they had not envisaged before.
- The unemployment rate of all fellows who have completed the education since 1988 is less than 1%.

[38] *http://www.eua.be/eua/jsp/en/upload/Study_report_designed_version.1151581567476.pdf, European Commission.*

The program benefits from Denmark's position as a medium-sized country with small markets and a restricted research infrastructure. Both its companies and its academics are accustomed to working internationally and the Ministry has recognized this in the development of the program, avoiding any restriction on mobility. While it is Danish companies that benefit directly, the cooperative networks that are put in place also benefit the international partners. While it does support academia, the program is very much focused on supporting and developing businesses and industries. Consequently, it has been designed to be very flexible and responsive to business needs, with the international elements simply reflecting the operating environment faced by Danish companies. Keeping it simple and avoiding imposing any barriers has allowed the natural, market driven development of transnational activity.

2. CIFRE

The second best practice is based on the French program "CIFRE" which stands for Convention industrielle de formation par la recherche or Industrial Agreement for Training Through Research. The queue for permanent research positions in the French academic sector in the early 1980s has created a specific labour market for PhD graduates. In order to facilitate the transition of PhD graduates to the private sector, the Ministry of Research has developed a specific programme (CIFRE) that connects PhD candidates, universities and firms in order to train young graduates more adapted to the needs of the private firms. More precisely, the National Association for Technology Research (ANRT), which is attached to the Ministry of Research and Technology, supports for a three-year period a firm hiring a young PhD candidate associated with an external lab. The student spends time between the two partners and can also contribute to technology transfer although the thesis topic is usually a problem of direct concern to the industrial partner. During the three years of the agreement, the company pays an annual gross wage of 20,000 Euros or more to the PhD candidate. Since 1981 13000 students have done their PhD thesis in 6000 companies, 50% of them SMEs. The theses were written in the field of technology (5700), material science (3054), nature science (2405) and social science (1519). In 2005 the program had 1100 signed students and aims to increase the participation to 2000 students by 2010. An evaluation revealed that 83% of the participating companies say they have benefited from the program through generating new know-how (39%), they could enhance product development (17%) as well as processes (18%). Last but not least new patents and new prototypes were created with the help of PhD students from the program.[39]

Recruitment of graduate programmes

Apart from the "Industrial PhD" program another scheme to support the Industry/ SMEs–University relationship has evolved that focuses on the funding of projects of students about to take their diploma from colleges of higher education, especially technicians. Those programs focus on highly educated people without a PhD qualification. The objectives of those schemes are similar to the PhD program: (i) to give students the opportunity to gain experience with corporate R&D, and (ii) to stimulate contact between SMEs and people from the tertiary education level. In the process the funding agency, mostly a publicly founded agency, pays between 50%–80% of the project's costs, the other half is often paid by the company. Within this budget the counselling staff receive payments too. The best practice within this category includes the "FFF Young Researchers Program" from Austria.

1. FFF Young Researchers Program[40]

The FFF Young Researchers Program was initiated in 1993 in Austria and focuses on the funding of diploma students as well as on PhD candidates[41]. Since then FFF has been pursued. In 2005, about 35 projects were financed by the fund for about 6,5 Million Euros that year. The prerequisite for enterprises to be part of the program is outlined on the size of the company. Small and Medium sized companies are ranged to fit the criteria of either a maximum of 250 employees, a business volume of maximum 50 Million Euros or a balance sheet total of maximum 43 Million Euros. Companies that predominantly work in the field of R&D are not allowed for funding. The prerequisite for projects is outlined as follows:

- projects have to aim at developing new products or techniques;
- projects have to fulfil high innovation standards;
- projects have to solve an ex ante defined problem relevant to the company;
- projects should be utilizable to business.

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[39] *www.anrt.asso.fr*
[40] *Contact: +43 5 7755 – 1201 (Austria)*
[41] *Focus within this section is given to the diploma student part of the programme.*

The financial perspective is defined as follows: (i) students about to take their diploma agree upon a salary with the company, the fund is going to pay 50% of the expenses which do not have to be repaid by the student; (ii) arising expenses at the university are compensated to 50% as well; (iii) companies receive for their admissible expenses a 50% funding which partly consists of a free fund and a loan.

An evaluation carried out in 1997 revealed that the impulse effect towards further projects was at 43%. Companies stated that they would engage in further projects at a rate of 96%. The hiring quota of researchers was at 30%. The lack of co-operation of universities and too much formalism (reporting) were stated as major impediments to the success of the program.

A third form to support knowledge transfer as well as to foster technological projects in companies through the hiring of technicians in SMEs would be to pay subsidies to companies that would hire qualified personnel. Those wage-subsidy programs are common within the low-wage sector, but less known as a policy measure for high-qualified worker schemes. Nonetheless, France and Turkey installed such programs.

2. CORTECHS (France)

Cortechs, introduced in 1988, is a program that favours the recruitment of young graduates in especially technical positions of SMEs with less than 250 employees for well-defined research projects. A third party, competence/-training centres, is involved in this program too. The financial perspective of CORTECHS is handled as follows: a 50% subsidy to the costs of hiring a young technician is given to the company for a twelve-month period. The maximum amount of money is set at 13.000 . The competence centre also gets a subsidy. The amount is to be specified. In 2004, the French government spent 1.4 Million Euros on the program. Another 1.9 Million Euros came from the Structural Fund of the EU. From 1989–2001, on average 280 technicians participated in the program. The largest participant rates were achieved in enterprises with 1–10 employees (45%) and enterprises with 11–50 employees (43,5%)[42], so that this tool is working very well for small businesses. Another very closely linked project called Diplome Recherche Technologique (DRT) by France builds upon the same objectives as CORTECHS, to foster technological and innovative capacities of enterprises through the hiring of engineers (young graduates). Furthermore, participants of this program have to be able to undertake R&D activities and that would maintain a close link to the research organization (either a university or technical school). The latter aspect distinguishes DRT from CORTECHS. DRT is an ongoing project installed in 1997. The financial assistance given to participants of DRT is in line with the CORTECHS funding: a 50% subsidy to hiring an engineer is given to the company, with a ceiling of 10.600 Euro per year.

A very similar kind of initiative was set up by Turkey (the project name is not known). They introduced in 2003 a measure which focuses on subsidies for enterprises that hire qualified personnel as well. The scheme allows for grants provided to the hands of the SMEs. This includes a level of finance between 60% and 80% of the wage of the employee (for graduates from university up to 11250 per year). Grants are provided for eighteen months.[43]

3. The Knowledge Transfer Partnership (UK)

The Knowledge Transfer Partnerships (KTP) is a scheme managed by the Government's Department of Trade and Industry (DTI) to strengthen the competitiveness and wealth creation of the UK by the stimulation of innovation in business through the establishment of collaborative partnerships with the UK knowledge base. KTP help businesses to improve their competitiveness and productivity through the better use of knowledge, technology and skills that reside within UK's public and private sector research institutes and higher education institutions.

The objectives of the Knowledge Transfer Partnerships are to facilitate the transfer of knowledge and the spread of technical and management skills; to encourage investments in training, research and development and to stimulate collaborative research and development projects, forging lasting partnerships.

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[42] *Source: www.recherche.gouv.fr/technologie/mesur/chapitre6idt.pdf#search=%22CORTECHS*

[43] *As there is no further information on this program yet, it has to be inquired whether those positions will be continued on both sides after the expiring of the grants.*

The heart of each Knowledge Transfer Partnership is a relationship between a company/organisation and staff in a knowledge-based institution applying their expertise to a project that is central to the development of the company. Each Knowledge Transfer Partnership is managed by a team involving senior staff from both the Knowledge Base and the Company Partners and a recently qualified graduate recruited as an "KTP associate" when the Knowledge Transfer Partnership proposal has been approved. As regards graduates, they may be recruited to work in a company for two years on a project of strategic importance, in close co-operation with a university. This enables the company and the university to learn how to collaborate.

The Knowledge Transfer Partnership scheme is financially supported by sponsors, the largest of which is the Department of Trade and Industry. A government grant, plus the contribution from the company partner, fully covers a Research Organisation's costs of participating in a Knowledge Transfer Partnership. The grant also includes a significant contribution to overhead costs. For each graduate (known as "KTP associate") engaged for two years on a Programme, the total funding available is around £94,000.

The Knowledge Transfer Partnerships Annual Report 2005/2006 states that for every £1 million of Government funding spent on KTP, average benefits to company participants amounted to £4.24 million increase in annual profit before tax and £3.25 million investment in plant and machinery, with 112 new jobs created and 214 company staff trained. For more information: www.ktponline.org.uk

Scheme overview

Scheme/Country	*Target Group*	*Nature of Policy Intervention*	*Time Frame/ Budget*	*Relevance to Estonia*
Industrial PhD (Denmark)	**Industry PhD** candidates, companies in need of research personnel **(SMEs & large companies)**	Fellowship, subsidies are paid to PhD candidates by government (50%) and Industry (50%);	Set up in the 1970s;	Researcher mobility scheme based on internal flows of high-skilled people;
CIFRE (France)	**Industry PhD** candidates, companies in need of research personnel **(SMEs & large companies)**	Fellowship, subsidies are paid to PhD candidates by government (50%) and Industry (50%);	1981– ongoing; budget for 1998: 48 Mio. €;	Researcher mobility scheme based on internal flows; upgrade technological capacities of enterprises & keep contact to research laboratory;
FFF – Young Researchers Program (Austria)	**PhD** candidates & **undergraduates** about to write their diploma & **SMEs** with less than 250 employees;	Fellowship to student (50%); funding to research centre up to 50% and funding to companies based on loans and free funding (50%)	1993- ongoing; budget in 2005: 6.5 Mio. €;	Focuses on very small enterprises; additional target group: under-graduates;
CORTECHS (France)	**Young graduates** (special focus on young technicians) & **SMEs** with less than 250 employees;	50% subsidy given to company for hiring a young technician for one year; subsidy to competence centre;	1988– ongoing; budget for 2004: 3,3 Mio € [1.4 Mio € by French government + 1.9 Mio € by EU]	Subsidy scheme that supports the hiring of young technicians that makes it affordable to Estonian companies to do so;
Diplome Recherche Technologique (France)	**Young graduates** (special focus on young technicians) & **SMEs** with less than 250 employees; special focus on contact between research centre/graduate/ company	Same subsidy scheme as CORTECHS, except a lower ceiling per year of 10.600€ per employee;	1997– ongoing;	Subsidy scheme that supports the hiring of young technicians that makes it affordable to Estonian companies to do so;

Scheme/Country	*Target Group*	*Nature of Policy Intervention*	*Time Frame/ Budget*	*Relevance to Estonia*
UK	Qualified personnel (graduates, vocational students) & SMEs	Subsidy given to company to hire employee from target group;	1987 under name Teaching Company Scheme	Subsidy scheme for lower educational groups that would support companies to hire urgently needed workers with at least some standard of qualification;
Turkey	Qualified personnel (graduates, vocational students) & SMEs	Subsidy given to company to hire employee from target group;	Introduced in 2003- ongoing; no overall budgets known;	Subsidy scheme for lower educational groups that would support companies to hire urgently needed workers with at least some standard of qualification;
KIM (Netherlands)	SMEs (<100 employees) & graduated students Contact: Boersma, Wim Tel.: + 31.70.379 69 00 (Ministry of Economic Affairs)	Subsidy; Enlarge innovative capacity of SMEs[44]	1994–2001 afterwards merged with other program (Transfer of knowledge between SME's (SKO)); Budgets in previous years: 1997 – € 1 million 1998 – € 6 million 1999 – € 5 million 2000 – € 4 million	Subsidy scheme that supports the hiring of young technicians that makes it affordable to Estonian companies to do so;

KIM: The instrument was last evaluated in 2000. The evaluation has assessed the impact of the subsidy in terms of: 1. the importance of the subsidy: for approx. 75% of the firms the non granting of the subsidy would have had an impact on the implementation/size/start/duration of the project. In 23% of the cases the projects would have proceeded anyway (free riders). 2. first order effects (impact on R&D input): for 50% of the "old participants" and 53% of the "new participants" KIM has had a positive effect on the R&D intensity – an average increase of 0,9 fte in personnel for R&D in case of "old participants" (n=13) and 0,5 fte in the case of "new participants" (n=11). On the other hand, there are also companies where there has been no demonstrable or even a negative impact. 3. second order effects (impact on R&D output/innovativeness): 91% of the "old participants" and 84% of the "new participants" have realised innovations; the majority of product innovations has been successfully commercialised; 57% of the companies have improved their efficiency due to process innovation 4. third order effects (impact on company performance): in 52% of "old participants" and 80% of "new participants" KIM has had a positive impact on turn-over. In 45% of "old participants" and 68% of "new participants" KIM has had a positive impact on employment – an average increase of 3,6 fte in "old participants" (n=5) and 3,3 fte in "new participants" (n=12); in 20% of "old participants" and 23% of "new participants" KIM has contributed to retention of jobs – on average 2,0 fte in new participants (n=3). In 30% of "old participants" and 42% of "new participants" KIM has contributed to an increase in the number of high-skilled personnel in the company – on average an increase of 1,4 fte in "old participants" (n=5) and 1,8 fte in "new participants" (n=13).

Conditions: – applicant should formulate an innovation plan (in co-operation with Syntens in the region of the applicant), including: a. description of the development trajectory b. goal of the innovation project; c. definition of the contribution of the knowledge bearer. At the time of submitting the proposal no agreement should yet exist between employer and knowledge bearer regarding carrying out activities (with the exception of apprenticeships or final projects).

[44] *subsidy to company for hiring a "knowledge carrier" (master level); graduate implements a previously drafted innovation plan, They must hire the knowledge carrier for at least 32 hours on a weekly basis for a period of at least one year.*

Appendix 3 | List of interviewees

Riin Ehin, Competence Centre for Cancer Research
Ülo Jaaksoo, Cybernetica AS
Teet Jagomägi, AS Regio
Indrek Kelder, Enterprise Estonia
Katrin Kiisler, Archimedes Foundation
Ilmar Kink, Nanotechnologies Competence Centre
Arvo Kivikas, AS Ilves-Extra
Erki Mölder, AS Quattromed
Rein Parelo, TERE AS
Mehis Pilv, AS Silmet
Katri Ristal, Estonian Academy of Arts
Suido Saarmets, Enterprise Estonia
Urmas Sannik, Competence Centre of Food and Fermentation Technologies
Alvar Savolainen, Tallinn University of Technology
Marek Tiits, Estonian Academy of Sciences
Rene, Tõnnisson, Biotechnology Park, Tartu Science Park
Kadri Ukrainski, University of Tartu
Urmas Varblane, University of Tartu
Madis Võõras, Enterprise Estonia

Appendix 4 | List of references

1. Aghion, P. and Howitt, P., (1990): A model of growth through creative destruction, Working Paper 32, Cambridge, MA: National Bureau of Economic Research, Inc.
2. Aghion, P., Howitt, P. (1997): Endogenous Growth Theory. MIT Press.
3. Archimedes Foundation (2007): Database of FP5 and FP6 projects.
4. Bhagwati, J. N. (1976): The Brain Drain and Taxation – Theory and Empirical Analysis. Amsterdam: North-Holland.
5. European Commission (2006): Annual Innovation Policy Trends and Appraisal Report. Estonia 2004–2005, European Trend C hart on Innovation, Enterprise Directorate-General. http://trendchart.cordis.lu/tc_country_list.cfm?ID=23.
6. European Commission (2001): European Trend Chart on Innovation, Policy Benchmarking Workshop. Favouring Industry-Science Relationships through Human Capital Mobility.
7. European Commission (2003): Evaluation of the Trend Chart Policy Benchmarking Workshops, 2001–2002, Trendchart.
8. Eurostat, Eurostat On-line Database, 2006. http://epp.eurostat.cec.eu.int/pls/portal/url/page/PGP_QUEEN/PGE_QUEEN_TREE?screen=welcomeref&open=/&product=EU_MAIN_TREE&depth=1
9. Estonian Research, Development and Innovation Strategy 2007–2013 (2007), http://web.riigikogu.ee/
10. Florio, M., Ozzio, E. (2006): Innovation Strategies for SMEs and Clusters: The challenges of a globalized Europe, Working Paper n. 2006–16, Guigno.
11. Fraunhofer ISI (2002): Research on the Estonian Biotechnology Sector Innovation System, Karlsruhe. http://www.biotech.city.ee/images/Fraunh-raport150203.pdf or http://www.mkm.ee.
12. Grossman, G. and Helpman, E., (1991): Innovation and growth in the global economy, Cambridge, MA: MIT Press.
13. Innobarometer (2004): Flash Eurobarometer 164, EOS Gallup Europe, http://cordis.europa.eu/innovation-smes/src/innobarometer2004.html
14. Jürgenson, A. (forthcoming in 2007), Impact evaluation of Estonian R&D financing programme, Tallinn: PRAXIS Center for Policy Studies.
15. Jürgenson, A., Kalvet, T., Kattel, R. (2005): Business Support Measures in the Budget Strategy for 2007–2013, Policy Analysis No 9, Tallinn: PRAXIS Center for Policy Studies.
16. Kalvet, T., Kattel, R., Küünarpuu, K., Vaarik, D., Rahu, K. and E. Ojamets (2005): Innovatsioon ja Eesti arvamusliidrid. Eeluuring riikliku innovatsiooniteadlikkuse programmi sihtrühmade relevantsete vajaduste leidmiseks (Innovation and Public Opinion Leaders in Estonia: Study with Recommendations for National Innovation Awareness Programme), Tallinn: PRAXIS Center for Policy Studies.
17. Kattel R. And Kalvet, T. (2006) Knowledge-based Economy and ICT-Related Education: Overview of the Current Situation and Challenges for the Education System. Tallinn: PRAXIS Center for Policy Studies.
18. Kalvet, T., Pihl, T., Tiits, M. (2002): Analysis of the Innovation System in the Estonian IT Sector. Summary, Tartu: SA Archimedes.
19. Labour demand prognosis until 2012 (2006), Tallinn: Estonian Ministry of Economics and Communication.
20. Lankhuizen, M., Klein Woolthuis, R. (2003): The National Systems of Innovation Approach and Innovation by SMEs, Netherlands.
21. Mahroum, S. (2000): Highly Skilled Globetrotters: The International Migration of Human Capital. Seville: Institute for Prospective Technological Studies.
22. Meyer, J.B., Brown, M. (1999): Scientific Diasporas: A New Approach to the Brain Drain, Prepared for the World Conference on Science UNESCO – ICSU, Budapest, Hungary. http://www.unesco.org/most/meyer.htm#note1.
23. Ministry of Economic Affairs and Communications (2003): Overview of Research Technology Development and Innovation (RTDI) policy in Estonia. http://www.riigikantselei.ee/failid/Overview_of_RTDI_Policy_in_Estonia_for_OECD___MoEC__2003.pdf
24. Mollerup Designlab A/S, (2002): Establishing the basis for the elaboration of the Estonian design policy measures, http:// www.mkm.ee.
25. N.S.F (1998): National Science Foundation, Science and Engineering Indicators 1998, N.S.F. Washington, DC.

26. Nedeva, M., Georghiu, L. (2003): Assessment of the Estonian Research Development Technology and Innovation Funding System, PREST, http://www.mkm.ee.
27. OECD (2006): Labour Force Statistics.
28. Oliveira Martins J., F. Gonand, P. Antolin, C. de la Maisonneuve and K.-Y. Yoo (2005): The Impact of Ageing on Demand, Factor Markets and Growth, OECD Economics Department Working Papers, No. 420, OECD, Paris.
29. Open Doors (2006): Students on the Move: The Future of International Students in the United States. ACE Issue Brief.
30. Operational Programme for the Development of the Economic Environment, Draft (in Estonian), (2006), http://www.struktuurifondid.ee
31. Operational Programme for Human Resource Development, Draft (in Estonian) (2006), http://www.struktuurifondid.ee
32. Pavitt, K., (1984). Sectoral Patterns of Technical Change: Towards a Taxonomy and a Theory, Research Policy, 13, 6.
33. PW Partners (2002): Sector Research of Estonian Information Technology and Telecommunications, Tallinn: SA Eesti Kutsehariduse Reform.
34. Ramböll Management AB (2006): „När kunskap ger resultat – värdet av ingenjörer i mindre företag".
35. Reid, A, Kurik, S. and V. Rouwmaat, (2003): Business Incubation: Review of Current Situation and Guidelines for Government Intervention in Estonia.
36. Reid, A. (2003): Optimising the Design and Delivery of Innovation Policy in Estonia: an Evaluation of Policy Instruments for Intensifying Business Innovation.
37. Saar Poll (2005): Development Trends of Estonian SME's.
38. Schmidt, E. (1997): Innovation im Mittelstand: Theoretische und empirische Aspekte, RWI, Essen.
39. SQW Limited (2003): Evaluation of the Spinno Programme, Final Report to Enterprise Estonia, Cambridge. http://www.eas.ee/ vfs/2127/Evaluation_of_the_Spinno_programme.pdf or via http://www.mkm.ee.
40. Study assessing the impact and implementation of the SPINNO programme in years 2001–2006
41. Statistical Office of Estonia (2006): The Community Innovation Survey (CIS IV 2002–2004).
42. Statistical Office of Estonia (2007), www.stat.ee and direct contacts.
43. Technopolis BV (2001): High Tech Venturing in Estonia: Background Report for the ESTPIN programme, (attached file).
44. Technopolis Ltd. (2002): Competence Centre Programme Estonia Feasibility Study.
45. Technopolis Consulting Group (2003): Estonian Innovation Awareness Programme Final Report, Pera International, http://www.mkm.ee.
46. Technopolis Consulting Group Belgium SPRL (2005): Evaluation of the design and implementation of Estonian RTDI policy: implications for policy planning. Final report, http://www.mkm.ee.
47. Thorn & Holm-Nielsen, 2006: International Mobility of Researchers and Scientists, UNU-WIDER, Research Paper 2006/83.
48. Tiits, M., Kattel, R., and T. Kalvet (2006): Made in Estonia, Tartu: Institute of Baltic Studies.
49. Tiits, M., Kattel, R., Kalvet, T. and R. Kaarli (2003): Competitiveness and Future Outlooks of the Estonian Economy, Tallinn: Research and Development Council
50. Todisco, E., M.C.Brandi, and G. Tattolo (2003): A theoretical Framework and the Case of Foreign Researchers in Italy, Fulor 1(3).
51. UNESCO (2004): UIS Survey of Science and Technology Statistics. www.uis.unesco.org
52. Wickramasekara, P. (2002): Policy responses to skilled migration: Retention, return and circulation, Social Protection sector international migration programme, ILO, Geneva.
53. Viia, A., Terk, E., Lumiste, R., Heinlo, A. Innovaatiline tegevus Eesti ettevõtetes Euroopa Liidu neljanda innovatsiooniuuringu (CIS 4) tulemused (Innovative Activities in Estonian Enterprises According to the EU CIS4 Study), Tallinn: EAS, 2007,
54. Zernike Group (2004): Access of Enterprises to Venture Financing in Estonia: Feasibility Study of Government Support Scheme.
55. Zimmermann, H. (2004): European Labour Mobility: Challenges and Potentials, Discussion Paper No. 1410, IZA, Bonn.
56. United Nations (2007), Population Division, Department of Economic and Social Affairs.

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