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TALLINNA TEHNIKAÜLIKOOL
TALLINN UNIVERSITY OF TECHNOLOGY

Baltic Metropoles
BaltMet Inno

The current state of clusters in Estonia and the possible role for local government initiatives: the cases of ICT, electronics, health care and biotechnology in Tallinn

Tallinn University of Technology
Institute of Humanities and Social Sciences

Project team:

Prof. Dr. Rainer Kattel
Tarmo Kalvet
Erkki Karo
Margit Suurna

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Lühikokkuvõte

Käesolev uuring käsitleb potentsiaalseid klastreid ning klastrite arendamist Tallinna piirkonnas. Uuring on osa *BaltMet Inno Workpackage 3 „Cluster development*" projektist. Uuringu tellijaks oli Tallinna Linnavalitsuse Ettevõtlusamet ning läbiviijaks oli Tallinna Tehnikaülikooli Humanitaar- ja sotsiaalteaduste instituut. Uuring viidi läbi oktoober kuni detsember 2007.

Uuringu eesmärgiks oli analüüsida Tallinna regiooni klastrite hetkeolukorda. *BaltMet Inno* laiema programmi eelvaliku alusel said uuringus käsitletavateks potentsiaalseteks klastriteks järgnevad valdkonnad:

a) **info- ja kommunikatsioonitehnoloogia,**
b) **elektroonika,**
c) **biotehnoloogia ja tervishoid.**

Uuringu jooksul selgus, et biotehnoloogia ning tervishoid moodustavad Eestis kaks erineva arengutasemega valdkonda, mistõttu oli informatiivsem ning otstarbekam käsitleda neid kahe erineva uurimisobjektina.

Eelvaliku alusel uuringu keskmesse valitud potentsiaalsed klastrid on olulised ka Euroopa laiemate trendide kontekstis, mis näevad neid valdkondi kõige tugevamate majanduskasvu ja -arengu mõjutajatena. Antud valdkondade populaarsus pakub ühelt poolt võimalust analüüsida ning õppida teistest klastrite arendamise initsiatiividest. Teisalt on antud valdkondade uurimine oluline, kuna nende üleüldine populaarsus võib varjutada nende valdkondade arendamisega kaasnevaid probleeme ja ohte, millest avalik poliitika peaks siiski teadlik olema.

Lisaks esindavad antud valdkonnad teadmiste-mahukaid potentsiaalseid klastreid. Teadmistepõhiseid või -mahukaid valdkondi võib mitmel põhjusel pidada Eesti klastriuuringute oluliseks algpunktiks. **Esiteks**, antud valdkondi on võimalik käsitleda potentsiaalsete horisontaalsete klastritena, mis võivad luua võtmetehnoloogiatel põhinevaid võimendajad, mida saab kasutada traditsiooniliste tööstusarude arendamisel. **Teiseks**, arusaam, et Eestis olemasolevad ressursid ja võimekus on liiga piiratud selleks, et rahvusvaheliselt konkureerida traditsiooniliste klastrite väljundite põhjal, on loonud konsensuse keskendumaks teadmistepõhistele tegevustele. Antud raamistik muudab keskendumise teadmistepõhistele klastritele äärmiselt vajalikuks. Reaalsuses võib iga majandustegevus oma olemuselt olla teadmistepõhine ehk iga majandustegevust võib arendada teadmistepõhiste sisendite kaudu, ning mainitud horisontaalsed klastrid võivad toimida kogu majanduse võimendajatena.

Olemasolevate rahvusvaheliste uuringute ja nendest lähtuva klastri kontseptsiooni üheks peamiseks puuduseks peetakse keskendumist majanduslikult edukatele ja hästitoimivatele regioonidele (*Silicon Valley, Baden-Wuerttenberg, Cambridge* jne.). Samas, et nende näidete põhjal teha laiemas kontekstis olulisi ning asjakohaseid järeldusi, peaks kogu klastrite uurimine põhinema analüütilisel lähenemisel, mis vaatab otsestest majandustegevustest ja edukriteeriumidest tunduvalt sügavamale. Klastreid tuleks seega analüüsida terviklikult, võttes arvesse, et klastrid on osaks kindla piirkonna laiemast ruumilis-majanduslikust, kultuurilisest ning administratiiv-poliitilisest struktuurist.[1]

[1] Dümmler, P., Thierstein, A. 2002. „The European Metropolitan Region of Zurich – A cluster of economic clusters?"; Den Berg, L., Braun, E., Van Winden, W. 2001. „Growth Clusters in European Cities - An Integral Approach", *Urban Studies*, 38(1), pp. 185-205.

Antud uuringu raames kasutatakse terminit „**klaster" kontseptuaalses, isegi heuristilises käsitluses ehk klaster kirjeldab võimalikku kindla majandustegevusega seotud valdkonna erinevate osapoolte kooslust, kes võiksid teha koostööd ning toimida võrgustike laadsetes kooslustes**[2]. Sõltumata klastri definitsioonist ja lähenemisest võib üldistavalt **klastrit käsitleda kui meetodit erinevate osapoolte vahelise koostöö ja võrgustumise analüüsimiseks, organiseerimiseks ning juhtimiseks.**

Käesolev uuring langeb samasse ajaperioodi Euroopa Liidu (EL) struktuurifondide uue kasutusperioodiga (2007-2013), mis hõlmab endas majandusarengu toetusmeetmena ka klastriprogrammide arendamist Eestis. Seega oli uuringu käigus võimalik käsitleda ka Tallinna kui kohaliku omavalitsuse võimalikku rolli kogu Eesti klastripoliitika kujundamisel ja selles osalemisel. Lisaks langeb antud uuring samasse ajaperioodi planeeritava *Tallinna Innovatsioonistrateegiaga* aastateks 2008-2013, mis rõhutab nii „klastrimõtlemise" ja -programmide kujundamist Tallinnas kui ka toob esile vajaduse koordineerida kohaliku omavalitsuse arenguplaane ning poliitikaid lähtuvalt laiematest riiklikest poliitikatest ja rahastamisvõimalustest (struktuurifondid).

Käesolev uuring on olemasolevat klastrite käsitlust analüüsinud kriitilisest perspektiivist. Nagu eelnevalt mainitud põhineb suurem osa klastrite alasest akadeemilisest kirjandusest ning uuringutest arenenud riikide kogemusel või seal välja töötatud metoodikatel. See aga tähendab, et need lähenemised eeldavad automaatselt teatud arenenud riikidele omaste tingimuste olemasolu. Antud uuring on seevastu pannud kontseptuaalse lähenemise kujundamisel eriliselt rõhku Eestile omastele konteksti-spetsiifilistele karakteristikutele: **Eesti kui üleminekuühiskonna ning väikeriigi tunnused**. Uuringu üheks väljundiks on seega olnud ka mainitud kontekstilistest kriteeriumidest lähtuva klastrite analüüsi kontseptuaalse raamistiku kujundamine.

Kontseptuaalse raamistiku algpunktina käsitleti uuringus klastri arengut ja kasvu mõjutavate faktorite jaotamise metoodikat[3]:

a) laiem piirkonna arengukontekst **ruumilis-majanduslike tingimuste näol**, mille üle klastri ettevõtetel või üksikutel avalikel poliitikatel ei ole eraldiseisvana lühiajalist ja otsest mõju, vaid mis vajavad kogu ettevõtluskeskkonna terviklikku ja teadlikku arendamist (nõudlus piirkonnas klastri väljundite järele, piirkonna elukvaliteet, ligipääs piirkonnale, kultuurilised tingimused piirkonnas);

b) **klastri-spetsiifilised tegurid**, mida võivad üksikud ettevõtted ja klastrisse sisenevad uued osapooled juba rohkem mõjutada (klastri suurus ja arengutase, klastri „mootorite"/ arendajate olemasolu, strateegilise suhtluse ulatus klastri liikmete vahel, uute ettevõtete loomise tase);

[2] On levinud arusaam, et koostöö ja võrgustumine, mis aja jooksul võivad areneda klastriteks või klastri-sarnasteks kooslusteks, on jätkusuutliku majandusarengu ning selleks vajalike struktuuride eeltingimuseks. Seega on tõhusate majandus- ja innovatsioonipoliitikate kujundamiseks vajalik koostöö ja võrgustumise põhjalik analüüs, isegi siis kui rääkimine klastritest võib kindlas majanduskeskkonnas olla liiga ennatlik.

[3] Den Berg, L., Braun, E., Van Winden, W. 2001. „Growth Clusters in European Cities – An Integral Approach", *Urban Studies*, 38(1), pp. 185-205.

c) **klastri organiseerumise võimekust** mõjutavad tegurid, mida võivad olulisel määral mõjutada ja kujundada avalikud poliitikad (visiooni ja strateegiate olemasolu klastris, avaliku ja erasektori vaheliste võrgustike kvaliteet, ühiskondliku/poliitilise toetuse ulatus klastri arendamiseks).

Tuleb ära märkida, et algsed plaanid rajada kogu uuring antud metoodilisele lähenemisel oli raskendatud nii statistiliste allikate puuduse kui ka väga erineva klastri mõiste käsitluse tõttu Eestis. Olemasolevad uuringud ning analüüsid käsitlevad klastreid nii territoriaalse innovatsiooni süsteemi raamistikus kui ka tehnoloogia või teatud majandussektoriga seotud võrgustikena. Lisaks selgus, et paljudes valdkondades, kus klastritest aktiivselt räägitakse, on klastri-spetsiifilised ja klastri organiseerumist mõjutavad tegurid alles väga algses arengustaadiumis ning nende terviklik käsitlemine ei ole tihti veel võimalik. Seetõttu tuli valitud metoodikat iga konkreetse valdkonna analüüsimiseks kohandada vastavalt keskkonnale ning valdkonna arengustaadiumile.

Uuringu läbiviimisel rajaneti peamiselt nelja tüüpi informatsiooniallikatele ja nende analüüsile:

a) laiaulatuslik olemasolevate päevakajaliste ja Eesti kontekstis (kas metodoloogiliselt või sisult) oluliste rahvusvaheliste võrdlevate uuringute, allikate ning ka siseriiklike poliitikadokumentide analüüs;

b) Eesti ja võimalusel spetsiifiliselt Tallinna ettevõtluse ja selle arengute kohta käivate statistiliste andmete analüüs[4];

c) olemasolevate klastreid käsitlevate või seotud majandussektoreid käsitlevate uuringute ja analüüside interpreteerimine käesoleva uuringu jaoks vajaliku informatsiooni välja selekteerimiseks[5];

d) pool-struktureeritud süvaintervjuud peamiste ekspertide ning potentsiaalsete klastrite osapoolte esindajatega. Kokku intervjueeriti antud uuringu käigus rohkem kui 15 erineva institutsiooni esindajaid (kokku 22 indiviidi).

Uuringu sisuline osa on jaotatud 6 alapeatükiks, mis käsitlevad järgnevaid teemasid:

a) „**Klastrimõtlemine" ja selle konteksti-spetsiifika**, mille eesmärgiks oli luua raamistik, mille alusel on võimalik analüüsida Eesti kui üleminekuühiskonna ja väikeriigi klastrite arengut ning võimalikku avalike poliitikate rolli;

b) **Tallinna ruumilis-majanduslike tingimuste analüüs**, mis lisaks eelnevalt väljatoodud metoodikale käsitles ka spetsiifiliselt sotsiaal-majanduslikke ja poliitilis-administratiivseid küsimus, mida standardsed arenenud regioonide ja riikide kogemuse põhjal tekkinud lähenemised arvesse ei võta, sest eeldatakse nende faktorite stabiilset ja etteennustatavat arengut. Samas Eesti kui üleminekuühiskonna ja

[4] Uuringu käigus selgus, et Eestis on paljudes valdkondades puudus olulistest ja usaldusväärsetest statistilistest andmetest, mis muutis statistiliste andmete kasutamise äärmiselt keeruliseks. Kuivõrd tihti ei olnud erinevatest allikatest kogutud andmed piisavalt usaldusväärsed, ei ole neid uuringus ka täpsemalt kajastatud.

[5] Olemasolevate allikate interpreteerimine toimus peamiselt läbi intervjuude konkreetsete uuringuid läbiviinud indiviididega – antud uuringutele on ka kogu analüüsi käigus pidevalt viidatud.

väikeriigi kontekstis, tuleb antud aspekte konteksti-spetsiifiliselt käsitleda ja põhjalikult analüüsida;

c) **Potentsiaalse IKT klastri analüüs;**

d) **Potentsiaalse elektroonika klastri analüüs;**

e) **Potentsiaalse tervishoiu klastri analüüs;**

f) **Potentsiaalse biotehnoloogia klastri analüüs.**

Uuringu kokkuvõttes on toodud välja peamised uuringu tulemused erinevate teemade lõikes ning välja on pakutud ka laiem kontseptuaalne raamistik, mille alusel kohalik omavalitsus saaks klastrite arendamist ja selle vajalikkuse analüüsimist ka teistes potentsiaali omavates valdkondades alustada.

Järgnevalt on välja toodud lühikokkuvõtted iga alapeatüki peamistest järeldustest ning nende olulisusest avaliku poliitika kontekstis. Iga potentsiaalse klastri kohta tehtud poliitikasoovitused on väljatoodud uuringu põhiosas, antud kokkuvõttes on väljatoodud kohaliku omavalitsuse rolli üldises perspektiivis käsitlevad soovitused ning raamistik.

<u>„Klastrimõtlemine" ja selle konteksti-spetsiifika</u>

Nagu eelnevalt on välja toodud, põhineb suurem osa „klastrimõtlemisest" peamiselt arenenud (ja suurte) riikide, regioonide kogemuse põhjal. Samas tuleks Eesti puhul arvesse võtta järgmist aspekti, mida „*mainstream* klastrimõtlemine" arvesse ei võta:

- Üleminekuühiskondades puuduvad tihti paljud tegurid, mida arenenud riikides võetakse iseenesestmõistetavalt – **konkurentsivõimeline kvaliteetne teadus- ja haridustegevus; erasektori võrgustumine; toimiv ja võimekas avalik sektor.**

On selge, et eksisteerib suur vahe kas klastripoliitikaid kujundatakse arenenud regioonides või tuleb seda teha vähemarenenud regioonides.

Konteksti-spetsiifiline lähenemine peab arvesse võtma Eesti kui avatud majandusega väikeriigi ja üleminekuühiskonna eripärasid, mis väljenduvad järgmistest iseloomulikes karakteristikutes:

a) majanduse väiksus ja avatus välismõjudele, mis on kaasa toonud avatuse välisinvesteeringutele ning ettevõtete välisomanike kõrge osakaalu paljudes majandusarengu võtmevaldkondades;

b) VKE-de ja mikro-ettevõtete domineerimine enamikes majandussektorites;

c) majandusarengu rajanemine lühiajalisel kulupõhisel eelisel;

d) puudub vajadus ja teadlikkus koostööst, võrgustumisest, nende mõjudest ehk **iseloomulik on usalduse ja koostöö traditsiooni puudumine**, mis väljendub nõrkades või olematutes klastri-tüüpi kooslustes ning potentsiaalsete klastri osapoolte väheses kogemuses ja kompetentsis koostöö ning võrgustumise arendamisel. Üleminekuühiskonnale omaselt on vähene usaldus ja koostöö iseloomulik nii avaliku ja erasektori

vahelistele suhetele kui ka erinevate klastri osapoolte vahelistele suhetele (näiteks ülikoolide ja ettevõtete vahel);

e) sektori- ja klastripõhiste poliitikate kogemuse puudumine avaliku sektori poliitikakujundamises;

f) avaliku sektori nõrk haldussuutlikkus, mis osaliselt väljendub puudulikus avaliku sektori poliitikate koordineerimises;

g) innovatsioonipoliitika rajanemine EL finantsvahenditel, mis tähendab, et suurem osa poliitikatest on kujundatud vastusena EL ja Euroopa Komisjoni soovitustele ning nõudmistele ilma, et oleks põhjalikult analüüsitud olemasoleva avaliku sektori poliitikaanalüüsi, poliitikakujundamise ja poliitikate elluviimise võimekust ja sobivust;

h) senini ei ole toimunud laiaulatuslikku teadlikku kompetentside loomist klastriarendamise ja kogu koostöö ning võrgustumisega tihedalt seotud poliitikavaldkondades.

Seega peaksid Eesti kui väikeriigi ja üleminekuühiskonna klastripoliitikad lähtuma arusaamast, et enne traditsiooniliste arenenud riikide kogemuste põhjal väljakujundatud programmide ja mudelite rakendamist tuleks analüüsida potentsiaalsete klastri osapoolte vahelise usalduse ja eksisteerivate seoste olemasolu, tugevust ning arengupotentsiaali. Ühiste kokkupuutepunktide ja usalduse baasilt saavad tekkida ühised arusaamad, visioonid ja strateegiad, mis saavad areneda selgeteks klastri initsiatiivideks – ja programmideks.

Seega eeldab Eesti hetke arengukontekst nn. **kompetentsipõhist klastriarendust**, mis seisneb esmalt kõikide osapoolte vajaduste, võimaluste, ootuste kaardistamisel ning kogumisel, millele peab järgnema **prioriteetide seadmine läbi koostöö**, et tekitada erinevate osapoolte usaldus, omanikutunne ning reaalne valmisolek osalemaks pikaajalistes ja ressursimahukates programmides.

Väikeriigi puhul on oluliseks vajadus keskenduda **T&A ning teadmistepõhistele potentsiaalsetele klastritele**. Väikeriigile on omane vähene kvaliteetse inimkapitali (lisaks vähesele finantskapitalile) hulk erinevates valdkondades, mistõttu võib klastrite kui koostööd ja võrgustumist arendavate programmide mõju ja võimekus jääda piiratuks, kui nendesse ei ole kaasatud kõige parem osa inimkvaliteedist. Loogiliselt on see enamasti seotud nii ülikoolide kui T&A tegevusega laiemalt.

Sellest tulenevalt peaksid erinevad poliitikainitsiatiivid selgelt olema suunatud ülikoolide ja akadeemia kaasamisele. Kuigi see eeldab keskendumist teadmistepõhistele tegevustele ja nendest lähtuvatele koostöövõrgustikele, ei pea see tähendama, et kogu klastriprogramm jääbki ainult ülikoolide keskseks ning nende T&A tegevusel põhinevaks. Pigem võimaldab see väikeriigis tagada seda, et valdkonna tippkompetents on seotud oluliste poliitikainitsiatiividega, mis omakorda aitab ka laiemat valdkonna teadmust ja kompetentse arendada läbi võrgustike toimuva ülekandeefekti. **See saab olla ka paindliku klastri(te) arendamise aluseks.**

Tallinna ruumilis-majanduslike tingimuste analüüs

Poliitikakujundamine, eriti programmide puhul, millel on otsene seos mitme valitsemistasandiga, peab üleminekuühiskondades arvesse võtma olulisi riigi sotsiaal-majanduslikke ning poliitilis-administratiivseid alustingimusi, mis poliitikate elluviimist mõjutada võivad. Tallinna ja Eesti kontekstis võib olulisemate tingimustena välja tuua järgnevaid aspekte:

a) Üleminekuühiskonnale omaselt on **poliitikakujundamisel ja -elluviimisel Eestis senini puudunud selge prioriteetide seadmine, poliitikate analüüs, horisontaalsete poliitikaküsimuste koordineerimine** (innovatsioonipoliitikat võib selgelt pidada üheks valdkonnaks, mis ületab traditsioonilisi haldussüsteemis väljakujunenud piire). Lisaks on poliitikate koordinatsiooni piiranud ka poliitikate elluviimine läbi nn. agentuuride (ametid, inspektsioonid, eelkõige aga sihtasutused), mis killustab poliitikaid ning takistab nende protsessipõhist koordineerimist. Ka innovatsioonipoliitika mehhanismide rakendamine ja seotud EL struktuurifondide rahastamismehhanismide ülesehitus hõlmab endas sarnaseid probleeme.

b) Üleminekuprotsessis olevale väikeriigile omaselt on Eesti viimase rohkem kui kümnendi jooksul **kannatanud selgelt kvalifitseeritud eriti keskastme ning tehnilise ametkonna puuduse all, nii keskvalituse kui eriti kohaliku omavalitsuse tasemel**. See omab negatiivset mõju haldussüsteemi võimekusele erinevate poliitikate elluviimisel.

c) Eelnevaga seotult on üheks valupunktiks **ebapiisav poliitikate koordinatsioon erinevate haldustasandite vahel**.

d) Väikeriigile omaselt puudub Eestis iseseisev ja autonoomselt tegutsev regionaalne valitsemistasand, mis tähendab, et traditsioonilised regionaaltasandi ülesanded on jaotatud kestasandi ning kohaliku omavalitsuse vahel, ja seda pigem tsentraliseeritult. **See aga tähendab, et traditsioonilise klastri-põhise lähenemise sobilikkust, mis tihti paneb suuremat rõhku regionaalse või kohaliku tasandi rollile, tuleb Eesti kontekstis kriitiliselt analüüsida**.

Tallinna ruumilis-majanduslike tingimuste hindamise keskmeks on fakt, et Tallinn on hetkel Eesti majanduse süda, mis tähendab, et enamikes analüüsitud aspektides (nõudlus piirkonnas klastri väljundite järele, piirkonna elukvaliteet, ligipääs piirkonnale, kultuurilised tingimused piirkonnas jne.) omab Tallinn selget eelist teiste Eesti piirkondade ees. **Lühidalt on Tallinnas soodsaim keskkond ja ka ressursid klastripoliitikate kujundamiseks**.

Samas tuleb arvestada ka seda, et mitmed riikliku tasandi sekkumist nõudvad probleemid võivad Tallinna arengutasemest sõltuvalt kohalikul tasandil esile kerkida varem kui riiklikul tasandil jõutakse ühtsete meetmete ning poliitikateni. **See tähendab, et Tallinnal kui kohalikul omavalitsusel peab olema piisav analüüsi ning poliitikakujundamise võimekus, et neid probleeme leevendada, ennetada ning vajadusel ka oma vajadusi keskvalitsuse tasandil teadvustada.**

Kõike arvesse võttes võib väita, et Tallinna kui kohaliku omavalitsuse poliitikainitsiatiivid, ka klastrite arendamisel, peavad selgelt olema seotud keskvalitsuste analoogsete poliitikatega. **Tallinna üldist arengukeskkonda ja selle eeliseid arvesse võttes võiks eeldada, et Tallinn on loogiline**

keskvalitsuse klastriprogrammide rakendaja, kuid nende jätkusuutlikkus eeldab:

a) teadlikku ja pikaajalist ruumilis-majanduslike tingimuste arendamist kohaliku omavalitsuse poolt;

b) omavalitsuse spetsiifiliste klastritega seotud poliitikainitsiatiivide kooskõla keskvalitsuse poliitikatega.

Seega võib väita, et kohaliku omavalitsuse klastripoliitika peab olema osa riiklikest klastrite arendamise poliitikatest ning Eesti arengutaset ja hetke sotsiaal-majanduslikku keskkonda arvesse võttes peaksid ka traditsioonilised kohaliku omavalitsuse funktsioonid (linnaplaneerimine, transpordikorraldus jne.) olema osa omavalitsuse läbimõeldud klastripoliitikast. Kõik see eeldab selget koordinatsiooni nii avaliku võimu erinevate tasandite sees kui ka erinevate tasandite vahel. Ilma ühtse avaliku poliitikata ei ole ka jätkusuutlik koostöö muude klastri osapooltega tõenäoline.

Potentsiaalse IKT klastri analüüs

Antud uuringus lähtuti klastri defineerimisel paindlikust lähenemisest, sest ühest IKT klastri definitsiooni ei eksisteeri. Ühelt poolt on IKT selgelt seotud elektroonikaga, mida antud uuringus käsitletakse eraldiseisvana. Teisest küljest on küsitav IKT kui eraldiseisva klastri mõttekus, sest oma sisult on tegemist pigem valdkonnaga, mille majanduslik edu on saavutatav läbi IKT tehnoloogiate ja lahenduste rakendamise teistes majandussektorites. Samas horisontaalse klastrina nähakse IKTs väga suurt potentsiaali ning paindlik lähenemine võimaldab IKT valdkonda analüüsida lähenemisnurgaga, mis lubaks selle erinevaid alaosasid siduda teiste majandusharudega.

Peamised analüüsi järeldused võib kokkuvõtlikult välja tuua järgmiselt:

- ei saa rääkida ei formaalsest klastrist, ega koostööst, võrgustumisest – iseloomulikuks on **usalduse ja koostöö traditsiooni puudumine**;

- **iseloomulikuks on turu killustatus**
  a) peamiselt on see tingitud välisomanike suurest osakaalust olulise turujõu ja klastri seisukohast määrava mõjujõuga ettevõtete seas, kellel on väiksem vajadus koostööks;
  b) paljude ettevõtete jaoks on välisturg ainuke prioriteet (või ollakse peamiselt seotud allhanke pakkumisega), mistõttu puudub hetkel vajadus koostööks kodumaiste ettevõtetega;
  c) domineerib väikeettevõtlus, millel ei ole reaalset võimekust oma vajadusi keskpikas perspektiivis prognoosida ning see piirab ka nende koostöövalmidust; lisaks on siseriiklikult tegutsevate VKEde jaoks sisemine konkurents selgelt suuremaks mõjutajaks kui koostööst tekkiv pikemaajaline kasu;
  d) suurettevõtteid iseloomustab vähene huvi koostööks, mis loob olukorra, kus vastupidiselt traditsioonilistele klastri arusaamadele ei ole valdkonna mõjuvõimsamad ettevõtted huvitatud klastrite arendamisest (peamiselt kuna on tegemist välismaa ettevõtete või turgudega seotud ettevõtetega, millel puudub iseseisev võimekus tegutseda T&A valdkonnas);
  e) turgu iseloomustab konkurents peamiselt odava sisendi pärast;

- IKT valdkonnas on üheks klastri arengut takistavaks teguriks nõrk üldpoliitiline sektoraalne esindusorganisatsioon;

- **oluliseks arengupotentsiaaliks on samas võimalike klastri liidrite olemasolu**, kes võiksid enda kanda võtta avalike poliitikate ja initsiatiivide toetamise ning propageerimise rolli, sest ainult omal jõul ei ole nende klastri liidrite institutsionaliseerumine antud hetkel reaalne;

- valdkonna tunnuseks on nõrgad seosed ettevõtete, ülikoolide ja avaliku poliitika vahel, mistõttu puuduvad selged arusaamad erinevate osapoolte kompetentsidest ja spetsialiseerumisest, mille tagajärjeks on kommunikatsioonibarjäärid ning ühiste prioriteetide seadmiste komplitseeritus;

- valdkonna koostöövõrgustike arengut on siiani takistanud ka puudulik avalike poliitikate koordineerimine ning vajalike kompetentside puudumine.

<u>Potentsiaalse elektroonika klastri analüüs</u>

Potentsiaalse elektroonika klastri defineerimisel kerkisid esile samad probleemid, mis IKT puhul ning tihti peetakse loogilisemaks IKT ja elektroonika ühist käsitlemist. **Samas, eristamine tõi välja mõned väga olulised erinevused IKT ja elektroonika vahel, mida klastri arendamise käigus tuleks arvesse võtta, isegi kui reaalsuses potentsiaalne klaster hõlmab korraga mõlemat valdkonda.**

Peamised analüüsi järeldused võib kokkuvõtlikult välja tuua järgmiselt:

- hetkel ei saa rääkida ei formaalsest klastrist, ega koostööst, võrgustumisest – seosed erinevate osapoolte vahel on isegi nõrgemad kui IKT puhul, sest kuigi eksisteerib **arusaam koostöö vajalikkusest, puudub valmisolek sellesse panustamiseks;**

- **iseloomulikuks on turu killustatus**
    a) peamiselt on see tingitud välisomanike ja sektorile eripäraselt ka välismaiste tegevjuhtide suurest osakaalust olulise turujõu ja klastri seisukohast määrava mõjujõuga ettevõtete seas, kellel on väiksem vajadus koostööks;
    b) paljude ettevõtete jaoks on välisturg ainuke prioriteet (või ollakse peamiselt seotud allhanke pakkumisega), mistõttu puudub hetkel vajadus koostööks kodumaiste ettevõtetega;
    c) valdkonna tegevust iseloomustab väikeettevõtlus ja turunišši des tegutsemine, mis väljendub nii väheses sisulises koostöös kui ka konkurentsis ettevõtete vahel (erandiks on ettevõtete vaheline konkurents odavate sisendite pärast), mis on kaks klastrite arengu olulist eeltingimust;
    d) kokkuvõtlikult väljendub see väheses valmisolekus klastri edasiviimiseks;

- valdkonnas eksisteerib ainult formaalne ettevõtlusorganisatsioon, kuna ettevõtjate seas ei tunta vajadust sisukama organisatsiooni järele, sest kasu saadakse nii seotud valdkondade (IKT) organisatsioonide üldpoliitilisest tegevusest ning valdkonna enda niššidesse spetsialiseerumine ei ole ettevõtjate seas tekitanud piisavat ühisosa ühistegevuse arendamiseks. Sisuliselt tähendab see seda, et valdkonnas

puudub organisatsioon, mis täidaks klastrite arendamisel ettevõtlusorganisatsioonidele seatud ülesandeid ning täiendaks avalike poliitikaid enda poolsete kompetentsidega;

- nõrgad seosed ettevõtete, ülikoolide ja avaliku poliitika vahel, mis on tingitud kommunikatsioonibarjääridest ning erinevatest prioriteetidest ettevõtlushuvide ja akadeemiliste huvide vahel – hetkel puudub kahe erineva osapoole ühendamiseks vajalik ühisosa;

- lisaks on osapoolte vahelist koostööd pärssinud sektoripõhiste ja klastri poliitikate puudumine, mistõttu ei ole tekkinud arusaama erinevate osapoolte kogemusest ja prioriteetidest;

- tehnoloogia arenduskeskust ELIKO võib vaadelda kui valdkonna seniste üksikute koostööinitsiatiivide keskust, mis oma pädevuspiirides on kokku toonud ja koostööle suunanud üksikuid T&A tegevusega seotud ettevõtteid ning ülikooli;

- valdkonna koostöövõrgustike arengut on siiani takistanud puudulik avalike poliitikate koordineerimine ning vajalike kompetentside puudumine.

<u>Potentsiaalse tervishoiu klastri analüüs</u>

Tervishoiu ja biotehnoloogia erinev arengukontekst (viimane on selgelt akadeemilisel tegevusel põhinev valdkond ning tervishoid on T&A tegevusest hetkel selgelt liigselt võõrandunud) ei võimalda neid kahte valdkonda sisuliselt koos käsitleda, küll peaks see reaalne olema tulevikus.

Peamised analüüsi järeldused võib kokkuvõtlikult välja tuua järgmiselt:

- kuigi **koostöö on formaalselt tervishoiu süsteemi sissekirjutatud**, klastrile omast koostööd ei toimu, seda paljuski süsteemi enda vigade tõttu;

- koostöö arengut takistavad põhimõttelised probleemid tulenevad tervishoiusüsteemi funktsioneerimisest, sest esineb probleeme informatsiooni liikumises erinevate osapoolte vahel; professionaalne koostöö tervishoiu teenuste pakkujate vahel (eelkõige vertikaalsel tasemel) on tihti pärsitud; dubleeritakse funktsioone, mis ei ole olemasolevate kompetentside ning ressursside puhul otstarbekas jne.;

- formaalne tervishoiu süsteem ei hõlma kõiki osapooli, mistõttu on ülevaade valdkonnast ja süsteemist paljude osapoolte jaoks mittetäielik ning fragmentleeritud;

- **iseloomulikuks on süsteemi killustatus**
    a) tervishoiusüsteem keskendub liigselt haigla- ja meditsiiniteenustele jättes võimalikud täiendavad funktsioonid (sh T&A tegevuse arendamine valdkonnas) tahaplaanile;
    b) esineb pakutavate meditsiiniteenuste ebaotstarbekas dubleerimine, mis väljendub pakutava teenuse ebaühtlases kvaliteedis, koormates nii üle teised tervishoiu teenust osutavad tasemed ehk teisisõnu on täna hierarhiline süsteem tervishoiuteenuste pakkumisel reaalsuses puudulik;

c) tervishoiu süsteem toimib liiga patsiendi-keskselt pöörates vähe tähelepanu ennetusele, mis peaks olema üheks süsteemi sisuliseks ja kandvaks osaks, samuti on täna veel liiga vähe tähelepanu osutatud hooldusravile;
d) esinevad puudujäägid informatsiooni liikumises teenusepakkujate vahel (sh "isiklike tutvuste" domineerimine);
e) tervishoiusüsteemil puuduvad reaalsed sidemed lootustandvate teaduslike ja majanduslike valdkondadega (nagu nt geenitehnoloogia ja biomeditsiinitehnoloogia), millede arengule võiks süsteem pakkuda olulist sisendit;
f) süsteemi iseloomustavad vähesed seosed teaduse ja ettevõtlusega (ning peamised sidemed tulenevad majanduslikest kaalutlustest), eriti oluline on rõhutada, et on liiga **vähe seoseid Eesti ettevõtetega**, mistõttu on süsteem peamiselt seotud välismaiste partnerite ning arengutega ning ei paku vajalikku tuge sisemise koostöö ja võrgustumise arengule;
g) kohalik omavalitsus tegutseb pigem kui kontrollija ning mitte kui nõustaja ja partner süsteemi arendamisel ning ümberkujundamisel;
h) kokkuvõtlikult on klastri arengu peamiseks takistuseks sobivate toimivate institutsioonide ning liidrite puudumine;

- süsteemiga seotud professionaalseid organisatsioone iseloomustab killustatus ja spetsialiseerumine, mistõttu on ka nende kvaliteet ning võimekus varieeruv ning tihti keskendutakse ainult kindla tervishoiu valdkonna problemaatikale ja jäetakse kõrvale süsteemipõhise koostöö arendamise küsimused;

- kogu süsteemi olukorda iseloomustavad nõrgad seosed tervishoiusüsteemi, ülikoolide ja avaliku poliitika vahel, kuigi vastupidised arengutrendid võivad tulevikus tekkida läbi Tehnomeedikumi ja sarnaste koostööd arenevate keskuste tekkimise ja ühise arendamise;

- klastri areng on sõltuvuses IKT mõjudest ning süsteemi erinevate osapoolte võimalikust geograafilisest kontsentreerumisest;

- valdkonna koostöövõrgustike arengut on siiani takistanud puudulik avalike poliitikate koordineerimine ning vajalike kompetentside puudumine, sealhulgas sektoripõhiste ja klastri poliitikate puudumine, mistõttu ei ole tekkinud arusaama erinevate osapoolte kogemusest ja prioriteetidest.

<u>Potentsiaalse biotehnoloogia klastri analüüs</u>

Potentsiaalse klastri peamisteks tunnusjoonteks on hetkel väike ettevõtete arv, akadeemilisus ning vähene väljund ettevõtlusesse.

Peamised analüüsi järeldused võib kokkuvõtlikult välja tuua järgmiselt:

- biotehnoloogia valdkonda iseloomustavad **alles tekkivad koostöövormid (**nt. Tehnomeedium**,** ettevõtete ja T&A kontsentreerumine TTÜ lähedusse), kuid reaalselt eksisteerivast klastrist ei saa veel rääkida;

- **osapoolte vahelisi suhteid iseloomustab vähene usaldus ja koostöö;**

- valdkonna arengut mõjutab oluliselt Kesk- ja Ida-Euroopa regioonile omane pigem negatiivne **maine** Lääne maailmas ning tugev sisemaine **rivaliteet ja killustatud tegevus** (Tallinn versus Tartu), mis pärsib koostöö kiiret ja sisulist arengut;

- **iseloomulikuks on turu ja süsteemi killustatus**
  a) tegevusvaldkondi iseloomustab heterogeensus ja kitsas spetsialiseerumine, mistõttu ei ole ei koostööd ega konkurentsi ehk puuduvad olulised klastrite arengut mõjutavad tegurid;
  b) erinev teaduslik ja väga kontsentreeritud lähenemine Tartu ja Tallinna teadusasutustes;
  c) valdkonna ettevõtlussektori moodustab väike arv peamiselt väikeettevõtteid;
  d) koostöö erinevate osapoolte vahel on sõltuv omanikusidemetest ehk samasse korporatsiooni kuuluvad ettevõtted teevad rohkem koostööd, kuid see ei ole klastri arenguks piisav koostöökooslus;
  e) suurem osa ettevõtetest on keskendunud peamiselt välisturule, mistõttu jäävad sidemed ja võimalik koostöö siseturu partneritega piiratuks;
  f) ettevõtete turuosa suurendamine toimub pigem läbi tegevuste horisontaalse ja mitte vertikaalse laiendamise;
  g) ettevõtluse põhitegevus keskendub tihti madalama lisandväärtuse kui teadmiste-mahukatele tegevustele;
  h) kokkuvõttes iseloomustab valdkonda täna veel tugevate klastri liidrite, nii organisatsiooniliste kui ka indiviidide (v.a. üksikud tärkavad näited), puudumine, kellel oleks nii huvi kui ka ressursid klastri arendamisse ja edasiviimisse investeerida;

- valdkonnas tegutseb suhtelisel tugev esindusorganisatsioon, mis siiski ei kata kõiki valdkonna ettevõtteid ning tegutseb pigem suuremate ja edukamate ettevõtete ühisplatvormina, samuti on esindusorganisatsioon hetkel keskendunud pigem riiklike funktsioonide täitmisele (a la riikliku tasandi strateegilise mõtlemise ja visiooni tekitamine) kui ettevõtluse esindusorganisatsiooni kompetentside ja pädevuste pealt valdkonna arendamisele;

- formaalsete sidemete kõrval esineb küllaltki tugev personaalsetel sidemetel põhinev koostöö ettevõtjate ja T&A vahel (kogu sektori raames on valdkonnas tegutsejad üldjoontes üksteisele teada-tuntud);

- kuigi biotehnoloogia peaks olema tugevalt seotud tervishoiu ja meditsiini valdkonnaga, on hetkel iseloomulikuks pigem **vähene side tervishoiusektoriga**, olulist rolli erinevate osapoolte kokkuviimisel võib mängima hakata Tehnomeedikumi loomine;

- valdkonna koostöövõrgustike arengut on siiani takistanud ka puudulik avalike poliitikate koordineerimine ning vajalike kompetentside puudumine, sealhulgas sektoripõhiste ja klastri poliitikate puudumine, mistõttu ei ole tekkinud arusaama erinevate osapoolte kogemusest ja prioriteetidest.

Kokkuvõte ja võimalik raamistik kohaliku omavalitsuse klastripoliitikateks

Hetkel ei saa klastreid käsitleda teisiti kui heuristiline kontseptsioonina. Reaalsete klastrite tekkimine, mille olemasolu ja jätkusuutlikkust tunnetaksid ka selle erinevad osapooled, eeldab veel pikaajalist arengut ja teadlikku arendustegevust.

Erinevalt klastrite tavakäsitlusest võib väita, et üldise võrgustumise ja koostöö arendamiseks võib ette kirjutada aktiivse kohaliku omavalitsuse ja keskvalitsuse rolli klastrite arendamisel.

Eesti majanduspoliitika kontekst on hetkel selline, et ilma „väliste" toetavate tõukefaktoriteta ei suuda majanduse struktuur väga suure tõenäosusega lühiajalises perspektiivis jätkusuutlikku ülesehitust iseeneslikult tekitada. Klaster kui heuristiline kontseptsioon ja klastriprogrammid kui keskne poliitikainstrument ettevõtete koostöö ja võrgustumise arendamiseks võiksid olla vahendid mainitud „välise" tõuke andmisel.

Avalikud poliitikad peaksid klastri arendamisel lähtuma järgnevatest tingimustest:

- **vajalik on kompetentside tõstmine** nii avaliku poliitika enda sees kui ka teiste osapoolte seas, ja seda läbi avaliku poliitika toetuse **– tulemuseks peaks olema mõtestatud planeerimine ja kogemusest õppimine, mille hulka peaks kuuluma ka konteksti-spetsiifiline vigadest õppimine**;

- **oluline on säilitada paindlik lähenemine klastritele ja nende piiritlemisele –** luua kontekst nende loogiliseks kujunemiseks ning vajadusel ümber arenemiseks kui selgub, et teatud klastrikooslused ei ole jätkusuutlikud.

Seega tuleb veekord rõhutada konteksti-põhise lähenemise olulisust, mis eeldab ka tugevat koostööd erinevate osapoolte vahel.

Eelneva põhjal võib välja tuua üldise raamistiku, milles kohalik omavalitsus saab klastrite arendamisel tegutseda. Selles raamistikus saab omakorda välja tuua kaks laiemat valdkonda, milles omavalitsus saab reaalselt tegutseda ning klastrite arendamisse panustada.

Terviklikuna võib kohalikku omavalitsust näha kui klastriarenduse liidrit ja moderaatorit, mis peaks väljenduma järgmistes prioriteetides, mida omavalitsus võtma peaks:

- oma valmisoleku, prioriteetide, vastutuse, lubaduste (ka finantsilise) paikapanek ning selge kommunikatsioon nii teiste osapoolte vahel kui ka avaliku sektori siseselt ehk usalduse loomine ja selle pinnalt edasi liikumine;

- kompetentside loomine konteksti-spetsiifiliseks klastriarendamiseks;

- keskvalitsuse ja teiste osapoolte initsiatiivide (ülikoolid, ettevõtted ja nende esindusorganisatsioonid jne.) suunamine, täiendamine omapoolsete pädevuste ja kompetentside baasil;

- T&A asutuste ja kõrgtehnoloogiliste ettevõtete kui regionaalse arengu mootorite tähtsustamine, et tagada võimalikult laiapõhjaline erinevate osapoolte kaasatus poliitikainitsiatiividesse.

Konkreetsemad tegevusvaldkonnad, kus kohalik omavalitsus aktiivselt tegutseda saab, on järgnevad:

a) **KOV kui klastri tekkimise "käimalükkaja"**

- kohalik omavalitsus saaks ennast presenteerida kui institutsiooni, mis saab tegutseda kui klastriarenduse liider ja moderaator, sest omavalitsuse paiknemine klastri osapoolte vahelises suhtlemisahelas ja kompetentsid võimaldavad tal olla vahelüliks ning võimendajaks keskvalitsuse, ettevõtluse, T&A asutuste vaheliste suhete ja koostöö tekkimisel;

- keskkonna loomine võimalike klastri liidrite koondumiseks, eelkõige läbi omapoolse initsiatiivi ning selge valmisoleku väljendamise;

- võimalike klastrite strateegiliste liidrite teadlik otsimine ning kokkuviimine ning nende vahelise kommunikatsiooni edendamine;

- teiste osapoolte initsiatiivide võimendamine läbi täiendavate ja toetavate programmide, projektide või finantseerimise;

- koostööd ja võrgustikke loovate initsiatiivide iseseisev arendamine lähtuvalt omavalitsuse kompetentsidest ja pädevusest, eelkõige läbi strateegilise juhtimise ning riigihangete, mis võimaldaks omavalitsusel tekitada kohalikku teadmiste-mahukat nõudlust ja turgu võimalike uute lahenduste järele.

b) **KOV kui olemasolevate klastriinitsiatiivide "edasiviija"**

- teiste osapoolte projektide toetamine, täiendamine, mille üheks keskmeks võiks potentsiaalselt olla tehnoloogia arenduskeskuste ümber tekkivate koostöövormide tugevdamine ning täiendamine;

- KOVi olemasolevate programmide – stipendiumid, mentoriprogramm, inkubaatorite ja teadusparkide arendamine jne. – täiendamine nõudluse baasil ehk vastavalt programmide kasutajate vajadustele nende täiendamine ja uuendamine, mille üheks väljundiks võiks olla programmide raames suurema välismaise kompetentsi ja kontaktide toomine Eestisse ja Tallinnasse;

- erinevate koostöövormide omavaheliste kontaktide ja sidemete loomine ja vahendamine, et tekitada keskkond sektoriteüleseks horisontaalseks suhtlemiseks ning horisontaalsete klastrite tekkeks.

Table of contents

Introduction

The following is a study of potential clusters and cluster development in the city and the region of Tallinn. The study is a part of the *BaltMet Inno Work Package 3 "Cluster development"* project. The study was conducted by the *Tallinn University of Technology, Institute of Humanities and Social Sciences* on behalf of the *Tallinn City Enterprise Board*. The study was prepared from October to December, 2007.

The aim of the study was to analyse the current state of clusters in the Tallinn region. Based on the framework of the BaltMet Inno project, the pre-selected "case clusters" were as follows: **a) information and communication technologies** (ICT); **b) electronics**; **c) biotechnology and health care**. However, as it appeared that biotechnology and health care represent two sectors that are in a very different development stage in Estonia, it was more reasonable to treat them in separate sections.

The importance of the given clusters also arises from the recent trend in Europe that sees these cluster areas as the most promising ones for economic growth and development. The popularity of the clusters provides, on the one hand, an opportunity to take stock of the experience of other cluster developing initiatives. On the other hand, it is also important to more thoroughly analyse the potential of these clusters as the popularity of the cluster areas may overshadow the potential pitfalls of concentrating on these areas.

Also, these fields represent potential knowledge-intensive cluster areas. It means that they can be seen as a suitable starting point for cluster analysis in Estonia. **Firstly**, these fields can be viewed as potential horizontal cluster areas that enable to develop technologies that can revive traditional industries. **Secondly**, there is a widespread understanding that Estonian capacities are too small for internationally competitive traditional clusters and the key for success in Estonia lies in knowledge-based economy.

The aim of the study was to map and analyse the current state of the named clusters. In this paper, **cluster is used as a tentative or even as a heuristic term for describing the pool of potential stakeholders who could cooperate and network in a cluster-like manner in a particular economic field**[6]. Furthermore, the aim was to point out possible policies and initiatives that the City of Tallinn could initiate to further reinforce the potential of actual cluster emergence.

The study coincides with the time of the outset of the new financial perspective for the use of the EU's *Structural Funds*. The latter includes policy plans for initiating cluster programs in Estonia. In this context, the study provides guidance for the City of Tallinn to develop its policies to complement the central government's initiatives. In addition, the study will also provide an input to the implementation of the ***Innovation Strategy of Tallinn 2008-2013*** that firstly, emphasises the need to initiate first wide-scale cluster programs in Tallinn, and

[6] There is a widespread agreement that the cooperation and networking (eventually evolving into clusters or cluster-like formations) are the basis for the development of the structure and potential of sustainable economic growth. **Thus, the importance of analysing the development of cooperation and networking is essential for better economic and innovation policies**, even if the cluster concept seems to be too artificial or premature for the context.

secondly, reiterates the need to coordinate local and central government's policies in order to make the best use out of the EU's Structural Funds.

The study is mainly based on four sources of information: **a)** extensive desk-research to analyse the current up-to-date international comparative cluster studies and best practice studies that either include Estonia in one or another methodological way or are relevant in the Estonian context; **b)** statistical information on enterprises and on their development in Estonia, and if possible, specifically in Tallinn[7]; **c)** interpretation of the existing studies made in Estonia on clustering or on the relevant economic sectors[8]; **d)** semi-structured in-depth interviews with relevant stakeholders and experts in the field who were kind enough to devote their time and provided valuable input for this study. Altogether 22 people from more than 15 institutions and stakeholder groups were interviewed in addition to the information gathered through other methods.

After the description of the methodology, the subsequent part will provide a context-specific framework for analysing clusters and the potential role for local government in cluster policies in Estonia. It will be followed by a brief discussion of the main characteristics of the general environment in Tallinn that influence cluster emergence. The most original part of the study is the analysis of the state of the art of the potential clusters in Tallinn and of the possible role for local government in reinforcing the developments. The study ends with the summary of the main findings of the current state of the pre-selected clusters and provides a tentative conceptual framework for local government to approach other possible sectors, in which cluster formations may have some potential to develop and local government initiatives may be of use.

[7] It has to be mentioned, however, that the lack of relevant reliable statistics has made the use of this approach extremely difficult and in most cases, the statistics derived from different sources have not been reliable enough to be included in the study.

[8] This has been done largely through interviews and face-to-face discussions with the authors of the relevant studies in the areas (these studies are also referred to throughout the study).

Methodological approach

This study departs from the assumption that a cluster as a phenomenon has to be studied based on the context specificity of the region where the potential clustering process emerges.

> *One of the key problems with the cluster approach is the biased focus most empirical studies apply**: the concentration on well-performing large-scale regions** like the "Third-Italy", Baden-Wuerttemberg, Silicon Valley, Research Triangle Park in North Carolina, or Cambridge. But in order to draw workable and viable conclusions from such cases it is necessary to adopt an analytical approach that goes beyond the economic activities and criteria most studies apply**. Clusters thus should be studied in an integral way, from the view that clusters are embedded in the spatial-economic, cultural and administrative-political structures of an urban or even rural region.**[9]*

This implies that this study takes a critical approach towards "standard text-book" cluster approaches. Instead, this study pays attention to the special characteristics of Estonia – its **transition state and small state characteristics**. One of the aims of the study is thus to specify first steps for tentative conceptual framework for cluster studies based on these contextual specificities.

The study is based on the generic methodological division of different factors that influence cluster development and growth. On a theoretical level these factors can be divided as follows:

- ***spatial-economic conditions*** (demand conditions, quality of life, accessibility, cultural conditions);

- ***cluster-specific conditions*** (size and development level, presence of cluster engines, degree of strategic interaction among actors, level of new firm creation);

- ***organising capacity regarding the cluster*** (presence of vision and strategy in a cluster, quality of public-private networks, level of societal/political support for cluster development).[10]

It has to be marked here that the initial plans to fully base the study on this methodological approach were complicated by the lack of reliable statistics, especially in the context of Tallinn, and by the inadequate common understanding and approach to clusters in Estonia. **Some of the views approach clusters as the territorial/or localised innovation systems, others as related to technology or sector oriented networks.** In addition, it appeared that most of the cluster-specific conditions and organising capacity in Estonia are in an emerging status, at the most. Thus, even this approach had to be accommodated to fully reflect the current state of the clustering in each of the studied fields. Thus, the methodological approach had to be specified in each of the cases.

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[9] Dümmler, P., Thierstein, A. 2002. "The European Metropolitan Region of Zurich - A cluster of economic clusters?".

[10] Den Berg, L., Braun, E., Van Winden, W. 2001. "Growth Clusters in European Cities - An Integral Approach", *Urban Studies*, 38(1), pp. 185-205.

This study approached the clusters in a more flexible manner, seeing the concept of a **cluster as a method for analysing, organising and managing the cooperation and networking between different stakeholders**. Thus, the concept is in line with a more network based concept of the cluster. At the same time, the abovementioned transition and small state characteristics require an even more flexible approach. There are no similar studies on clustering in Estonia. Most current studies have been based rather on statistical approaches or more sector-based studies. Thus, there is not much competence or information on the essence of networking and cooperation.

Because of it this study takes a more exploratory approach and seeks to analyse the current context of cooperation and networking – the basis of more sophisticated clustering - in Estonia and, more specifically in Tallinn. It has been recognised that for this purpose the best approach is a qualitative study, mainly based on interviews with different stakeholders of clustering.

For this purpose, the study is mainly based on four sources of information:

- **Extensive desk-research** to analyse the current up-to-date international comparative cluster studies and best practice studies that either include Estonia in one or another methodological way or are relevant in the Estonian context. This enables to develop a context specific approach for Estonia.

- **Statistical information** on enterprises and their development in Estonia, and specifically in Tallinn, if possible. It has to be mentioned that the lack of relevant reliable statistics has made the use of this approach extremely difficult and in most cases the statistics derived from different sources have not been reliable enough to be included in the study.

- **Interpretation of the existing studies** on clustering or on the relevant economic sectors in Estonia. This has been done largely through interviews and face-to-face discussions with the authors of the relevant studies (these studies are also referred to throughout the current report). It has enabled to limit the amount of interviews with enterprises[11] because the existing studies of the last 2-3 years have covered the main enterprises in the potential cluster areas.

- **Semi-structured in-depth interviews** with relevant stakeholders and experts in the field who were kind enough to devote their time and provided valuable input for this study. Altogether, we were able to interview 22 people out of approximately 30 key persons identified as key experts for this study. The people interviewed covered the main institutional stakeholders of the clustering process. Altogether the study succeeded in gathering the views from more than 15 institutions. For the detailed overview of the institutions studied, please refer to Appendix 1.

  Each of the interviews lasted between 60-90 minutes. The questions asked were respondent-specific, but in general covered the following areas: understanding of the presence of the cluster and cluster related factors in Estonia and in Tallinn; the main obstacles of cluster development; presence and obstacles of cooperation and networking between different stakeholders; the proper division of tasks (and

[11] The need for this was dictated by the short period given to conduct the study.

positioning of the centre of cluster approach) between central and local government; the possible role for local government in clustering.

"Cluster thinking" – the context and its specificity

The *Estonian Research and Development and Innovation Strategy 2007-2013 "Knowledge-based Estonia"* sets its main focus on sustainable development of the society by means of research and development and innovation (RD&I). One of the founding principles of the strategy is the **recognition that the current economic development in Estonia is not sustainable**. It is largely based on FDI inflow and contract manufacturing, to which the advantages of the geographical location of Estonia and (still) comparatively cheap labour form a favourable basis.[12] The strategy aims to address the following challenges that Estonia is facing:

- challenges to the organisation of R&D and innovations;
- challenges to the entrepreneurship and economic competitiveness;
- challenges to the public sector and development of R&D and innovation policy.

The objectives of the strategy are strongly linked to the achievement of the goals of the Lisbon Agenda and are concentrating on increasing the intensity of R&D, globally competitive innovative enterprises and creating innovation friendly society aimed at long-term (sustainable) development. It is to be achieved through supporting the strategic key technologies: information and communication technologies (ICT), biotechnologies, and material technologies. **The strategy also recognises that the future success of all actions aimed at achieving these goals depends on the cooperation and networking between all important stakeholders of the society**. As the main strategic document, it should set the tone for all other activities within the public administration and society as a whole.

In recent years, **one of the most popular concepts for addressing the cooperation of stakeholders who are relevant for innovation, economic growth and competitiveness has been the concept of clusters**. While the concept itself is more than a 100 years old and has borne different names (industrial districts[13], development blocs[14], agglomerations etc), it has become one of the most used theoretical and practical concepts in innovation theory and policy. It has been advocated by different think thanks, academics, the EU[15] etc.

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[12] See also for example Kattel, R. 2004. "Governance of Innovation Policy: the case of Estonia", *Trames,* 8 (58/53), 4, pp. 397-418; Kattel, R. & Kalvet, T. 2006. *Knowledge-based Economy and ICT-related Education in Estonia: Overview of the Current Situation and Challenges for the educational System.* Praxis, Tallinn.

[13] Marshall, A. 1890/1920. *Principles of Economics*. London: Macmillan and Co., Ltd., Eighth edition.

[14] Dahmén, E. 1989. "Development blocks in industrial economics", in Carlsson and Hendriksson (ed.) *Development Blocks and Industrial Transformation*, IUI, Almqvist and Wiksell, Stockholm, pp. 136-149.

[15] See for example Commission of European Communities. 2001. "Enterprises' Access to Finance", Staff Working Paper SEC 667, Brussels.; Commission of European Communities, DG Enterprise. 2002. *Regional clusters in Europe*, Observatory of European SMEs 2002.; Commission of European Communities, DG Enterprise. 2003. *Final Report of the Expert Group on Enterprise Clusters and Networks,* Brussels.; Commission of European Communities, DG Enterprise. 2003. *European Trend Chart on Innovation, Thematic Report Cluster Policies*, Brussels.; Commission of European Communities, DG Enterprise. 2003. *European Trend Chart on Innovation, Innovative Hot Spots in Europe: Policies to promote*

It has also found its way into current Estonian strategic policy documents as the *National Strategic Reference Framework 2007-2013* and its *Operational Programmes*[16] include plans for the first central government initiated cluster programmes in Estonia. This will set the policy-agenda for the following years and make the concept of clusters even more central to economic and enterprise policies.

Using the definition of **Michael E. Porter**[17]:

> *Clusters are geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition. They include, for example, suppliers of specialized inputs such as components, machinery, and services, and providers of specialized infrastructure. /…/ Finally, many clusters include governmental and other institutions – such as universities, standard-setting agencies, think thanks, vocational training providers, and trade associations – that provide specialized training, education, information, research and technical support.*

As the underlying key in the phenomenon of clustering is about the exchange and flow of information as well as respective coordination system[18], clusters do not respect state borders in reality and can develop as regions within a state or as regions that transcend state borders and link several countries. **Thus, clusters can have international, national, regional or local character.** In addition, as clusters involve both horizontal and vertical relationships, the concept of clusters brings to the fore **the role of the government in an economy – the *facilitator of cluster development and upgrading*** – but only if the first seeds/indications of a cluster are already present. In other words, the conventional wisdom implies that **governments should concentrate on reinforcing and building on established and emerging clusters rather than attempt to create entirely new ones.**

On the other hand, this does not imply that the state should not have any policies for reinforcing different aspects of the clusters (like R&D capabilities, the quality and content of the educational system, infrastructure, market regulations, tax policies, standards or regulations that influence or determine buyers needs, general societal environment supporting cooperation and networking, support for international competitiveness etc.). **It rather means that the state should refrain from artificially creating clusters not corresponding to the local conditions.** This also means that state-led policies, actions aimed at fostering clusters or creating environment for cluster development should be aimed at and implemented on the proper level of government policy-making capacities.

In addition, it has to be remembered that the concept of cluster is one of the several methods for approaching the cooperation among different

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trans-border clusters of creative activity, Background Paper on Cluster Policies, Trend Chart Policy Workshop 5-6 May 2003. For more recent initiatives: http://www.clusterobservatory.eu/.

[16] See Operational Programme for the Development of Economic Environment 2007-2013. Accessible at http:www.fin.ee.

[17] Porter, M.E. 1998. "Clusters and the New Economics of Competition", *Harvard Business Review*, November-December, pp. 77-90. See also for example: Porter, M.E. 2000. "Location, Competition, and Economic Development: Local Clusters in a Global Economy", *Economic Development Quarterly*, vol. 14, no.1. pp. 15-34.

[18] Sölvell, Ö., Zander, I., Porter, M.E. 1991. "Determinants of Competitive Advantage", *Advantage of Sweden*. Norstedts, Stockholm, pp. 23-55.

stakeholders in economic development. Other concepts, such as *innovation systems*[19]*, triple helix*[20]*, and knowledge-based society* etc. offer similar and in some cases overlapping or parallel tools. **The distinctiveness and popularity of the cluster concept stems from its distinct focus and practical approach that supposedly allows it to facilitate analytical work and real-life policy-making**[21]. As such, it still remains a method (or a policy-tool) and should not be seen as an ultimate goal in itself.

However, similarly to highly popular national innovation systems concept, clusters are often associated with rather highly developed countries or regions (Northern Italy, Stuttgart region etc). Thus, much of the theoretical discussion as well as policy tools used in clustering discourse assume a relatively high level of education, R&D, private sector networking, and, above all, functioning and capable governance structures.

Many developing countries and regions lack all or many of these aspects. **Clearly it makes a huge difference whether to build cluster policies in a highly developed region or in a laggard region.** Indeed, perhaps the most interesting discussion of clustering originates from writings dealing with laggard regions and/or countries; see for instance Lars Mjøset's classical study of Ireland of 1992. Such studies look at much wider socio-economic context of economic development and use wider conceptual tools such as virtuous or vicious circles of growth.[22] This study also looks into some wider aspects in trying to explain why certain key elements in some clusters under view are lacking.

From an organisational design perspective, the wisdom of developing the integrated organisations should lie in the saying: "coming together is the beginning, and working together is the success" [23]. This notion is in a line with the overall suggestion that networking should start from micro level, amongst the parties that want to cooperate (bottom-up development), but the implementation of that should be top-down to ensure that the development will progress as foreseen[24]. This raises an obvious question whether politicians can keep faith with a concept that may not deliver quickly enough for the electoral cycle[25].

There has been considerable effort to create internationally comparative knowledge on the current state of networking practices and clustering in Europe and in different parts of the continent[26]. Clusters are seen to provide one of the

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[19] See for example, Lundvall, B.-A. (ed.) 1992. *National Systems of Innovation – Towards a Theory of Innovation* and *Interactive Learning,* London, Pinter Publishers.

[20] Etzkowitz, H., Leydesdorff, L. 1997. *Universities and the Global Knowledge Economy: A Triple Helix of University-Industry-Government Relations*, Continuum, London, New York.

[21] Andersson, T., Serger, S. S., Sörvik, J., Hansson, E. W. 2004. *The Cluster Policies Whitebook.* IKED

[22] Much of it goes back to classical development economics from 1950s, e.g. Myrdal, Nurkse, Singer and others.

[23] Blossom, Y-J.L. 2007. „Integration in primary community care networks (PCCNs): examination of governance, clinical, marketing, financial, and information infrastructures in a national demonstration project in Taiwan", *BMC Health Services Research*, Volume 7(90).

[24] Pirnejad, H., Bal, R., Stoop, A.P., Berg, M. 2007. "Inter-organisational communication networks in healthcare: centralised versus decentralised approaches", *International Journal of Integrated Care*, Volume 7(16).

[25] Woods, K.J. 2001. "The development of integrated health care models in Scotland", International *Journal of Integrated Care*, Volume 1(1).

[26] For interesting developments in the USA, see various analytical works by National Governors' Association and by International Economic Development Council.

necessary tools for achieving the Lisbon Agenda goals. In summary, **some of the more recent research and initiatives on clusters**, relevant for the current report, are as follows:

- ***The Cluster Initiative Greenbook***, 2003 (by Sölvell, Ö., Lindqvist, G., Ketels, C.) – it assembles, for the first time, survey evidence on a large sample of clusters. The data allows analysing the different shapes of cluster initiatives, how they evolve over time, and factors that appear to influence the success or failure of the initiatives. In addition, the Greenbook covers the region of Central and Eastern Europe (CEE) and pays special attention to transition economies.

- ***The Cluster Policies Whitebook****,* 2004 (by Andersson, T., Serger, S. S., Sörvik, J., Hansson, E. W.) – based largely on the experience of the Greenbook and also based on the lessons learned from the wide-scale conference *Innovative Clusters – A New Challenge* (organised by the Competitiveness Institute in 2003); it concentrates on whether, when and how policy-makers can and should attempt to develop or strengthen clusters and clustering.

- ***Clusters in the EU-10 new member countries****,* 2006 (by Ketels, C., Sölvell, Ö.) – provides a comprehensive overview and comparison of the clusters in EU-10 and offers major insights into the strengths and weaknesses of the current economic structure of the EU-10 countries.

- ***State of the Region Report. The Baltic Sea Region – Top of the Europe in Global Competition****,* 2006 (by Ketels, C., Sölvell, Ö.) – presented at the 2006 Baltic Development Forum. The report gives an overview of the current state and competitiveness of the Baltic Sea Region and makes a comparison between EU-10 and EU-15 countries of the region. The 2006 report pays special attention to the clusters in the region, which makes it more relevant from the cluster perspective than the already published 2007 report.

- ***2006 Innobarometer on cluster's role in facilitating innovation in Europe****,* 2006 (by the Gallup Organization Hungary and Gallup Europe upon the request of DG Enterprise and Industry) – deals with a comparative analysis of the specific characteristics of companies that operate in a cluster-like environment. Provides comparative information on awareness, intensity and current state of clusters in the EU.

- ***Potential to Network Innovative Clusters in the Baltic Metropoles Regions Present State and Perspectives***, 2007 (report issued in the framework of BaltMet Inno Programme, supervised by Sydow, J.) – on a general level, the project deals with the reinforcement of collaboration in cluster research and development work as well as the identification and improvement of transferable cluster elaboration tools between the cluster developers in the Baltic metropolitan areas.

The given comprehensive comparative studies offer a basis for briefly analysing the context of Estonian economy and clusters from 3 most relevant perspectives:

- **the perspective of CEE countries** i.e. the countries Estonia is compared with i.e. *how is Estonia doing in comparison with its closest reference group?*

- **the perspective of Scandinavian countries** as the region Estonia is aiming to be compared with i.e. *how is Estonia performing in relation to its main "target" group?*

- **the perspective from the best practice view** i.e. *what can Estonia learn and take into account from the general experience?*

At the same time, these reports emphasise that there are different understandings of/and approaches to clusters among different scholars, business consultants, research groups etc. This will provide the context for the following cluster analysis by positioning Estonia in the international context and giving first insights into the current state and extent of clusters in Estonia, whether Estonia can relate itself to more developed regions of the world and whether Estonia can adopt the general best practices and policies related to cluster development.

The following is a brief summary of these studies. For more detailed layout of the different arguments and analysis provided by these studies on Estonia, refer to Appendix 2 that is a separable but essential part of the study.

How is Estonia doing in comparison with its closest reference group i.e. EU-10?

The only comprehensive study on EU-10 clusters[27] uses, for its quantitative analysis, the statistical NUTS-2 categories for dividing the EU-10 countries into clusters. In addition to Estonia, Cyprus, Lithuania, Latvia, Malta and Slovenia are seen as one nation-wide region in the NUTS-2 classification as well. At the same time, Czech Republic is divided into 8 regions and Poland into 16 regions. This gives the first indication that **Estonia might be too small for having several similar clusters**. Or at least, too small for clusters that are comparable to the rest of the EU countries in their size. This also implies that there might be **contextual obstacles for adopting generic cluster approaches that have been developed based on the experience of larger countries.**

The smallness of the economy is especially relevant with the view to the size of the possible pool of employment in a cluster area, assuming that there needs to be a critical mass of employment in a particular field to have any meaningful cluster development potential. In total employment terms only *fishing and fishing products* cluster[28] of Estonia (out of 38 clusters defined in EU-10 cluster report) has employment level that is comparable to the top 5 *fishing and fishing products* clusters in the EU-10. In all other clusters, the employment rate is considerably smaller than in other EU-10 regional clusters.

The general conclusion is that the intensity of clusters in Estonia is rather low and to date there have not been any explicit cluster policies or cluster development policies in Estonia. As a unique hypothesis (not found in any other analysis), it has been brought out that the reason for low intensity of clusters in Estonia stems partly from the **privatisation process** that Estonia went through after regaining its independence. The process was mainly focused on attracting foreign ownership. This has provided inflows of new capital, know-how and linkages to global markets but has not been conducive to the development of regional clusters or the thinking that is needed for clusters to

[27] Ketels, C., Sölvell, Ö. 2006. *Clusters in the EU-10 new member countries.* Europe Innova.
[28] Of course, this is a cluster that is realistic only in coastal regions and this limits the potential geographic existence of the cluster within the EU-10.

emerge. The foreign owners have not been prepared and willing to cooperate or network with local stakeholders.[29]

Others have hypothesised that as in most CEE countries, the practical experience of the Estonian business sector in the democratic market system has been too short for the development of real understanding and of widely felt need to cooperate and network among companies and other stakeholders[30].

This explains why so far, there has not been a wider debate on the need to develop different cluster initiatives and explicit policies to benefit from the concept in Estonia. There is also no clear indication that there is a common understanding of the cluster concept and a common understanding of the first necessary steps to be taken.

So far, most of the economic policies in Estonia have focused on cross-cluster based economic strategy with cluster not being central to economic policy. The shift of the previous priorities may be seen in the measures worked out in the framework of the *Operational Programme for the Development of Economic Environment 2007-2013*, the sub-programme for the usage and implementing the EU Structural Funds in Estonia[31]. However, the measures supporting clustering are very strongly concentrating on competitiveness that is to be increased in traditional industries. This is to be achieved through closer collaboration between private sector actors rather than between private sector and R&D institutions.

At the same time, it has been emphasised at the EU-10 level that there is a general dominance of small employment cluster categories over the relatively smaller number of large employment cluster categories[32]. Also, the data has indicated that EU-10 countries are significantly more specialised in labour-intensive cluster categories (textiles, apparel, footwear, processed food) with much less employment in advanced manufacturing (analytical instruments, aerospace, defence, medical services, advanced services). This implies that the EU-10 has to carefully analyse its starting position and the current context of economic development before entering different cluster development programs or adopting cluster policy mechanisms and tools that are initiated or used mainly in the more developed and sophisticated EU-15 economies.

All in all, the studies on clusters agree that the EU-10 countries suffer from low innovative capacity. To increase the potential, capacity and competitiveness of the clusters, most of the countries need to overcome two main challenges:

- **overcoming the barriers of collective action, especially the lack of trust between the public and private sector**;

- **identifying the unique strengths and weaknesses of the location, deciding upon a strategic positioning for their regional cluster category that is both feasible and attractive, and designing and executing an action agenda**.

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[29] Ketels, C., Sölvell, Ö. 2006. *Clusters in the EU-10 new member countries.* Europe Innova.
[30] Sydow, J. 2007. *Potential to Network Innovative Clusters in the Baltic Metropoles Regions Present State and Perspectives.* Freie Universität Berlin.
[31] Operational Programme for the Development of Economic Environment 2007-2013. Accessible at http:www.fin.ee.
[32] Ketels, C., Sölvell, Ö. 2006. *Clusters in the EU-10 new member countries.* Europe Innova.

How is Estonia performing in relation to its main "target" group i.e. the Baltic Sea Region?

Estonian policy-makers and general public have always preferred to link Estonian economy with the more developed Scandinavian economies. The living standard of the welfare states in Scandinavia has been often viewed as the target that the Estonian economy and society should aim to achieve. In this context, the comparison between Estonia and the western part of the Baltic Sea Region offers a complementary approach to the EU-10 cluster comparison summarised above. Furthermore, the comparison should also highlight the main **differences that have to be taken into account when trying to adopt (cluster-related) policies and policy tools used in the Scandinavian countries.**

In most of the comparative listings based on macroeconomic indicators, the indicators of economic sustainability, quality of education, quality of public administration, science rankings, innovation capacity rankings, Estonia ranks below the EU-15 countries of the BSR (Finland, Sweden, Norway, Denmark, Germany) but above other EU-10 countries of the region (Latvia, Lithuania, Poland)[33]. For more detail refer to Appendix 3.

What is more important is the fact that in international rankings, e.g., innovative capacity, Estonia is dropping in the rankings year by year. Between 2001 and 2004 this has happened e.g., in the proportion of scientist and engineers index (from 22nd position to 28th), innovation policy index (from 24th to 27th).

This means that despite the relatively high level of Estonian competitiveness (in the 2007 competitiveness report, Estonia is ranked 27th), there are fields where Estonia's achievements and policies are not adequate enough for keeping its position in global rankings. This may be mainly related to the fact that the economic growth in Estonia has been based on the cost-advantages of cheap labour and not on the knowledge intensity of the economic activities. Also, this raises the question of the ability of Estonia to catch up with the more developed north-coast of the BSR. Further, it implies that current cluster-related policies may have fundamental flaws in them. **New policy initiatives (like cluster development) need to take into account the potential problems inherited from previous policies (or lack thereof) that are relevant to cluster emergence or that have not been conducive to clustering**.

Summarising the main conclusions of the EU-10 and BSR comparisons, Estonia seems to represent a rather unique case. From economic competitiveness point of view, it is doing better than most other EU-10 countries, at the same time its cluster positioning is much weaker than in most EU-10 countries. **One of the reasons for this dichotomous economic context is clearly the smallness and extreme openness of the Estonian economy**. It has implications on the cluster intensity in Estonia, but also on the international comparability of the statistics.

On the other hand, the smallness and openness of the economy (to foreign investments and the movement of capital and goods) and reliance on the cost-advantages may escalate the problems of the sustainability of the economic growth and development as these factors increase the challenges that Estonia is

[33] Ketels, C., Sölvell, Ö. 2006*. State of the Region Report. The Baltic Sea Region – Top of the Europe in Global Competition.*

facing in developing a more knowledge- and technology-intensive economic structure.

Table1. The impact of the size of the country on clustering.

Large countries	Small countries	Consequence for clustering process
Large population with several densely populated cities/areas	Fewer densely populated areas	A more narrow range of cluster initiatives can be developed in small countries.
A broad representation of sectors and areas of possible competitive advantage	A limited representation of sectors with a distinct competitive advantage	
Larger public and private sources of funds	Less critical resources and fewer skilled employees	
Larger domestic market - less reliance on foreign trade	Small domestic market - high reliance on foreign trade	Smaller countries more accustomed to "looking outward" for economic growth possibilities - higher readiness to collaborate in a clustering process

Source: Andersson, T., Serger, S. S., Sörvik, J., Hansson, E. W. 2004. *The Cluster Policies Whitebook.* IKED.

For policy-making, this implies that the smallness of the country, its geographical position and the past economic policy decisions have created a context where Estonia seems to be growing and moving higher and higher on the development level and so far has done better than its reference group. **At the same time, however, there are indications of the relative lack of cooperation and networking between different stakeholders that is relevant for economic development - i.e. clusters or cluster-like formations that are regarded as one of the formula for higher value-added, innovative, sustainable economic growth.** Notwithstanding that clustering has been claimed to be a prominent feature of all advanced economies (e.g. Sweden)[34].

As such, there is a need to systematically analyse the current context of Estonia and avoid blind adoption or transfer of tools, best practices, recipes for cluster development, economic restructuring etc.

What can Estonia learn from the general experience?

Based on the comparative studies positioning Estonia in relation to EU-10 and the BSR as the target area, and relying on the lessons provided by the comprehensive studies that aim at developing best practices and general recommendations for cluster development and related policies[35], the following aspects have to be emphasised:

- As every economic system and every cluster (and cluster development initiatives) is unique, there are no clear-cut or one-size-fits-all policy tools

[34] Sölvell, Ö., Zander, I., Porter, M.E. 1991. "Determinants of Competitive Advantage", *Advantage of Sweden*. Norstedts, Stockholm, pp. 23-55.
[35] Mainly: Sölvell, Ö., Lindqvist, G., Ketels, C. 2003. *The Cluster Initiative Greenbook.*; also Andersson, T., S. S. Serger, J. Sörvik, E. W. Hansson. 2004. *The Cluster Policies Whitebook*, IKED.

and solutions that can be transferred from the experience of other countries.

Special attention has to be paid to the general contextual factors that dictate suitable solutions.

- In developing its cluster policies and initiatives Estonia has to be very aware of its unique characteristics and prior (policy) legacies. The more important contextual characteristics are as follows:

    a) smallness of the economy, openness to foreign investments (and high level of foreign ownership in the economy);

    b) dominance of SMEs and micro-enterprises in most economic sectors;

    c) dependence on the short-term cost advantage of the labour as the main catalyst of economic development;

    d) low need for and awareness of the potential positive effects of cooperation and networking between economic actors;

    e) lack of prior experience and use of cluster policies resulting in weak presence of cluster-like formations and limited know-how among all cluster stakeholders;

    f) limited public sector experience in participating or initiating cluster-like cooperation and networking;

    g) policy coordination of different innovation and education policy areas is almost non-existent;

    h) generally, public sector's administrative capacity in designing and implementing policies has serious deficiencies, almost all Estonian innovation policy initiatives and measures are part of the EU structural funding schemes and thus, have been developed largely as a reaction to European Commission's suggestions;

    i) transition state characteristics emphasising the lack of trust between the government and the private sector, between different cluster stakeholder segments;

    j) limited conscious and competence-based development of different aspects brought out as possible policy subject on the *cluster initiative target board*[36]: cluster expansion; innovation and technology; education and training; commercial cooperation; policy action; research and networking;

In summary, the lack of prior cluster policies and the general low awareness of the need for clusters or cluster-like cooperative formations as well as cooperation for economic development indicate that as a transition state, Estonia has to start developing its cluster policies and initiatives from the scratch.

[36] For more detail, see: Sölvell, Ö., Lindqvist, G., Ketels, C. 2003. *The Cluster Initiative Greenbook.*

It means that before proposing specific policy tools, initiatives, mechanisms, priority areas, investment priorities, a thorough analysis of the current state of all possible cluster stakeholders is required, whether the conditions are suitable for the formation of clusters, whether there is enough potential for specific clusters in specific areas etc.

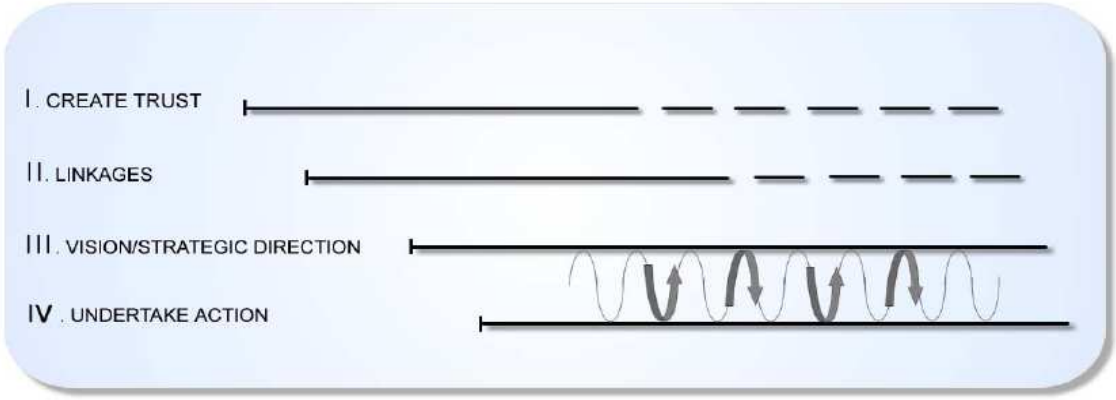
The characteristics of a small state dictate the necessity to choose clear priority areas (i.e. economic sectors) as subjects of policy initiatives, especially for local government initiatives. **They can be chosen only in cooperation with different stakeholders.** In a small state with limited resources, the priority should be set on developing cooperation and networking between all the stakeholders.

This first and foremost implies the prioritisation of the development and emergence of R&D based and intensive cluster-like cooperative formations. The benefits of them will not be sector or cluster specific only, but will have the highest spill-over to other economic spheres and to other policy fields as well.

Before the initiation of specific policies, there should be a comprehensive understanding of the readiness of all stakeholders (enterprises and their respective cooperative formations, R&D and general human capital, public policy makers on all relevant government levels) to carry their roles in a cluster like environment. The following aims to analyse where different stakeholders stand as to their readiness to give their input to cluster development and carry their roles in this cooperative formation of economic activities. **Without explicit confirmation that the basic foundation needed for clusters is present, there is a threat that proposed and planned policies may be premature and lose their intended efficiency and impact.**

One of the possibilities for mapping the phases that a clustering process entails has been provided by Waelbroeck-Rocha[37]:

Table 2. Timeline of the four phases in clustering.



It would be possible to propose more complicated and sophisticated models for analysing cluster development, providing guidance for initiatives and policies. But, as the studies on clustering in the CEE transition states have indicated, one of the first main challenges that the CEE countries have to face is the lack of

[37] This model was proposed by Waelbroeck-Rocha in 2003 in the framework of developing the *Cluster Policies Whitebook.*

prior experience and trust in cooperation both within the private sector and between different sectors of society. **This graph reiterates that the existence of basic foundations, continuous development (trust and social capital, linkages between stakeholders, visions and strategies) are inevitable before explicit actions and policies can be implemented.**

Spatial-economic conditions in the Tallinn region

The methodology initially proposed for this project divides the spatial-economic conditions into four sub-sections: demand conditions, quality of life, accessibility, cultural conditions. Based on the main conclusions of the previous chapter it can be seen that as a small CEE transition state that has recently joined the EU, the capital region of Tallinn requires a wider and more context-specific mapping of its spatial-economic conditions. For this reason, the following analysis contains a specific sub-section on general socio-economic and politico-administrative conditions that have considerable impact on the cluster developments around Tallinn as well.

Socio-economic & politico-administrative conditions

Without going into great detail, it is possible to distinguish several essential characteristics of the Estonian socio-economic and politico-administrative situation and developments that influence the general economic environment of this country and its policy-making[38]:

- Throughout the transition process **policy-making and implementation in Estonia have often lacked clear prioritisation, analysis and coordination that would have transcended the borders of traditional policy areas**. Innovation policy and cluster development is certainly one of the policy areas that requires inputs from a wide range of government activities[39].

  In addition, **the coordination capacities have often been reduced by the agencification of the public administration** i.e. the implementation of public policies delegated to (semi-)autonomous executive agencies fragmenting the coherence and the coordination of the implementation of the public policies. This is especially the case with innovation policy mechanisms and the management of the related EU's Structural Funds[40].

- It has been noted that as a small and developing state, **Estonia has through the last decade or more suffered from the lack of sufficient amount of qualified staff at the middle management and technical levels** of civil service (both at the national as well as the local

[38] For more thorough accounts refer to Aslund, A. 2002. *Building capitalism: the transformation of the former Soviet bloc*, Cambridge University Press.; Randma, T. 2001. "A Small Civil Service in Transition: The Case of Estonia", *Public Administration and Development*, 21, pp. 41-51.; Verheijen, T. 1998. "Public management in Central and Eastern Europe: the nature of the problem", in: Verheijen, T., Coombes, D. (eds.) *Innovations in Public Management: Perspectives from East and West Europe*, Cheltenham: Edward Elgar, pp. 207-19.; Viks, K., Randma-Liiv, T. 2005. "Facing the Challenges of EU Accession: Development of Coordination Structures in Estonia", *International Journal of Organization Theory and Behavior*, 8/1, pp. 67-102.

[39] The same has been emphasised in the context of clustering in another CEE country i.e. Slovenia in: Sölvell, Ö., Lindqvist, G., Ketels, C. 2003. *The Cluster Initiative Greenbook.*

[40] For instance, the case of Enterprise Estonia as the agency involved in implementing innovation policies has been critically discussed by Tavits, M., Annus, T. 2006. "Agencification in Estonia", *Public Administration and Development,* 26, pp. 3-14.

level). It has negative effect on the ability to transform policy initiatives into sustainable implementation mechanisms.[41]

- Another issue closely related to the staff shortage has been the **insufficient coordination and control within the Estonian public administration**[42].

- The administrative system of **Estonia lacks a functional and independent regional level which means that the tasks of the state are divided between the central government and the local level** (i.e. Tallinn City Government) in a more centralised manner[43]. It means that in the context of clustering the general presumptions of the division of roles between the central and the local government (with the latter being in a more influential position) have to be critically reassessed[44].

In sum, Estonia as a small transitional state has gone through rapid development within the last decades (currently presenting one of the highest GDP real growth wages in the EU[45]). **But there are indications that these developments lack sustainability in their fundamental policy options that may be linked to the socio-economic and politico-administrative characteristics presented above**[46]. Even more, since productivity and wage growth started from a remarkably low level, the high growth rates at the beginning of the new millennium have not significantly decreased differences in terms of productivity between Estonia and the leading EU-15 countries. Even in such high growth areas as ICT, Estonia's productivity has been falling behind EU member countries such as Denmark, Finland, and Sweden[47].

This notion is in line with current studies which indicate that **economic development in Estonia is based on short-term and not sustainable factors** (cost-efficiency, cheap labour, significant foreign financing and loans etc.)[48]. The support to one of the main foundations of economic growth and progress – research and development (R&D) and the use of it in economic processes – is currently not sufficient enough. Prior studies have indicated that there are severe problems in the cooperation between R&D institutions,

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[41] See for example European Commission *Regular Reports on Estonia's Progress towards Accession* (1998-2003).
[42] Ibid.
[43] At the same time, it is also brought out that Tallinn as the capital city may be too large (creating specific need and roles) to function on the basis of the general local government regulation (see for example Strategy *Tallinn 2025*, p. 84).
[44] See also Andersson, T., S. S. Serger, J. Sörvik, E. W. Hansson. 2004. *The Cluster Policies Whitebook*, IKED.
[45] According to Eurostat, only Latvia has slightly higher GDP real growth over the last years, but for 2008 Eurostat forecasts that the GDP real growth in Estonia (8.2%) would be slightly higher than Latvia's and 3 times higher than the EU-27 average (2.7%).
[46] For an overview of the problems of Estonian economic policy and strategic choices see Kattel, R. & Kalvet, T. 2006. *Knowledge-based Economy and ICT-related Education in Estonia: Overview of the Current Situation and Challenges for the educational System.* Praxis, Tallinn.
[47] See Eurostat databases for statistics on industry.
[48] Similar arguments can also be found it the Estonian Research and Development and Innovation Strategy *Knowledge-Based Estonia 2007-2013* (p. 16) that reiterates the fact that most of the economic sectors (except for telecommunications and financial intermediation) have low value-added per employee and low competitiveness due to the company strategies that focus on cost advantage and/or the growth of domestic (credit) demand.

enterprises and industry[49]. This problem is further escalated by the lack of sufficient private investment in R&D – it has become a well-known argument that in most CEE countries public investment in R&D exceeds private investment while in most developed countries the ratios are opposite[50].

Clusters as institutionalised cooperative relations and networks between pivotal stakeholders in an economic sphere in a distinct geographical area carry a role of reinforcing the synergies, mutual benefits and general economic progress in these areas. In this context, Tallinn can be viewed as the most promising and already most successful region in Estonia.

Yet, taking into account that Estonia is a small state (in demographic, economic and geographical terms) with distinct centralised administrative structure that is under transition, **it may be questioned whether one should try to distinguish separate clusters in and around Tallinn from the general economy of the whole Estonia**[51]. In a wider context, it can be argued that most of the entrepreneurial activity in Estonia is not regional in nature (i.e. limiting itself to certain regions of Estonia and seeing other national and international regions as "export" markets). The high level of personal contacts (characteristic of a small state), close geographic concentration etc. should make it easier to communicate, cooperate and operate nationwide.

So, the separation of different clusters in different economic fields in Estonia might be rather artificial. Nevertheless, it has been recognised that in most economic fields there is a lack of cooperation and networking across different institutions that is usually characteristic of clusters**. So far, with a few exceptions, public policy makers and other stakeholders in clusters (enterprises and their representative networks, universities and R&D institutions, chambers of commerce etc.) have not been able to come out with wide-scale efficient initiatives for inducing better cooperation between all stakeholders, synergies and cluster development.**

At the same time, it has been argued that national political, social and economic setting is of pivotal importance for cluster development and performance of the cluster[52]. In addition, **most of the successful cluster developments have**

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[49] Kattel, R., Kalvet, T. 2006. *Knowledge-based Economy and ICT-related Education in Estonia: Overview of the Current Situation and Challenges for the educational System.* Praxis, Tallinn.

[50] According to Eurostat, in 2004 industry in Estonia financed around 36% (though there has been an increase from around 25% at the turn of the millennium) of gross domestic expenditure on R&D (GERD) while in EU-27 and EU-15 the average was around 55%. The government's share in the finance of GERD in Estonia in 2004 was 44% (in earlier years the government's share has been slightly dropping from 65%) while the EU-27 and EU-15 average were both around 35%. At the same time, foreign financing of the GERD is more than twice as high in Estonia (17.2%) compared to EU-27 (8.3%) and EU-15 (8.2%) and this explains the reduction of the government's share in the financing of GERD. See also Jürgenson, A., Kalvet, T., Kattel, R. (2005). "Business Support Measures in the State Budget Strategy for 2007-2013." *PRAXIS Working Paper No 23/2005.*

[51] In addition, in some fields (like ICT, biomedicine and pharmaceutical industry) there have been arguments that Estonia in reality is a small (and R&D and technology developments wise insignificant) part of a much larger cluster covering the Scandinavian economic sphere. See Kattel, R & Kalvet, T. 2006. *Knowledge-based Economy and ICT-related Education in Estonia: Overview of the Current Situation and Challenges for the educational System.* Praxis, Tallinn; Tiits, M., Kattel, R., Kalvet, T. 2006. *Made in Estonia*. Institute of Baltic Studies, Tartu.

[52] Sölvell, Ö., Lindqvist, G., Ketels, C. 2003. *The Cluster Initiative Greenbook.*

benefited from high trust in government initiatives and from the support of influential local government decision makers to cluster development initiatives[53]. Thus, it is worth analysing what the options and the role of local level initiatives might be in fostering cooperation (between policy-makers both from local and central level, R&D institutions, enterprises etc.), networking and resulting innovations in economic spheres and clusters.

To summarise, the main actors potentially influencing the **politico-administrative context** from the public policy-making perspective are:

- Research and Development Council under the Prime Minister
- Ministry of Economic Affairs and Communications
  - → Department of Economic Development
  - → Enterprise Estonia
- Estonian Ministry of Education and Research
  - → Higher Education Department
  - → Research Department
- Ministry of Social Affairs (especially in relation to the health care cluster)
- Harju County Government
  - → Social and Health Care Department
- Tallinn City Government
  - → Tallinn City Enterprise Board
  - → Social Wealth and Health Care Department
  - → Tallinn Technology Park TECHNOPOL
  - → Tallinn Business Incubators Foundation

Demand conditions

As was briefly noted above, **Tallinn is the centre of most economic activities in Estonia** – e.g., 53% of active enterprises are residing in Tallinn, and by including the Harju County, the figure rises to 62%[54]. As of 1 September, 2007, Tallinn had registered 51,677 enterprises, including 2,958 self-employed entrepreneurs and 387 subsidiaries or branch offices of foreign businesses as well as 9,032 non-profit associations and foundations[55]. It is worth mentioning that the number of enterprises owned by the state has increased by almost three times (in 2006 there were 28 state owned enterprises as compared to 72 in 2007) and the number of foreign enterprises in Tallinn has increased by more than 1,000 in 2007. Further, the turnover of about one fourth of enterprises in Tallinn is over 1 million EEK[56].

About one third of the population of Estonia lives in the area. Despite constant decline in the population of Estonia since the 1990s, an opposite trend can be observed in Tallinn in the last decade (since 2005)[57]. The city of Tallinn with its 396,852 inhabitants (as of 1 January, 2007) [58], is the largest municipality compared to the other municipalities with 100 to 100,000 inhabitants[59]. One of

[53] Ibid.
[54] Statistical Office of Estonia.
[55] Registry Centre of the Ministry of Justice.
[56] See *Fakte Tallinnast, 2006*. Tallinna Ettevõtlusamet, p. 15; and *Tallinn: Facts & Figures, 2007*. Tallinn City Enterprise Board, p. 14.
[57] Statistical Office of Estonia.
[58] Statistical Office of Estonia.
[59] Altogether, Estonia is divided administratively into 15 counties, 227 rural municipalities, and 33 towns. See portal for Local Governments in Estonia, http://portaal.ell.ee/.

the reasons for this is the internal migration of the population towards bigger cities and towns[60].

Due to increased population in the area, local tax revenues in the budget of Tallinn municipality have also been increasing[61]. In addition, Tallinn is the centre for most FDI coming to Estonia – the share of FDI to Tallinn as compared to Estonia was about 76.9% in 2006[62]. However, the overall share of FDI (as % from GDP) made to Estonia (and hence to Tallinn) has considerably dropped during the last year, from 21.1 to 9.8. Further, FDI has been mostly invested in the areas of financial intermediation (45.5%), followed by manufacturing (14.0%) and real estate, renting and business activities (13.2%)[63].

Tallinn contributes most to the GDP of Estonia, has the highest employment rate together with the highest wage level and the lowest unemployment rate in Estonia (for key macroeconomic indicators for Tallinn refer to Table 3.).

Table 3. Key macroeconomic indicators of Tallinn in 2005-2006:

Indicator	**Tallinn**	**Estonia**
RGDP (at market prices), million EEK, in 2005*	104,048.6	175,392.0
RGDP real growth, in 2006	-	11.2
Contribution of regions to GDP, %*, in 2005	59.3%	100%
RGDP per capita, % of Estonia average*, in 2005	153.2%	100%
RGDP value added, total, million EEK*, in 2005	91,702.3	154,580.1
Industrial production (at market prices), in 2005	28,261	96,615
Industrial sales (at market prices), in 2005	28,249	96,252
Share of value added as % in GDP by economic sector, in 2005*****	Primary sector: 1.1% Secondary sector: 23.8% Tertiary sector: 75.1%	Primary sector: 3.6% Secondary sector: 28.4% Tertiary sector: 68.0%
Share of citizens with elementary- and basic education in economically active population, in 2006	6.7%	11%
Share of citizens with secondary and/or vocational education after basic education in economically active population, in 2006	49.0%	38%
Share of citizens with vocational secondary education after secondary education in economically active population, in 2006	11.6%	6.0%
Share of citizens with Bachelor's degree, master's degree, doctor's degree in economically active population, in 2006	32.8%	24%
Employment rate (aged 15-64), % in 2006,	74.2	67.7
Unemployment rate, % in 2006,	4.5	6.0
Average hourly gross wages (salaries), EEK, in 2006,	64.23	55.54

*Note: *Data for Harju county; **Data for Northern Estonia*
Source: Statistical Office of Estonia; *Rahapoliitiline ülevaade.* September 2007. Eesti Pank, p. 8.

[60] See here also Statistical Office of Estonia for the statistics about population density by administrative units in Estonia.
[61] Development Plan for Tallinn, 2006-2015.
[62] See here *Tallinn: Facts & Figures, 2007*. Tallinn City Enterprise Board, p. 11.
[63] *Foreign Direct Investments,* 2006. Invest in Estonia http://www.investinestonia.com/pdf/fdi2007.pdf.

In 2006, the volume of Estonian foreign trade increased by 27% as compared to the previous year[64] (the increase was largely based on the real growth in import rather than export). The year of 2007 is showing, however, the opposite trend – foreign trade turnover has decreased by 7% as compared to September 2006[65]. According to the Statistical Office of Estonia, the most export oriented economic activities are as follows: ICT, electronics, pharmaceuticals, medical equipment and textiles. See here Table 4. The main export commodity sections in Tallinn are machinery and mechanical appliances; electrical appliances; wood and articles of wood; transport means; mineral fuels and mineral oils; furniture, mattresses and pillows[66].

At the same time the statistics do not reveal the fact that most of ICT/electronics export is based on contract-work made to foreign owners (based on labour-cost advantage) and place the industrial activities low on the value chain of the production processes. **Tables in Appendices 4, 5, 6 reveal the true reality of the low value added of the activities and indicate that currently Estonia is not benefiting much from these activities**. Overall, the data in Appendix 4 confirms the low intensity of high value-added activities in the current economy.

In this context, it may be argued that the smallness of the country and the limited size of its human, financial and social capital demand that any (economic) policy initiative should first strive for including the best of the capital. Logically, this leads to prioritising knowledge and R&D based clusters as the basis of economic restructuring. Other options may lead to further fragmentation of the existing pools of different capital and may leave the economic growth potential to linger.

Furthermore, every economic activity, even traditional economic activities, can be knowledge-based (i.e. wood industry in Finland). For sustainable economic development in the current economic context, every sector has to be approached with the view of increasing its knowledge-intensity and also competitiveness. Thus, the first sectoral or cluster-based policy initiatives have to clearly take this into account.

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[64] *Tallinn: Facts & Figures, 2007*. Tallinn City Enterprise Board, p. 17.
[65] *Rahapoliitiline ülevaade.* September 2007. Eesti Pank, p. 8 - http://www.eestipank.info/pub/et/dokumendid/publikatsioonid/seeriad/ylevaade/_2007_09/rpy_907.pdf, p. 8; See news releases of Statistical Office of Estonia.
[66] *Tallinn: Facts & Figures, 2007*. Tallinn City Enterprise Board, p. 18.

Table 4. ***The list of economic activities with the share of exports in industrial sales (%) over 50%, in 2005***

..**manufacture of radio, television and communication equipment and apparatus**	96.1
..manufacture of motor vehicles, trailers and semi-trailers	84.3
..manufacture of textiles	82.5
..**manufacture of electrical machinery and apparatus**	81.8
..manufacture of chemicals and chemical products	80.1
....manufacture of footwear	77.8
..**manufacture of medical, precision and optical instruments**	76.9
..tanning and dressing of leather; manufacture of leather products	73.7
..manufacture of pulp, manufacture of paper and paper products	69.8
....processing and preserving of fish and fish products	69.6
..manufacture of wearing apparel; dressing and dyeing of fur	67.4
..extraction of peat	66.9
..manufacture of furniture; manufacturing not elsewhere classified	63.3
....manufacture of furniture	61.6
..manufacture of wood and wood products	60.4
..**manufacture of machinery and equipment**	59.7
..manufacture of other transport equipment	54.1
....manufacture of glass and glass products	52.8

Source: Statistical Office of Estonia

In the potential electronics cluster, it has been indicated that more than 90% of the products are exported abroad, while most of the companies in Estonia are placed on lower levels of the international value chains (as producers who are not involved in design and development phases)[67]. This fragments the prospective electronics cluster and may reduce the probability of cooperation between enterprises and between all other actors in cluster as well.

In the potential ICT cluster, it has been argued that Estonian ICT-industry is a part of a larger Nordic/Scandinavian manufacturing industry as the structure of the ICT-industry is comparable to the ones in Sweden and Finland[68]. As a result, it can be said that the most important developments in the ICT market in Estonia are dictated by the developments in Swedish and Finnish enterprises that have branches, sub-companies or collective enterprises in Estonia[69].

In the potential biotechnology and health care cluster, the internal demand for medical services and health care services creates on the one hand potentially sufficient internal (and also growing external) demand for outputs of the cluster[70]. On the other hand, the biotechnology section of the wider cluster

[67] See Tiits, M. (ed.) 2007 *Kaupmeeste riik*, Estonian Academy of Sciences, pp. 78-87.
[68] Kattel, R., Kalvet, T. 2006. *Knowledge-based Economy and ICT-related Education in Estonia: Overview of the Current Situation and Challenges for the educational System.* Praxis, Tallinn.
[69] Ibid.; According to the Statistical Office of Estonia, around 46% of foreign conglomerates (out of around 1600) active in Estonia are either of Swedish or Finnish origin.
[70] The ageing of the population in Estonia and in Europe as a whole further reinforces this demand and widens nit in scope as there is growing potential for the increase of foreign demand for the healthcare and medical services through the concept of health-tourism (see for example the Strategy *Tallinn 2025*, that perceives it as an economic option for the Tallinn region in the future). In addition the cost advantage in medical-aid pharmaceuticals

has a more export-oriented nature (in addition to the internal demand of the biotechnology output horizontally across economic activities). The smallness of the Estonian economy and general demand prescribe export oriented strategies for the growth of the enterprises. These may, however, lead to similar fragmentation risks experienced by electronics and ICT companies.

Quality of life

As the capital region of the rapidly developing transition state, Tallinn has experienced double-faced development. Tallinn is in many senses seen as one of the more innovative cities with a modern living environment and opportunities[71]. At the same time Tallinn is experiencing severe social problems (large income differences, high crime rates, problems with prostitution etc.), difficulties in balancing urban planning and creating sustainable living environment etc. To a certain extent, these problems are common to most densely populated, capital regions in the world. But in this context and in comparison with the more developed regions of the world, **the transition state characteristics make it more important for the region to have suitable stable public policies that foster the reduction of these differences and provide an environment for economic and social development**[72].

In population dynamics, Tallinn has experienced parallel increase in the population numbers (despite the general decrease in the population figures in Estonia) as well as increase in the average age of the population (which has been much faster than in the rest of Estonia). On the one hand, the demographic labour pressure index of Tallinn (0.73 compared to the Estonian average of 0.88 in 2007)[73] sets serious challenges to the labour market. A mention should be made here of foreign countries with higher living standards that are attractive especially to younger population. On the other hand, the increasing average age of population is an indication that the demand for health care services might be higher in the future.

Most likely, this can provide positive incentives for the development of health care sector (and possible formation of a cluster) as the need for more services will increase. This may potentially lead to innovation in service delivery and

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rehabilitation services etc. (due to low labour costs and health insurance system etc.) seem to increase the likelihood of health-tourism becoming and important aspect of the economic activity in the area of medicine.

[71] Tallinn with its relatively good living conditions and employment opportunities is providing an important push for internal labour migration in Estonia. See for example Tiits, M. (ed.) 2007 *Kaupmeeste riik*, Estonian Academy of Sciences. This makes region-base comparisons based on skills or education less representative of the real labour market conditions of Tallinn because Tallinn has an advantage above other regions in providing conditions that allow attracting the best people from other regions as well.

[72] See for example *Tallinna innovatsioonistrateegia lähtealused* and (working version of) *Tallinna Innovatsioonistrateegia 2008-2013.* For an overview of positive factors affecting the development of Tallinn (the rise in the average quality of living environment, development of the enterprise environment, transportation infrastructure, cultural environment etc.) and negative factors (increases in the social imbalances, structural unemployment, decreases in the security of the city environment, lack of sufficient land-ownership reform and problems with transport planning and capacities), see the strategy *Tallinn 2025*, pp. 8-12.

[73] *Demographic labour pressure index* — the share of persons (aged 5–14 years) who will enter the labour market and persons (aged 55–64) who will exit the labour market during next ten years. If the index is bigger than 1, the number of persons entering the labour market is larger than the number of persons potentially leaving, Statistical Office of Estonia.

provision as the financial strains on health care system will be further increased. These developments should also give positive impetus to the development of the ICT and electronics cluster as there will be a higher need for better service provision applications, medical apparatus, new organisational forms etc.[74]

In terms of education, it has been recognised that similarly to most post-Communist countries Estonia in general has a relatively high educational level in comparison with the EU member states[75]. The quality of education has also been highlighted by the recent *PISA* studies. Also, in Estonia, Harju and Tartu counties (the centres for tertiary education) have the highest educational enrolment[76]. Altogether, there are 41,000 students studying at the universities in Tallinn in 2007[77].

Despite high enrolment and attainment rates in tertiary education, Estonia still falls short of countries like Finland and Ireland, e.g. in the field of science mathematics and computing that are commonly seen as countries with good conditions for innovation and development[78]. However, the number of students studying in the sphere of life sciences and science mathematics, especially in computing, has increased considerably (2.3 times) during the time period from 1997 to 2006 (but mainly on the account of fee-paying students).

The case in the fields of engineering, manufacturing and construction is the same, in 2006 the number of students increased by 7.4% in comparison with the previous year. In vocational education, the respective change was 24%. At the same time, the share of students in the spheres like health and social care has been gradually decreasing since the year of 2003, mainly at the expense of social care.[79]

The relevance of higher education has been found to be of particular re-emphasis during the last years by Lundvall who sees the economic development to be highly dependent on the changing role of higher education. The role of graduates is more substantial than just increasing the pool of educated persons. Rather, their role is to act as innovators and equilibrators.[80]

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[74] See also strategy *Tallinn 2025*, p. 23.

[75] For example, in 2004, 35% of the population attained tertiary education, making it higher than in most of the EU member states *Science, technology and innovation in Europe, 2007.* European Commission, Eurostat, p. 64 - http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-AE-07-001/EN/KS-AE-07-001-EN.PDF,. According to Eurostat, in 2006, 88% of the Estonian population aged 25-64 had completed at least upper secondary education while the same indicator for EU-27 was 70% and EU-15 it was 66.7%.

[76] See Statistical Office of Estonia for e.g. statistics about enrolment in different higher educational institutions.

[77] *Tallinn: Facts & Figures, 2007*. Tallinn City Enterprise Board, p. 17.

[78] Kattel & Kalvet. 2006. *Knowledge-based Economy and ICT-related Education in Estonia: Overview of the Current Situation and Challenges for the educational System.* Praxis, Tallinn; *Science, technology and innovation in Europe, 2007.* European Commission, Eurostat, p. 70 - http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-AE-07-001/EN/KS-AE-07-001-EN.PDF, p. 70.

[79] Tina, A., Tõnisson, E. 2007. *Statistiline ülevaade kõrghariduse õppekavadel õppijate näitajatest*. Riikliku koolitustellimuse komisjonile. Tartu, pp. 9-10 - http://www.hm.ee/index.php?popup=download&id=5810.

[80] Lundvall, B.Å. 2007. *Higher Education, Innovation and Economic Development*. Paper presented at the World Bank's Regional Bank Conference on Development Economics, Beijing, January 16-17, 2007, Department of Business Studies, Aalborg University.

In the fields of training and life-long learning Estonia falls short of both EU-27 figures and even more so of the EU-15 figures[81]. The same tendencies are to be traced in the comparison of doctoral graduates as well, where only 0.88% of doctoral students aged 25-29 graduate with PhD while the figure for the same age group in EU-25 is 2.9%[82].

In general, as compared to other regions Tallinn has a rather educated workforce, with 49.0% having secondary level education and 44.4% having tertiary education; the latter level is by 10 percentage points higher than the general level in Estonia as a whole. The same applies to higher education levels, with 32.8% of labour force of Tallinn having higher education, while the respective figure in Estonia is 24% (see Table 2 above)[83]. This has also created a situation that there are relatively more unemployed people with higher education in Tallinn and Harju county than in Estonia in general (26% and 17% of the unemployed in 2006, respectively)[84]. On the one hand, this is a clear indication of the problems that arise during the transition in the reconstruction of economy and of the inability of the labour force to re-specialise. Finally, it also means that Tallinn has a high quality human capital at its disposal that is not currently being used.

This implies that Estonia has to face the problems arising from high dependence on the education provided by the formal educational system (and comparatively less support from the private sector initiatives) as well as the threats of losing to cutting edge R&D and innovation in comparison with other countries in the EU. This is a serious handicap when it has to do with rapidly developing fields like ICT and biotechnology.

Speaking of the educational capacities, there are currently (in 2006) 26 vocational education institutions in Tallinn, which is about 40% of all vocational institutions in Estonia and they provide education to 33% of all vocational education students. There are also (as of 2007) 22 higher educational institutions, including 4 public and 5 private universities that provide education to approximately 50% of the students in public universities and to 98% of the students in private universities in Estonia.[85]

However, the strategic development, regulation and the provision of support mechanisms for developing the body of educational institutions is the central government's competence. The City of Tallinn has mostly

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[81] According to Eurostat, the percentage of population aged 25-64 participating in life-long learning programs in 2006 in Estonia was 6.5% while in EU-27 this was 9.6% and EU-15 11.1%. Also despite the fact that almost similar amount of enterprises provide training in Estonia as in EU-25 and EU-15 (47%, 53%, and 54% respectively), the employees participation in company-provided training is more than two times smaller in Estonia compared to EU-25 and EU-15 (19%, 29% and 40% respectively) (as of 2004). Though, according to a survey by Estonian Ministry of Education and Research, the workers in Tallinn participate significantly more in training programs in comparison with other regions in Estonia (see *Täiskasvanu tööalase koolituse kvaliteedi tagamise eeldused. Aruanne,* p. 31 - http://www.hm.ee/index.php?popup=download&id=4483).

[82] Kattel & Kalvet. 2006. *Knowledge-based Economy and ICT-related Education in Estonia: Overview of the Current Situation and Challenges for the Educational System.* Praxis, Tallinn.

[83] Statistical Office of Estonia.

[84] See statistics of Estonian Labour Market Board - http: www.tta.ee.

[85] See Tina, A., Tõnisson, E. 2007. *Statistiline ülevaade kõrghariduse õppekavadel õppijate näitajatest*. Riikliku koolitustellimuse komisjonile. Tartu, p. 33: http://www.hm.ee/index.php?popup=download&id=5810.

indirect or informal/voluntary mechanisms for influencing the developments of the educational system in the region. This re-emphasises the importance of cooperation between public administration entities as well as (voluntary networking and cooperation) between the City of Tallinn and other stakeholders in the potential cluster areas, if Tallinn is to have any real influence on the development of clusters from the educational perspective.

To sum it up, **the main institutions** in Tallinn that provide educational services relevant for the potential clusters in the light of this study are as follows[86]:

- Potential ICT cluster
  - → Tallinn University of Technology
  - → Tallinn University
  - → IT College
  - → Mainor Business School

- Potential electronics cluster
  - → Tallinn University of Technology
  - → Tallinn College of Engineering

- Potential health care and biotechnology cluster
  - → Tallinn University of Technology
  - → Tallinn University
  - → Tallinn Health College

Accessibility to the region

In brief it can be said that Tallinn is geographically situated in a rather good position that provides the region with the best possibilities for economic development in Estonia due to the following reasons:

- closeness to the main metropolitan areas of the northern Baltic Sea region (Helsinki, Stockholm, St. Petersburg);

[86] We have consciously not presented a comprehensive overviews of the different curricula or programs offered by these higher education institutions, mainly for 2 reasons. Firstly, there is an ongoing transfer from the old curricula system towards the new Bologna Declaration based curricula system (the so called "3+2 system") and as a result there are overlapping (but soon to be closed) curricula still represented in the official curricular register (http://www.ehis.ee) as there are still students who attend the former master's curricula. Secondly, by 2009 all existing curricula should be revised to comply with the ECTS credit system (as a part of the Bologna process). This means that the majority of the curricula are subject to analysis and subsequent revisions. **This offers opportunities for both higher educational institutions as well as for other stakeholders of the potential cluster formations to revise the current educational structure and cooperate on changing the content of the curricula.** In this context, further analysis and mapping of different curricula will not provide long-term supplement to the already systemised overview of the curricula – e.g. the curricula in the ICT cluster (and partially the electronics cluster) have been already thoroughly analysed in Kattel, R., Kalvet, T. 2006. *Knowledge-based Economy and ICT-related Education in Estonia: Overview of the Current Situation and Challenges for the Educational System.* Praxis, Tallinn. In addition, there is a web-site under development that summarises the current opportunities for acquiring ICT and electronics related higher education (http://www.startit.ee/).

- existence of the main transportation infrastructure (ports, railroad, airport that could offer future advantages thanks to its increased capacity).

Nevertheless, these are the positive characteristics that are applicable to the greater part of Estonia because of the smallness of the country. **On the negative side, Tallinn has to resolve several issues that concern the availability of and accessibility to sufficient amount of affordable industrial and service-purpose land and buildings**. There are problems both in legal terms as well as in terms of urban and transportation planning.

Currently, there has been a trend for big enterprises to move to neighbouring local governments and locate themselves geographically (and mostly in uncoordinated manner) out of the borders of the City of Tallinn[87]. In a way it is an inevitable development because of the scarcity of affordable land. At the same time, without clear public policies, forecast capacities and incentive measures that indicate potential future promising economic areas and clear public policy support for cluster development, uncoordinated relocation to the outer boundaries of the region may create new obstacles for cluster developments in the future.

Initiatives like technology and science parks or incubators counterbalance these developments[88]. Establishment of the *Tallinn Technology Park TECHNOPOL* in the city district of Mustamäe, and 2 business incubators located in the city districts of Lasnamäe (so-called *Ülemiste Innovation City*) and Kopli, plans for creative business incubator for SMEs[89] are policy responses based on these arguments. So is the emerging understanding that these initiatives could be developed cluster or sector specifically.

This further increases the importance of both private and public sector organisations to agree on future potential fields of entrepreneurship. This is a necessary precondition for developing most optimal specialisation schemes.

<u>Cultural conditions</u>

In general, it can be stated that the general cultural context of Estonia is suitable for innovative activities – as a rule, Estonia has been described as a country open to new ideas and initiatives, be it the development of new services (public or private) or carrying out of varied reforms.

At the same time, **traditionally more individualistic cultural context and strongly market-oriented understanding of societal development may counterweight this potential.** One of the latest studies on innovation-related cooperation in Estonian enterprises revealed that most enterprises are not keen to cooperate neither with other enterprises (because of the fear of competition) nor with R&D institutions (because there is not enough awareness of the positive effects of this cooperation – like sharing of innovation related risks)[90].

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[87] See strategy *Tallinn 2025,* p. 35.

[88] Andersson, T., Serger, S. S., Sörvik, J., Hansson, E. W. 2004. *The Cluster Policies Whitebook.* IKED.

[89] *Tallinn: Facts & Figures, 2007*. Tallinn City Enterprise Board, p. 14.

[90] Jürgenson, A., Kalvet, T, Kattel, R. 2005. *Ettevõtluse toetusmeetmed Riigieelarve Strateegias 2007-2013.* PRAXIS. Also, recent studies have indicated that on average cooperation among enterprises in Estonia is more frequent than the EU average, but this

The reasons for the lack of cooperation stem from the reality that in their own opinion most companies are doing rather well (according to the referred study, this was stated by about 30% of companies). **But there is also a lack of understanding about what it takes to achieve long-term sustainable development and economic growth both on an enterprise level and on a wider scale**[91].

At the same time, it is recognised that successful business strategies and development plans on regional scale (with regional synergies and benefits) – like cluster initiatives – require good environment for cooperation and networking and more emphasis on social consciousness and participation in the business strategies of companies[92]. This may culturally be one of the challenges that needs to be met.

Furthermore, the most profound study on cluster initiatives in 2003[93] identified that most cluster initiatives are found in the areas - IT, medical services, communications equipment, biopharmaceuticals, etc. – that have been identified as relevant for cluster development in the Tallinn area as well[94]. **This further emphasises the need to overcome cultural obstacles and old traditions to foster more sustainable cooperation and networking within the framework of clusters**. As most cluster initiatives are usually initiated and financed by either governments or industries or equally by both, there is a clear need to overcome the current challenges that inhibit cooperation between different cluster stakeholders in Estonia.

One of the tools for creating better framework for cooperation has been the formation of specialised organisations or unions of enterprises in specific clusters. The networks between the enterprises are seen to offer better structure for cooperation with other stakeholders in the cluster (mainly with public policy-makers and R&D institutions)[95]. In Estonia, the main institutions in these clusters can be summarised as follows:

Table 5. List of industry-led associations of the potential clusters.

Cluster area	Organisation	No. of members
ICT	Estonian Information Technology and Telecommunications Union	38, including - 1 university; - 1 foundation; - 36 enterprises
	Estonian Information Technology Foundation	5 institutional founders

cooperation is mainly concentrating on cooperation with suppliers and customers and not with universities and R&D institutions. See, for example *Estonian Research and Development and Innovation Strategy*, p. 17.

[91] Jürgenson, A., Kalvet, T, Kattel, R. 2005. *Ettevõtluse toetusmeetmed Riigieelarve Strateegias 2007-2013.*

[92] Sölvell, Ö., Lindqvist, G., Ketels, C. 2003. *The Cluster Initiative Greenbook.* The importance of the role of the state in developing clusters on a regional basis is also recognised in the *Estonian Research and Development and Innovation Strategy*, p. 17.

[93] Sölvell, Ö., Lindqvist, G., Ketels, C. 2003. *The Cluster Initiative Greenbook.*

[94] For the latest, see for example (working version of the) *Tallinna innovatsioonistrateegia 2008-2013.*

[95] Andersson, T., Serger, S. S., Sörvik, J., Hansson, E. W. 2004. *The Cluster Policies Whitebook.* IKED.

	Estonian Information Technology Society	- 6 corporate members; - 106 individuals
Electronics	Federation of Estonian Engineering Industry - *Electronics and electrotechnics*	- 75 corporate members (4 in the sub-group of companies of electronics and electrotechnics); - 5 higher education institutes; - 6 secondary vocational educational institutions;
	Estonian Electronics Society	N/A
Health care and biotechnology	Estonian Biotechnology Association	23, including - 1 university (Tallinn University of Technology); - 1 science park; - 1 non-profit organization; - 2 foundations.
	Tallinn Family Medicine Association	263 family doctors.
	The Professional Association of Doctors in Tallinn	1205 doctors.

Yet, the current state, capacities and functions taken by these associations fall short as compared to what is presumed in the standard cluster approaches that are based on the experiences of more developed regions.

Conclusion

In summary, it has to be reiterated that the spatial-economic conditions are the foundation on which a sustainable clustering process depends upon. This means that without conscious attention to these issues, any more sophisticated cluster policy or initiative may face difficulties. The "standard text-book" clustering approaches tend to disregard the importance of these issues. In more developed environments strategic and conscious attention to these issues is usually a norm.

But, the transition state context usually implies lack of sufficient conscious, competence-based approach to the development of spatial-economic conditions. **Thus, a universal prerequisite of any cluster-related public policy is the conscious long-term strategic management of issues like entrepreneurial environment, education and training, urban planning and development, social cohesion and social capital etc.**

In the case of Tallinn, the spatial-economic conditions largely reflect the structural problems the entire country is facing. **At the same time, Tallinn as the capital region has considerable "competitive advantages" in comparison with other regions.** Tallinn has better entrepreneurial climate, better educational level and education provision, better labour market condition, better location etc. Thus, Tallinn seems to be a logical test-ground for cluster initiatives in a small state like Estonia. **This also provides Tallinn with better potential for bringing the EU's Structural Funds to the region and absorbing them**, including both programs for the development of spatial-economic conditions as well as specific cluster programs. However, this requires better coordination and alignment of local and central government policies.

Thus, Tallinn has to take into account the following principles:

- **Firstly, there needs to be a conscious long-term strategic development of the general spatial-economic conditions of the**

local government area. There should be clear priorities for the development of entrepreneurship, urban planning, transport, social cohesion etc. These are the areas that condition the success of any more sophisticated initiative i.e. cluster programs etc.

A clear distinction should be made between issues that mostly belong to the competency of the local authorities and the issues in which the central government has more mandate for policy-making (i.e. higher education and research). The former areas require strong internal planning and management capacities. The latter also need supplementary general capacities for policy coordination with the central government and skills to influence the central government's policy-making in a suitable direction. For this, Tallinn has the best starting position.

- **Secondly, there needs to be an understating that any specific policy initiative has to be in line with the general central government policies**. In the end the central government and local government policies should add up to state policies.

  As Tallinn is the most influential local government region, it is obvious that most of the central government policies should take Tallinn as the reference point in one way or another. The role of the local government should be to create competencies for supplementing central government initiatives with suitable (even more) context-specific policies**. In a small state, there is not enough financial and human capital and potential to have complementary policies and initiatives between different levels of government.**

- **Thirdly**, the previous analysis leads to a general hypothesis that in a small transition state that is in the beginning of the conscious sectoral and cluster-based policy development, the first policy initiatives should encompass as wide a pool of stakeholders as possible. It would help create required capacities among all potential stakeholders. **Naturally, this presumes that more emphasis should be put on knowledge intensive potential cluster areas and there should be sufficient flexibility maintained for including new fields as well as traditional industries in the initiatives**.

  In a small state there are limited capacities and the sufficiently high level of internationally competitive skills is limited in most fields. **Thus, to create new competencies, all existing resources need to be included in the policy initiatives.** Without it, there is a threat that the potential capacities are fragmented and some of the main competencies are excluded from the policy development and learning experience.

  It certainly means the inclusion of academia and scientific competencies. **Logically, this leads to more knowledge-based cluster approach.** Still, it does not have to mean concentrating solely on inventions, fundamental innovations etc. as the core of clusters. The academia may also have complementary competencies for more enterprise-centred initiatives. It is important not to exclude academia from possible initiatives. Eventually, the goal of the economic policies is to induce structural change of the economy and increase the added value of economic activities. This has to be based on general scientific progress, if it is to be sustainable in the long run.

Analysis of the potential ICT cluster

The following is mainly based on the information gathered through the interviews conducted for the purpose of this study. During the preparation process of the study, it was revealed that there is a lack of comprehensive statistical information, both at national level as well as at the level of Tallinn.

Definition of the ICT cluster

There is no common definition of the ICT sector or cluster[96]. **This is mainly because ICT has gone through rapid development over the last decades, being the locus of the current techno-economic paradigm**[97], and there has been an increase in its applicability across various fields of economic activities. *The Estonian Association of Information Technology and Telecommunications* (ITL) has emphasised that statistically there is no distinct ICT or telecommunications sector. Based on the NACE Rev.1.1 statistical division and its Estonian replication the *Estonian Classification of Economic Activities 2003,* ICT is represented in the fields of manufacturing industry (subfields of paper and publishing, electronics and optics), wholesale and retail, communications, and real-estate etc.[98]. Previous studies on the potential ICT cluster in Estonia have extended the concept of cluster to include parts of electronics and medicine and biotechnology (treated separately in this project)[99]. This further implies that depending on the approach, the understanding of the cluster may differ.

The cluster should be defined from the perspective of the potential enterprises that can be part of the cluster as they are seen as the core motors of any cluster formations. The rest of the stakeholders (R&D institutions, industry associations, public administration etc.) have to be distinguished based on the enterprise composition of potential clusters as they are mainly seen as facilitators or supporters of enterprise development.

As it has been argued in the previous parts of this study, the concept of cluster has unique characteristics and composition in different settings. It means that the statistical division of companies and other institutions in different sectors provide a pool of organisations that can potentially be part of a cluster. It is wrong to presume that all companies in one specific sector are a part of a potential cluster. As it has been argued, the transition state characteristics usually entail low trust both in other companies as well as public administration, which limits the cluster formation potential. In the Estonian context, the importance of foreign owners, the lack of previous conscious cluster policies or initiatives and the smallness of many companies further question the

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[96] It has been argued previously that each cluster has unique characteristics and composition. Thus, it is not sensible to limit the cluster analysis with pre-determined definitions of ICT sector or cluster anyway.

[97] See Perez, C. 2002. Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages. Edward Elgar, Cheltenham, UK, Northampton, MA, USA.

[98] For more detailed listing see: http://www.itl.ee/docs/EestiIKTsektor2005analyys_ITL.doc . In addition, the same distribution divides the companies in the sector into four groups: telecommunication companies; distributors; subsidiaries and branch offices of foreign businesses; "traditional IT companies".

[99] See Pihl, T. (2001). *Analysis of Estonian IT Sector Innovation System: Estonian ICT Cluster, Present State and Future Outlook*. Estonian eVikings, Archimedes Foundation.

experience of the companies to consciously develop long-term cooperation and networking.

For deriving the list of ICT companies that could potentially form a cluster in the Tallinn area, this study derived a list from the database of the *Centre of Registers and Information Systems* based on the *Estonian Classification of Economic Activities 2003*[100]. In general terms, the database **confirmed the common presumption that the majority of companies active in the ICT field are rather small that results in the fragmented ICT sector.** And once again, it leads to the hypothesis that in general there is low potential and tradition for the development of cluster-like formations in Tallinn. It means that the approach to cluster should start from trying to identify the **presence of basic foundations for cluster formations** (i.e. social trust, social capital, presence of preliminary links between stakeholders, capacity and organisation building).

Table 6. The list of ICT companies registered in Tallinn.

	2001	**2002**	**2003**	**2004**	**2005**	**2006**[101]
No. of companies in the official register	557	672	743	814	842	735
No. of companies with turnover over 5 million kroons	70	94	94	109	110	113
No. of companies with turnover over 10 million kroons	41	58	58	64	68	58

Thus, despite the general rhetoric about the ICT cluster, it is worth to question the existence of any real cluster characteristics in the field. This study proceeds from the assumption that a cluster is a method for describing, organising and managing deep synergetic cooperation and networking centred around the readiness and belief of the companies in the field in the usefulness of organised cooperation and networking. Instead of relying on quantitative statistics[102] (i.e.

[100] The list included all potential fields of economic activities where ICT and its applications would be of central importance. For limiting the potential size of the database we excluded the companies mainly dealing with wholesale and retail, intermediation etc. The exclusion was based on the understanding that most likely the preparedness and willingness to participate in cluster formations is the highest among more innovative companies who are seeking new productions, development options. Yet, due to the limited statistical data, the information retrieved is mostly not analysable and can provide only general tendencies. Because of the separate analysis of ICT and electronics we included the production of different ICT-related appliances (computers, communication equipment etc.) mainly in the electronics database, while the ICT database covered mainly services and development activities.

[101] The 2006 figures may not be final because the 2006 database is still under construction by the *Centre of Registers and Information Systems.*

[102] The problem with quantitative analysis is that when it indicates that there are real linkages between the companies of a sector it does not show whether there is a proper environment for cooperation and networking that traditional cluster formation include. Furthermore, recent studies have shown that there are not many internal linkages between the companies of a cluster (i.e. subcontracting and the like) and that most of the value of the cluster comes in a form of transfer of tacit knowledge, common information-sharing systems, common marketing and strategies towards foreign markets etc. For more see: Andersson, T., S. S. Serger, J. Sörvik, E. W. Hansson. 2004. *The Cluster Policies Whitebook*, IKED.

input-output table analysis etc.) this report intends to analyse whether there are the "soft" mechanisms at hand for the development of sophisticated and synergetic cooperation between the companies as well as other relevant stakeholders.

Presence of cluster characteristics – entrepreneurs as the centre of cluster formations

From the point of view of entrepreneurs (who are seen as the core of any cluster formation) there seems to be a **common understanding that there is no ICT cluster** (and accompanying stable cooperative networks) present either in Tallinn or Estonia as a whole. Rather there is a common belief that **in the current economic structure and development path of Estonia there is no real demand or need for a specific ICT cluster**. The reasons for this can be summarised as follows:

- Any kind of cooperation and networking could potentially happen between companies who define themselves **as more innovative companies** as compared to the rest of the mainstream ICT companies (dealing with wholesale and retail, intermediation etc.)[103]. But currently most companies cannot be defined as innovative as they are active in the mentioned areas.

  Most larger or more successful companies[104] in ICT are either **telecommunications companies** or companies active in **wholesale, assembly or intermediation of ICT products and services** (see also Appendix 7). These companies tend to concentrate in Tallinn[105].The majority of larger wholesale and assembly companies are of Estonian origin, except for foreign subsidiaries. At the same time telecommunications companies are parts of larger foreign-owned (multi-national) companies and it has been brought out that they represent (together with larger banks and financial institutions) a rather separate section of the Estonian ICT market. **Banking institutions** have their own quite developed competencies, and they act in closed independent systems. Telecommunications companies seem to be another separate group who are able to cooperate in infrastructure development etc. At the same time, being parts of larger multi-national companies they do not have independent capacities and interest in the wide-scale cooperation and development of the ICT sector and the possible cluster. Thus, this already implies **fragmented market where the companies with the highest financial power and competencies have different interests, priorities and willingness than the rest of the market**.

  It has been brought out that the **foreign ownership and management** of many key ICT (and related) companies reduces the likelihood of any large scale R&D and strategic development initiatives to be located in Estonia. Foreign owners do not feel the need for it as they are mainly

[103] The Estonian Association of Information Technology and Telecommunications has distinguished between four types of companies all, which have different characteristics and priorities: telecommunication companies, distributors, branch offices and representations of foreign companies, "traditional" IT companies (Estonian ICT sector analysis 2005: http://www.itl.ee/docs/EestiIKTsektor2005analyys_ITL.doc.).

[104] One of the options for evaluating the success rate of companies is to use the yearly TOP500 rankings provided by Äripäev.

[105] At the same time their activities mostly cover the entire country.

interested in attracting the suitable labour force on the market. Additionally, people from foreign environments may also lack experience and belief (and mandate from foreign owners) for networking and communicating with prospective partners.

- For any cluster to emerge there needs to be a private-sector-led demand for it or, in the context of a transition state, at least a common understanding and belief in the usefulness of it. But currently, because of the economic development and highly unstable and competitive environment (smallness of companies, concentration to local markets), **most companies do not feel the need and do not have the necessary trust for cooperating with other partners for seeking potential future markets or developing higher competitive advantages.** So far the greater part of the cooperation is mostly project-based rather than consciously long-term oriented one.

- The need for cooperation in ICT is different from other fields because **in ICT the geographical closeness of the companies, the need for large-scale investment in infrastructure etc. are not as important** as in more industrial or resource-intensive sectors[106]. Thus, there needs to be more innovative and flexible approach to clustering.

  Because of the more flexible nature of ICT, the entrepreneurs emphasise the **need to look above certain regions (i.e. Tallinn) in developing their cooperation and different initiatives**. **First** of all, it is recognised that Estonian market is too small for companies to grow and move higher in the value chain; one geographical location (i.e. Tallinn) may not have sufficient critical mass and complementary assets to provide sufficient capacities for entering foreign markets. **Second**, it has been realised that one region and its local government administration are not able to provide sufficient public-policy support for raising the potential of ICT in order to increase it's relevance in the national economy and its competitiveness in the international markets.

  Thus, what is actually expected is the **better coordination** between different levels of government and society to develop a more efficient division of labour with central government taking the lead (from public-policy perspective) in fostering the development of cluster-like formations.

- Further, it is understood that firstly, there needs to be a **clear development of specialisation** within the sector before ICT can start to cooperate with other stakeholders or cross the boundaries of its current activities.

  It is understood that ICT alone can not increase the added value provided to the economy, thus there needs to be more **horizontal cooperation with other sectors** (and transfer of ICT applications and organisational principles). For this to happen, ICT currently lack sufficient experience and information about the current state of other sectors.

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[106] This was brought out as one of the main reasons why *the Federation of Estonian Engineering Industry* has been more able to gather their sector needs (though it has taken years for the initiative to get sufficient support) and communicate them to public-policy makers to develop a program for meeting their needs. At the same time, **it was emphasised that each sector has its own customised operational logic and the imminent needs and successful policy initiatives in one sector/field may not succeed in other economic areas** (i.e. ICT having different logic and needs).

- The potential of the development of cluster formations is further diminished by the **lack of links between R&D institutions and enterprises,** largely because of different time perspectives of R&D activities (programs developed for years) and ICT market (products and services needed in months),the lack of common nodes (or contact-points) to increase the communication, the lack of resources and time for entrepreneurs to develop close cooperation with R&D institutions.

In summary, from the point of view of the entrepreneurs, **the current potential for ICT to develop into a cluster is under doubt and its usefulness is also called in question**. What is needed is the clear and conscious specialisation of the ICT sector based on strategic choices and apprehension of the future economic trends. **In this respect, public policy that is based on extensive procurement process might provide one of the best options for fostering networking and cooperation between private sector agents**. Yet, it is an aspect of the procurement process that has been currently understudied and underutilised[107]. Though, it could provide a basis for increasing cooperation and networking between stakeholders in any sector.

Further, the potential for ICT is seen in **horizontal linkages with other potential sectors to form a cluster where ICT acts as the (technology-based) enabler of the cluster.** At the same time the ICT companies lack the capacities for developing these strategies, as well as foresight competencies and cross-sector linkages on their own.

The dominant view seems to be that **cluster formations can emerge in response to certain crises or shock-event**[108]. It is expected that this would force companies to re-consider their strategies and priorities because under the current (though fading) context of economic growth it cannot be expected to happen just on its own. If this is to happen, there is a view that there needs to be a **better analytical preparedness and higher competencies among public policy-makers** to be able to respond correctly to the changing circumstances and provide support for enterprises to change their business principles. Indeed, this – **competence and network building** – seems to be the most important task that a local government can fulfil in fostering cluster-building.

The role of industry associations

The usual cluster rhetoric perceives **industry/sectoral associations as one of the main supportive institutions for developing industry and enterprise centred competencies and visions that are necessary for developing**

[107] For the first comprehensive study that also includes the mapping of the current state of the procurement and innovation capacities in Tallinn, see Lember, V., Kalvet, T., Kattel, R., Penna, C., Suurna, M. 2007. *Public Procurement for Innovation in Baltic Metropolises.* Tallinn University of Technology.

[108] This is similar to general observations of the cluster formation as clusters usually form because of economic or technological downturn that requires the development of new competencies and competitive advantages or because of new technological breakthroughs or innovations that bring about new opportunities that are being taken advantage of through the cluster formations. Sölvell, Ö., Lindqvist, G., Ketels, C. 2003. *The Cluster Initiative Greenbook;* Andersson, T., S. S. Serger, J. Sörvik, E. W. Hansson. 2004. *The Cluster Policies Whitebook*, IKED.

cooperation within the sector and with other sectors in the economy[109]. It is assumed that the associations are able to take a long-term vision for analysing and communicating the potential developments and future orientation of the industry to the wider audience and provide guidance for the companies for making strategic choices and finding partners and fields of activities that could lead them towards higher competitive advantage and increased added value of their activities. In a transition state context the capacity of the associations is usually weaker and these roles need additional support from other stakeholders[110].

In Estonia, the main and most active industry association for the ICT sector is the *Estonian Association of Information Technology and Telecommunications*[111]. Currently, it encompasses 36 companies, one foundation and one university. Thus, the overall membership of the association is remarkably small considering the total number of ICT companies – as of 2006 there were more than 1,900 companies that the association identified as ICT companies in Estonia[112]. One of the reasons for low participation stems from the **limited activities of the associations** – it is mainly able to act as a general political lobby organisation whose activities cover the most general interests of the sector. This has not provided sufficient incentives for a larger membership to develop. As the association has not been very effective in providing guidance for developing specialisation or mapping the competencies of the cluster, "exporting" their vision, specific needs or input to national level policy decision, most companies do not see the benefits of participating in the activities of the association. They can enjoy the benefits of the general political lobby without explicit membership (i.e. free-riding).

On the other hand, the smallness of the majority of Estonian ICT companies reduces their incentives and possibilities for joining such industry associations. They **lack sufficient and proper human capital** (people and skills) to actively participate in the activities of associations and quite often they lack the financial resources for acquiring membership of the association as well.

In addition, the association does not include some of the more innovative enterprises usually seen as success stories in Estonia (i.e. Skype, Playtech). It is so mainly because so far the association has lacked the capacity to provide real input to their activities. As larger companies who are oriented at foreign markets (and have foreign owners and financing) they have sufficient capacities of their own and higher motivation due to higher returns from independent R&D or for cooperation with foreign companies and clusters.

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[109] Sölvell, Ö., Lindqvist, G., Ketels, C. 2003. *The Cluster Initiative Greenbook;* Andersson, T., S. S. Serger, J. Sörvik, E. W. Hansson. 2004. *The Cluster Policies Whitebook*, IKED. Also, Porter, M.E. 1998. "Clusters and the New Economics of Competition", *Harvard Business Review*, November-December, pp. 77-90. See also for example: Porter, M.E., 2000. "Location, Competition, and Economic Development: Local Clusters in a Global Economy", *Economic Development Quarterly*, vol. 14, no.1. pp. 15-34.

[110] Sölvell, Ö., Lindqvist, G., Ketels, C. 2003. *The Cluster Initiative Greenbook;* Andersson, T., S. S. Serger, J. Sörvik, E. W. Hansson. 2004. *The Cluster Policies Whitebook*, IKED.

[111] Other associations (*like the Estonian Information Technology Foundation, the Estonian Information Technology Society*) are even less concentrated on industry/enterprise centred policy issues and are more or less specialised in developing industry-related education and training policies and services.

[112] *Estonian Association of Information Technology and Telecommunications*: http://www.itl.ee/docs/IKT_firmade_list060905.xls.

Finally, the capacities of the association are further constrained by the **limited capacities of other industrial associations to carry out similar tasks and roles**. As ICT is often seen as the horizontal strategic key technology for innovation and increased added value of the economy, the ICT sector requires input from other industries for developing strategies, competencies, policy choices that would provide the necessary technological support. Currently, there is a lack of input from the other sectors. This is further reinforced by the **limited capacity of policy-makers to include the association in its activities and initiatives**. Thus, the problem of the scope of the association and its more active participation and inclusion in the policy-making requires coordinated efforts on both sides of this relationship.

The role of R&D institutions in cluster formations

It is mostly understood that considering the smallness of Estonia and the limited human capital at hand, **successful cluster initiatives should include the highest quality amongst all possible stakeholders**. There are rarely enough qualified people and resources in Estonia to be able to afford complementary initiatives and programs. In most cases it would result in fragmentation and creation of new borders among the best people who could be the cornerstones of successful initiatives, such as cluster formation. **It also means that any cluster initiative should aim to include the best pool of R&D institutions and people available.**

Yet, the general understanding among entrepreneurs, central government policy-makers and academics seems to be that **there is not enough reciprocal cooperation between the R&D institutions and enterprises that one could talk about clusters in its intended sense.** There is no general consensus whether there is proper willingness from the academic side to be part of a cluster-like cooperation[113]. The general view tends to be skewed towards indicating less willingness than would be needed for cluster-like formations. But the problems causing this cannot be viewed as one-sided.

The reasons should be considered from different perspectives. On the one hand, it has been emphasised that universities and R&D institutions are not able to provide necessary input in terms of cooperation, exchange of know-how, human and physical capital etc. if there is no explicit demand or need shown by the other side (i.e. enterprises). There is also a lot of criticism towards R&D institutions as the latter are seen to be more concentrated on achieving their competitive advantage in relation to other academic institutions rather than taking leadership and a perspective necessary for achieving more socially beneficial results. This means that on the priority lists, **cooperation with other**

[113] From the point of entrepreneurs there seems to be a common understanding that the competencies, technologies, innovations provided by the universities lack relevance to the current market situation (because of different time perspectives, because the "output" of university and academic R&D is currently not ready to be taken to the market i.e. not enough attention paid to market demand analysis, design, marketing, functionality etc.). At the same time, from the public policy point of view, there has evolved a belief that currently universities do not feel the need to cooperate and work towards achieving better cooperation and developing entrance possibilities to the market. It is believed that the accession to the EU has increased other sources of funding of R&D that are independent of the market actors. On the other hand this view can also be the reflection of highly fragmented communication between different stakeholders meaning that relevant people and institutions from different sides are unable to find the common points of interest and common nodes of communication.

stakeholders in society is behind the objectives related to infrastructure development, research and teaching objectives. At the same time the potential benefits of cooperation could provide positive input into achieving all other objectives.

On the other hand, the current structure of Estonian economy and the ICT sector (dominance of small companies, foreign ownership of key companies, and high competition on a rather limited market) **limits the capacities of the enterprises to be more efficient in their role as well**. **Firstly**, smaller companies do not often have the necessary resources, competencies, realisation of the need to be involved, or even informed about the R&D developments that might be beneficial for their long-term development. Often, their problems are related to more short-term practical issues that tie them up and reduce the potential for having a long-term perspective. **Secondly**, foreign ownership of some of the key companies (i.e. Skype) or their main orientation towards foreign markets seems to reduce their incentives (and in case of sub-contracting to foreign companies their legal opportunities as well) to actively cooperate with other Estonian companies and with Estonian R&D institutions. Their main concern is to acquire enough qualified staff to develop their internal technologies and processes with limited spill-over or feedback to the field in Estonia as a whole. **Thirdly**, the high-level of competition among the companies that are active in Estonian markets only, reduces the time-span of their strategic management and planning processes (because of increased uncertainty over the future) as well as their willingness (and trust) to cooperate on a higher level with other companies and R&D institutions. **Thus, the cooperation is more project-based than long-term**.

Overall, this leads to **the highly fragmented potential pool of ICT companies with low willingness and capacities to actively cooperate with other institutions of potential clusters.** As in theory the R&D institutions are the most sophisticated and long-term oriented institutions, the willingness and competencies to cooperate with them seem to be insufficient for cluster developments. Thus, **the common missing link seems to be social capital, higher trust and tradition of cooperation that would reinforce the tradition and culture of cooperation, exchange of information, and tacit knowledge that would help overcome the current lacuna in the cooperative environment**. The above-mentioned missing links can be all viewed as one of the main prerequisites of any cluster formation.

<u>The role of government organisations in cluster formations</u>

The interviews with different stakeholders revealed more or less consensual understanding that the **centre for any public sector involvement in cluster formations should lay in the central government**. Local governments can play a supporting role only in coordinating, representing, and developing local interests. This argumentation is contrary to the general understanding of clusters where local government's involvement and participation is seen as more important, or at least as important as the role of the central government[114]. This may be conditioned by the size of Estonia and the distribution of tasks between local and central governments as most cluster-related policy fields belong to the competencies of the central government's institutions. **It has been recognised that small states without an active regional level tend to centralise the**

[114] Andersson, T., S. S. Serger, J. Sörvik, E. W. Hansson. 2004. *The Cluster Policies Whitebook*, IKED.

tasks that usually belong to the competencies of regional or larger local entities.

It has been emphasised that currently **Estonian public administration institutions lack experience in developing necessary tools for developing cluster formations or cooperation between different stakeholders**. Part of it is also due to lack of industry-/cluster-specific policies in Estonia. This is partly so because entrepreneurs feel that the policy-makers do not approach the private sector enough in developing specific projects and programs in the framework of general economic policies[115].

Further, various stakeholders have mentioned that currently there **seems to be the lack of need, skills and most importantly, the lack of explicit sense of the urgency or necessity to develop different wide-scale cooperative formations**. This is strongly linked to consensually emphasised problem of the **shortage of qualified personnel** in all levels of government and among the stakeholders as well. The **lack of coordination and possible duplication of different policy initiatives** and programs at different government levels is seen to cause excess administrative costs and further fragmentation of potential policy initiatives and necessary competencies.

On the other hand, it also boils down to the **inability of the Estonian central government as well as local government institutions to coordinate policies within their own ranks and between different levels**. From the central government's point of view local governments seem to be the most active of all stakeholders in trying to initiate different programs and cooperation projects[116]. However, they seem to be unable to communicate their intentions to other stakeholders and effectively involve the central government and enterprises in their initiatives. **This is seen to fragment local government initiatives and to decrease their sustainability as wider participation of different stakeholders is seen to increase the success of the initiatives**.

It has been emphasised in ICT more specifically, that **currently Estonia lacks a comprehensive and realistic governmental strategy for developing information society that could provide input for enterprises to upgrade their strategic planning, specialisation and future outlooks.** It has been recognised that currently, enterprises are unable to develop sector or industry-wide future outlooks and strategies on their own (through the *Estonian Association of Information Technology and Telecommunications*) This is partly due to the fact that the association has a small membership and partly because there is the lack of wider societal and governmental support and incentives for such activities. Further, it has been emphasised that there **is no real communication between central government institutions and enterprises to develop policies that the enterprises perceive as necessary for creating trust and common understanding**.

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[115] It has been noted that Tallinn as a local government unit is more approachable and prone to communicate with the enterprises than the central government. At the same time Tallinn has not enough policy tools and competencies at its disposal to have real impact on the policies. Additionally, Tallinn has not been able to communicate its more advanced competencies to the central government level.

[116] One of the reasons is perceived to stem from the regional policy tools that the EU has opened for local governments to take advantage of. But, the problem is seen to lie in the fragmentation of different initiatives that have been launched by local government and project-based approach to policies and projects requires long-term and stable policy plans.

In this framework, **Tallinn as a local government entity is seen to be more approachable and there are more contacts between the local government institutions** (the *Tallinn City Enterprise Board*) **and enterprises than with the central government institutions** *(the Ministry of Economic Affairs and Communications* and its agencies). Nevertheless, it has been indicated at the same time that Tallinn has not been able to use its position (being the centre of Estonian economy, largest local government unit etc.) to broker the need and knowledge to the central level to influence the policy-making in a more favourable manner. **However, without the input of the central government competencies, the cluster initiatives may lack sufficient capacities to succeed.**

Both entrepreneurs and central government officials share a common understanding that **Tallinn as a local government unit can not be the public policy centre of cluster formations as it lacks suitable policy competencies to participate in cluster evolution** (i.e. education, R&D, general economic policy etc. fall into the competence of the central government). Even though it may seem that Tallinn can be taken as a specific cluster area because of its centrality to Estonian economy etc., this vision is not shared by entrepreneurs and the central government. **Firstly**, there is a consensus that Estonian market is too small for further fragmentation in order to be able to have a more export-oriented approach to ICT[117]. **Secondly**, the central government policies approach different sectors and clusters from the perspective of their overall input to Estonian economy. This view means that the central government policy tools should be directed towards fields or sectors with most potential to Estonia as a whole[118].

Thus, there seems to be a consensus that the **local government should take the role of supporting central government policy-making by providing input that they can gather from the closeness to enterprises and entrepreneurs**. This certainly means increased coordination capacities, both on the central and local government level. To have effective policies, there has to be a clear division of roles, responsibilities with explicit accountability and the tasks of different stakeholders should be clearly defined.

One of the more consensual and most prominent needs that was pointed out is the need to give wide-scale support to the emergence of leadership in cluster development i.e. the **emergence of "clusterpreneurs"** . in conventional "cluster talk". From the local government's point of view (and to a certain extent from the central government's position), it has been understood that the leadership should emerge from the enterprise sector i.e. clusterpreneurs as successful business leaders with social consciousness to take the leadership in trying to develop potential cooperation between stakeholders. At the same time, the enterprise sector itself has emphasised that **it should not matter who takes the leadership whether it is a local government, the central government, enterprises or the associations, or a few clusterpreneurs**.

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[117] There is also some argumentation that Estonia alone cannot form a sustainable cluster because of its lack of critical mass and the smallness of the market and Estonia should be seen as a part of a larger (Scandinavian) cluster, if one can talk about ICT cluster at all. See for example: Pihl, T. 2001. *Analysis of Estonian IT Sector Innovation System: Estonian ICT Cluster, Present State and Future Outlook*. Estonian eVikings, Archimedes Foundation; Kattel & Kalvet. 2006. *Knowledge-based Economy and ICT-related Education in Estonia: Overview of the Current Situation and Challenges for the educational System.* Praxis, Tallinn; Kalvet, T. 2004. *The Estonian ICT and Software Manufacturing Industry: Current State and Future Outlook*, IPTS.

[118] The geographical concentration of the sectors/fields is of secondary importance.

This different view or approach to cluster facilitators can be explained by approaching the cluster concept as a method for understanding and managing the cooperation between the relevant stakeholders in different economic spheres. It can be seen that the point of view that emphasises entrepreneurs as the creators of leadership in cluster development assumes the presence of necessary conditions for cluster emergence (social capital, tradition of cooperation, presence of formal and informal linkages, common need and belief in the usefulness of clusters). The presence of these conditions is the basis of the cluster theories indicating that enterprises are the core leaders of any clusters[119].

At the same time, the approach of not granting the leadership role to specific stakeholders allows questioning the presence of these preconditions for cluster emergence and takes a more flexible approach that can be potentially useful in providing impetus for the creation or initiation of the emergence of these preconditions. It means that the latter way is more capable of initiating societal discussions and raising the awareness of the different stakeholders about the potential usefulness of the cooperation and networking of different partners who have stake in economic development. So far the policy in Estonia has been to leave this role solely to the capacity of entrepreneurs and the private sector. But for cluster type formations that are to be developed in an unstable environment (with low trust, lack of prior experience and tradition of cooperation) of transition states, the opposite should be emphasised. **It has been brought out that in these cases the public sector's involvement in initiating clusters (and also creating necessary preconditions for any cluster-thinking to emerge) tends to be more pronounced and of critical importance than in more developed economic environments**[120].

Possible role for local government

When looking at possible policy-choices, initiatives, programs that local government (i.e. Tallinn) could initiate, one needs to take into account specific contextual factors of the ICT cluster area. In summary, the context specificity creates the following framework:

- **All possible policy initiatives should take into account the current state of the cluster development in the field**. It means that the local government should clearly distinguish between the two roles it can have in cluster policies: ***cluster initiator*** i.e. initiating new clusters or providing incentives for cluster perspectives to emerge; and ***cluster developer*** i.e. providing support to already existing plans or initiatives.

  There is no point in trying to duplicate organisations, programs or projects that are already in motion in the Tallinn area. Mainly because of the limited capacities of the key partners in cluster initiatives (industry associations, R&D institutions) uncoordinated initiatives may fall short of the necessary support from these stakeholders. This could further fragment the limited pool of different (and high quality) parties who could give necessary input to cluster emergence.

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[119] Starting with Porter, M.E. 1998. "Clusters and the New Economics of Competition", *Harvard Business Review*, November-December, pp. 77-90. See also for example: Porter, M.E. 2000. "Location, Competition, and Economic Development: Local Clusters in a Global Economy", *Economic Development Quarterly*, vol. 14, no.1. pp. 15-34.

[120] *The Cluster Initiative Greenbook;* Andersson, T., S. S. Serger, J. Sörvik, E. W. Hansson. 2004. *The Cluster Policies Whitebook*, IKED.

It would be more beneficial to identify the most promising initiatives (starting with the most R&D and innovative) and to provide support for them, identifying at the same time the caps in existing developments to achieve complementarities of different initiatives[121].

- **Another important factor is the need to achieve higher coordination between the central government's initiatives and the initiatives of Tallinn and with different local government** (mainly Tartu).

  Firstly, the state has a rather clear objective of approaching different initiatives from the perspective of the general input to the economy as a whole and there seems to be an indication that potentially competing and expensive initiatives (i.e. cluster initiatives of Tallinn and Tartu) will not gain direct state financing[122].

  Secondly, because of the smallness of the Estonian market, complementary resources of different regions and the lesser importance of the geographical concentration of ICT, enterprises favour a nation-wide approach to potential clusters in the field more. Local government initiatives should aim at reinforcing them or providing region-specific complementarities to the existing initiatives and cooperative formations.

Most ICT-specific recommendations that this study managed to gather where rather hesitant about general wide-scale local government led cluster initiatives taking Porter's approach as its foundations. **More emphasis was put on small steps and policy initiatives that Tallinn could take for fostering cluster development potential .i.e. acting in the role of *cluster initiator*.** These ideas mainly departed from the approach that it is too early to speak about any explicit indications of possible clusters. What is expected from local government initiatives are rather soft supportive activities that could lead to wider realisation, awareness of the possible benefits of cooperation and networking, such as:

- **Provide a context or framework for gathering different "cluster developers" or "clusterpreneurs" (local and central government administrators, industry associations or the distinguished leaders of different industries, the interested parties of the academia etc.) to moderate the socialisation and breaking of barriers currently present between different institutions, sectors, industries**. This could provide possibilities for the sharing of knowledge, getting to know each other's perspectives, strengths and weaknesses that could potentially lead to possible grass-root cooperation, eventually leading to potential cluster formations based on the needs of the different stakeholders.

  Taking into account the limited human capital, this can not be achieved in any other way than direct targeted communication with different stakeholders and clear appropriation and recognition of

[121] Current cluster talk emphasises the new approach to cluster policies in a systematic and comprehensive manner as the studies have indicated that the efficiency of uncoordinated and project-based initiatives falls short of the comprehensive, systematic initiatives. For more on this: Andersson, T., S. S. Serger, J. Sörvik, E. W. Hansson. 2004. *The Cluster Policies Whitebook*, IKED.

[122] I.e. appropriations from the EU Structural Funds.

responsibilities that different stakeholders (and mainly local government as a moderator) will take. It must also include the development of common nodes of communication and shared gathering of experience i.e. electronic databases for mapping the competencies, joint programs and project applications, study trips etc. The important thing is however, to have a qualitative increase in the context of the already existing initiatives and not to fall into the traps of too rigid formalism of these initiatives.

- **In addition, local government could also provide support to the reinforcement of the industry association** (*The Estonian Association of Information Technology and Telecommunications*) – either through co-financing some of their capacity-building activities, or carrying through complementary studies and network building among the ICT companies in the Tallinn region, or reinforcing links with other industry associations, or providing a communication line to other local governments and the central government.

- As a more general remark, there was also some consensus that **the central and local governments could provide potential signals for cooperation, networking and eventually for emergence of cluster like formations through the quality of their own strategy planning** (sectoral development plans, clear statements of interest by the government institutions) **and (innovative) procurement activities**.

In a more practical or short-term level, the most prominent needs emphasised were related to the reinforcement or evolvement of already existing projects and programs:

- One of the main priorities addressed by multiple stakeholders was the need to **manage the shortage of qualified labour force**. Most importantly, there is a demand for people with skills for working in a more cooperative environment as well as with international experience and contacts for entering foreign markets and developing internationally competitive marketing and development strategies).

  One of the possible solutions could be in **the reinforcement of mentoring programmes** that could help companies get better counselling and guidance. It has been emphasised that in ICT there are already people who have sufficient experience in developing their companies and communicating with foreign partners who are not active in business anymore and would be willing to take on these tasks. However, these people cannot be motivated through open competitions, they are to be approached personally with clear commitments and promises.

- Further, another possible solution mentioned was the **use of foreign consultants or experts with experience in different markets, e.g. as a service provided within science parks and incubators**. All this could be achieved through local government's (co-) financing or through its assistance in other capacities (i.e. providing housing and other services to foreigners working in these areas). In all, it was also emphasised that there is a need for someone to provide counselling, awareness raising and practical help in trying to find possible state-level financing or supportive mechanisms that the companies in the Tallinn area are eligible for (and not to duplicate already existing mechanisms). **Small enterprises do not have enough human capital, stability and motivation to start taking long-term perspectives on their own.**

Summary

Current state and potential of the ICT cluster

- no distinguishable cluster or need for it at present
- low trust and tradition of cooperation among stakeholders
- fragmentation of the market
    a) foreign ownerships
    b) or orientation only to the foreign market (sub-contracting)
    c) dominance of small companies,
    d) no actual large companies with interest and resources to take the role of the centre of a cluster
    e) high competition between companies for low-cost input factors

- weak industry association
- presence of few leaders who could perform the role of clusterpreneurs
- low awareness of the competencies and specialisation between enterprises in the sector
- weak links between enterprises and R&D institutions because of barriers to communication and alignment of priorities
- weak links between enterprises and public authorities because of the lack of previous cluster and sectoral policies, low awareness of each other's activities and priorities
- low coordination between public administration institutions
- only emerging competencies of public authorities

Role for local government

- to communicate its willingness to act as a part of a cluster or foster its evolution
- taking explicit responsibilities and (also financial) commitments
- complementing central government policies and supplementing them with own inputs
- valuing R&D institutions as the core of the regional development
    a) through web-sites
    b) official cooperation agreements
    c) official and planned inclusion of R&D institutions in policy planning

- local government as the moderator of cluster evolution
- local government as the *facilitator of cluster emergence*
    a) providing a context or framework for uniting different cluster developers or "clusterpreneurs"
    b) supporting the development of industry association
    c) taking initiatives for cooperation and networking to emerge (public procurement, strategic planning etc.)

- local government as the *developer of existing cluster initiatives*
    a) managing the shortage of specific skills in the labour force through reinforcement of mentoring programmes and providing new services in incubators and science parks (providing support for bringing in new foreign consultants and experts with international expertise and contacts)

b) providing competence-based support and complementary services to programs and initiatives lead by other stakeholders of the process

Analysis of the potential electronics cluster

The following is mainly based on the information gathered through the interviews conducted for the purpose of this study. Another pivotal source of information has been the study made for the *Estonian Regional Innovation Strategy*[123] that includes the analysis of the electronics sector, and the interpretation of the study in the context of Tallinn and local government capacities by the author of the electronics sector study (*Maidu Harjak*).

Definition of the electronics cluster

As with ICT, there are several possibilities for identifying the electronics cluster from the enterprise point of view[124]. One of the options proposed[125] includes the following: production of office equipment and computers; production of electrical appliances and machinery; production of radio, television and communication appliances; production of medical, optical and precision instruments. Once again this division indicates that the borders of potential clusters can bridge different sectors. In this case there are clear links to ICT and medical sectors that are treated as separate possible cluster-bases in this study. **It can also mean that depending on the context, the cluster composition could potentially cover several sectors.**

Based on the NACE Rev.1.1 statistical division and its Estonian replication *The Estonian Classification of Economic Activities 2003,* the electronics sector potentially covers areas from manufacturing industry (subfields electronics and optics), wholesale and retail, communications etc. In general terms, the database of possible cluster enterprises in Tallinn confirmed the common presumption that the **majority of companies active in the electronics field are rather small that results in fragmented electronics sector**. Once again, this leads to the hypothesis that in general there is low potential and tradition for cluster like formations to develop. It means that the analysis should start from trying to identify the presence of basic foundations for cluster formations (i.e. social trust, social capital, presence of preliminary links between stakeholders).

Table 7. The list of registered electronics companies in Tallinn.

	2001	**2002**	**2003**	**2004**	**2005**	**2006**[126]
No. of companies in the official register	282	303	336	338	350	311
No. of companies with turnover over 5 million kroons	59	63	62	68	71	72
No. of companies with turnover over 10 million kroons	42	42	42	43	52	46

[123] Tiits, M. (ed.) 2007 *Kaupmeeste riik*, Estonian Academy of Sciences.
[124] The rest of the cluster stakeholders (R&D institutions, industry associations, public administration etc.) have to be identified from the perspective of the enterprise composition of possible clusters and the latter are seen as the core of any cluster formation.
[125] Used in the study of the electronics sector in Tiits, M. (ed.) 2007 *Kaupmeeste riik*, Estonian Academy of Sciences..
[126] The 2006 figures may not be final because the 2006 database is still under construction by the *Centre of Registers and Information Systems.*

As a general note, it has to be mentioned that no study has tried to extract ICT and electronics companies of Tallinn from general statistics in a similar way. It was revealed that there is a **lack of common understanding of what is actually treated as either ICT or electronics cluster and often the approaches tend to overlap.** This means that the borders of the potential clusters are rather blurred and as an exploratory study into potential cluster formations, it might be more reasonable to approach the sectors in a single comprehensive manner. At the same time, by viewing Table 6 (ICT) as well as Table 7 (electronics), one can see the potential list of all ICT and electronics companies and the statistics still reveal that most of the potential enterprises that could form a basis for a cluster, are rather small and with limited or insufficient critical (most importantly, financial) mass for entering to and competing on foreign markets, for independent R&D activities, for creating formal networks and cooperation above the imminent needs of particular enterprises.

Presence of cluster characteristics – entrepreneurs as the centre of cluster formations

One of the main obstacles for cluster emergence in the field of electronics has been the structure of enterprises and their ownership: a **few large companies mostly in foreign ownership, the majority are really small niche companies**. As a result, there is a consensus that **currently there is no qualitative cluster present in this field and there is not even short-term potential for cluster emergence**. The reasons for this can be summarised as follows:

- It has been emphasised that **most key enterprises are foreign-owned (by Swedish or Finnish owners) or are sub-contractors of foreign companies**. These enterprises are limited in their freedom to start new initiatives in or share their knowledge and experience with other enterprises and institutions in Estonia. In addition, there is also a trend for foreign-owned companies to have **foreigners as their managers** that further reduces the motivation of these companies to network and cooperate in the Estonian context.

  The list of the most successful electronics companies[127] reveals (see also Appendix 8) that in geographical terms, these **companies tend to be more dispersed all over Estonia than is the case with ICT**. At the same time the greater part of the companies are owned and managed by foreigners. It implies that there are even less ties to the general local market of the electronics sector than was the case with ICT.

  Thus, there is **fragmentation in the sector and the large companies who are perceived to have real interest in the development of cluster-type initiatives in cluster development theories or take the lead in restructuring the electronics sector do not show such motivation or intent.** Most of their interests in Estonia are related to getting necessary qualified staff from the labour-market. At the same time this limits the potential pool of qualified staff that could be employed by smaller or more independent enterprises that in theory could have higher willingness for cooperation, but who currently face the same problem of the shortage of **qualified labour**. Thus, the enterprise structure of the electronics sector creates a highly fragmented pool of

[127] Again, based on the ranking of Äripäev TOP500 companies in 2006.

companies who mostly **recognise the benefits of more cooperative relations, but are unwilling, constrained or unable to personally invest in creating any such formations**.

- Most enterprise strategies are rather strongly based on **utilising the cheap labour advantage** that Estonia is still enjoying[128]. This reduces the readiness for cooperation further as most R&D and marketing-type activities are located outside Estonia and there is no perceived need to locate them in Estonia[129].

- The fact that most enterprises have **stable and long-term contractual relationships** with their suppliers and contractors and **small companies operate in rather small** niches implies that in the current state there is a really weak potential for cluster development. Most companies are not only sceptical about the benefits of cooperation but in reality they are not even competing with each other, with the exception of attracting high quality labour force. Thus, **there are no valid arguments even to talk about either cooperation or competition that are the two basic foundations of cluster relationships.** Enterprises that mainly operate on foreign markets are more likely seen as **being interested in or even active in foreign clusters**. Without sufficient incentives it seems rather utopian to change their priorities.

- It has been recognised that in general the **electronics sector can have two paths of development** – either the application of the existing international knowledge and inventions to local demand and capacities or, competing in the high-end of innovation and development. It has been pointed out that the former solution would be cheaper and more in-line with potential capacities of Estonia, but currently the greater part of the sector is not even competent in this. It is mainly due to the **shortage of relevant skills** – primarily in engineering, product development, marketing, strategic management and in the international context.

In summary, it seems that the field of **electronics has more profound obstacles and problems for the emergence of independent cooperation and cluster emergence**. Thus, this creates further necessity to analyse potential facilitating and developing mechanisms that other stakeholders could provide for creating the basic foundations for cluster formations.

<u>The role of industry associations</u>

Compared to the situations in ICT, there is even more pronounced **lack of supportive industry- or sector-wide organisations and associations**. Officially there are two organisations that in theory should provide necessary support for the electronics enterprises. Firstly, *the Federation of Estonian*

[128] Though, it has been pointed out that even the sub-contractors and subsidiaries active in Estonia are relocating inside Estonia to benefit from even cheaper labour available outside the capital area of Tallinn. See also Tiits, M. (ed.) 2007 *Kaupmeeste riik*, Estonian Academy of Sciences.

[129] It has been argued that one of the few foreign-owned companies who has some R&D activities of its own and who is located in Estonia is Elcoteq, but this is actually an arrangement that allows to take advantage of the existing engineering capacities found in Estonia (it has been also emphasised that Estonia has inherited a rather high-quality human capital in ICT and electronics), rather than being based on more strategic and long-term vision.

Engineering Industry has a subsidiary organisation for electronics and electrotechnics, but it has currently a membership of only four companies[130]. Secondly, *the Estonian Electronics Society* is mainly supposed to be a network for professionals (academics) to provide them with an environment for cooperation and networking[131]. Currently, it is recognised that both organisations are in a rather idle situation and **do not provide any of the conventional support services that an industrial/sectoral association should provide**. Thus, in most cases these organisations only form a **formal umbrella** and often lead only to misconceptions about the organising capacity of the sector.

The lack of active sectoral association has been argued by several reasons, most of them related to the **unique enterprise structure, low cooperative culture and coordination of the sector**:

- As was stated above, most companies realise the benefits of an industrial organisation, but there is the **lack of willingness to personally commit or invest resources** of any kind in the formation of these kinds of organisations. In most economic spheres these associations do not provide any qualitative added value with their services, other than general policy-monitoring and lobby towards the policy-makers. This is partly due to the limited capacities of these associations, but also because other stakeholders (i.e. policy-makers) lack capacities and prior tradition to systematically include the associations in their own activities. Thus, it is a **two-sided problem that needs a coordinated solution**.

  Based on this general experience in the field of electronics, there seems to be even **less interest from the part of larger companies to specifically lobby for electronics-specific initiatives**. Most likely they also benefit (through free-riding) from the actions of other industrial/sectoral organisations (most likely by ICT organisations as well) and central employers' networks and organisations. As there seems to be less leadership in the sector, free-riding seems to be a more common strategy. Thus, in the end there seems to be **even less sharing of information and communication than in the case of ICT**.

- The fact that most of the **companies have their own stable and long-term suppliers or are part of foreign value-chains or operate in small niche areas further decreases the demand for and willingness to participate in sectoral associations**. Most partners may come from other economic spheres or even other countries and clusters. Thus, it seems that there is a general lack of practical demand for sectoral association in electronics, but at the same time there is a general understanding of the benefits of cooperation and networking.

In the end, this means that there should be a fundamental change in the economic structure for the need for associations to evolve or there needs to be **leadership or guidance from other sectors or other stakeholders to provide incentives for cooperation and networking in another context**. This could happen through product-based or cross-sectoral associations and cooperation that could create incentives for common strategies, large-scale agreements and common actions towards achieving higher competitive advantage, mainly in the international perspective.

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[130] For more detail, see: http://www.emliit.ee/index.php?page=222.
[131] For more detail, see: http://www.lr.ttu.ee/eeu/ .

The role of R&D institutions in cluster formations

Similarly to the case of ICT, it is widely recognised that **R&D institutions need to be involved in both cluster initiatives and activities preceding real cluster formation**. The smallness of Estonia once again limits the possibility of different competing initiatives and requires a comprehensive approach to unite all most promising stakeholders. It is recognised that **firstly one has to strive for more innovative and R&D intensive cooperation to gather together the best pool of stakeholders and then move towards more inferior cooperative forms**. It is believed and recognised that Estonia can not afford the fragmentation and creation of barriers between the limited amount of high quality human capital of different parts of society.

At the same time, it is well recognised that the **electronics companies are currently not capable of providing independent R&D activities** (both technological and organisational). Yet again, this is a precondition for restructuring the sector, achieving specialisation and better competitiveness. Thus the **cooperative formations depend highly on the quality of the R&D institutions involved in the initiatives**. The quality of the latter is once again dependent most importantly on the people and the internationally competitive skills of the people involved. The lack of support (suitable public policies, public financing) for the creation and development of human capital is one of the main challenges to be solved from the R&D institutions perspective.

At the moment there seems to be rather **fragmented and occasional cooperation between R&D institutions, different companies and other stakeholders**. Several reasons can be distinguished for the fragmentation, most of them are related to issues of **limited social capital, the lack of traditions of cooperation, the lack of necessary support mechanisms, low communication and information sharing**:

- **Firstly**, it has been recognised that **for most enterprises everyday problems and most persistent needs are much simpler than the university or academia might offer** (shortage of personnel, financing, technological appliances etc). On the one hand, it means that they do not feel the need and do not have the time-frame for intensive cooperation with R&D institutions. On the other hand, it also means that they **expect simple information and communication that opens the content of such complex terms as innovation, clusters** etc.

  As such, it is expected that the **R&D concepts and the general context is communicated to the enterprises in a more practical and "down-to-earth" manner** i.e. by providing information on the latest trends, technologies and increasing the general awareness of R&D possibilities. As this is not the core function of R&D institutions (yet they seem to be the only competence centre in it, as there is no active sectoral association and other capacities and traditions are also rather limited), there should **be more support and incentives for R&D institutions to be active in it as it is the foundation for wider R&D cooperation.**

- Some of the **more innovative companies whose main activities include R&D as well have found their way towards R&D**

institutions[132]. In the context of Tallinn, this has happened in the context of the *ELIKO Competence Centre in Electronics-, Info- and Communication Technologies*[133] that includes the competencies of the Tallinn University of Technology and several enterprises[134].

On the one hand, this indicates that ICT and electronics are viewed in a more common framework than potential separate cluster formations by the academics. On the other hand, it also implies that the real market-related competencies (i.e. engineering capacity and more entrepreneurial activities) do not lie in the traditional universities proper, but in new organisational forms developed in recent years. **It means that any cooperative initiative needs to be well informed of the whereabouts of the critical mass of human capital**.

- The more common framework for cooperation is also poor because there is no common sectoral association to provide the necessary initiatives and the way forward for developing such frameworks. Also, the initiatives of the academia (like ELIKO) have so far not gained sufficient ground, awareness and recognition of their importance. Mainly, as these organisations are constrained in their activities by the financing rules and procedural requirements (prescribing the limits of their activities) that limit the motivation of enterprises to fully participate (as investors for example) in these organisations.

- In addition, **one of the core problems for R&D institutions to be active in searching and attracting new cooperation partners seems to stem from the two-layered fragmentation of their activities**. **Firstly**, Estonian universities are characterised by rather high level of autonomy and in the current demographic situation it has led to competition rather than sustainable and academic cooperation between the institutions themselves. **Secondly**, the inside of the academia is further characterised by another level of fragmentation through the independence of the structural units of the universities.

  On the one hand, this leads to the **inability to set national priorities and initiatives and to communicate them within the academia**. In the end this hampers the development of clear competences and prioritised centres of knowledge. On the other hand, it also means that **below the managerial level there is actually a lot more cooperation and networking (mainly informal) that can act as one of the core elements of cluster formations**. Thus, the challenge seems to be not only to distinguish the key organisations that could potentially provide input to cluster formation, but also to **find the key people who can be at the heart of it.**

In summary, it seems that any cluster formation in electronics (from the perspective of involving R&D institutions as well) requires a fundamental change in the way of thinking and approaching the sector by most stakeholders. **None of the stakeholders seem to be in a logical position for taking the leadership**. This is because some of the fundamental prerequisites for

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[132] At the same time it has been revealed that some of the niche companies not finding competencies in Estonia are also looking towards R&D institutions in Stockholm and St. Petersburg. See: Tiits, M. (ed.) 2007 *Kaupmeeste riik*, Estonian Academy of Sciences.
[133] For more detail, see: http://www.eliko.ee/.
[134] The centre was formed by the Tallinn University of Technology and eight companies active in the field of the centre.

cooperation (sense of need, leading sectoral associations, R&D capacities of the enterprises to complement the academia, the consensus and priorities in government and academia) are still lacking. **This prescribes rather unique solutions for solving the challenges**. **In a transition state context this also implies a rather central role for government initiatives to support the existing initial sources of potential cooperation and cluster formation**. Most likely this should be allowed to develop, if perceived as suitable by other stakeholders, **into cross-sectoral development dictated by the willingness of R&D institutions**. The latter group of stakeholders should be able to organise its know-how and academic capacities and has already managed to attract some of the key companies currently interested and involved in R&D.

From the R&D institutions perspective **any cluster formation needs to be based on academic excellence and sound international market-oriented approach** (from both the academia in its adapted organisational forms i.e. competence centres and also from industry and enterprises). It also means that ICT and electronics should be perceived as one common potential cluster formation.

In addition, **the limited human capital available in Estonia limits the potential competitiveness of different academic and economic fields and most likely results in few potential competence areas that are likely to transcend the traditional borders of academic and entrepreneurial activities**. Thus, the cluster initiatives need to be based on adaptable and flexible approaches providing possibilities for the fields like biotechnology and medicine and material technologies to be merged, if seen as suitable, into electronics and ICT framework. This does not imply that these fields in their entirety will form potential clusters, but they will provide the general framework from where potential sub-fields could form sustainable cooperation and networking for clusters to emerge.

In the context of Estonia, this can not happen from the scratch as the limited quality of human capital seems to logically prescribe a path that reinforces the existing and more promising initiatives and tries to fill the existing caps in the current formations. **This would provide logic for demand-driven cluster formation where public policies play a facilitating role while providing development-related input as well.**

<u>The role of government organisations in cluster formations</u>

In the field of electronics it is also recognised (as in ICT) that the **Estonian market and the size of local government units are too small to afford further fragmentation through competition and the uncoordinated development of cooperation and networking by local government units**. Thus, the emphasis should yet again be on the central government's cluster initiatives with a local government providing supporting initiatives that are based on its specialities and competencies. This once again re-emphasises the importance of **coordinated policy-making between different administrative levels and units**.

In the case of electronics (and also ICT) it is recognised that the City of Tallinn may have more important role than in other possible areas as most activities in the field are centred in or depend on the activities of the Tallinn area. **Yet so far, most companies and R&D institutions do not feel the support and are unaware of the preparedness of a local government (and the central government) to actively seek contacts, take stock of their needs and**

provide potential development perspectives. Thus, so far governmental institutions have been rather perceived as bureaucratic entities creating excess administrative burden and being unable to include enterprises and R&D institutions in developing suitable policies and mechanisms for creating better environment for cooperation, networking and cluster formation. It has also reduced the willingness of these stakeholders to approach governmental institutions on their own initiative in order to communicate their needs and perceptions. **Thus, there seem to be barriers between the partners that are created by the lack of trust, tradition and willingness to cooperate**.

Most stakeholders of potential cluster formations do not believe in or see the use of short-term wide-scale innovative projects initiated by either the central or local governments to start building or developing new clusters or other cooperative forms. It is expected that governmental institutions would to take into account the current seeds of cooperation among different stakeholders and would fill the lacunas between these initiatives that have emerged due to the lack of necessary support activities (because of no active sectoral association) or because of low awareness of the potential cooperative networking possibilities. This does not imply that a local government should not, for instance, try to establish its own round-tables, steering groups, training programs etc. Rather, it means that **all initiatives should be linked to the needs of the stakeholders already trying to cooperate or initiating some forms of cooperation. Again, the limited pool of qualified personnel sets the limits to the success rate of different overlapping or even competing initiatives.**

One of the key aspects brought out by most stakeholders has been the issue of **long-term financing of the enterprises in the sector**. Currently it is a common presumption that the private sector lacks incentives for long-term investments in electronics (and ICT), in R&D, restructuring, approaching new markets etc. There are too high risks in the sector; there is uncertainty over the future competitiveness of the electronics sector if it keeps relying on the advantage of cheap labour; small companies face high barriers for accessing private financing because they lack capacity for entering foreign markets on their own; on the other hand local markets are too small for providing sufficient rate of return and potential for private investors to be interested in financing new ventures.

It is expected that the governmental sector should create incentives for other parties to take the role of the financer of the enterprises. It could be achieved through (better and more prioritised) financing of start-ups, setting clear priorities and objectives by explicitly defining the obligations and responsibilities of different government institutions and between central government and local government.

In all, independent of any specific sector, the **most useful approach and the one that is most believed in by other stakeholders in the case of Estonia is the approach where every initiative (whether by the central or a local government) can be clearly defined as a part of the general governmental/or state policy towards increasing cooperation and networking between stakeholders that could potentially lead the cluster towards higher added value and international competitiveness**.

In general, this also implies the revision of the majority of the current policies and mechanisms in educational policy (trying to find a better balance between education provision and the needs of labour market); in the organisation of governmental financial support mechanisms (by *Enterprise Estonia)* to better

fulfil the specific needs of the electronics sector (financing of the expansion of production, renewal of the equipment etc.); in the support to the development or taking initially over some of the functions of the industry/sectoral association; in the provision and maintenance of the basic infrastructure (and science parks) to also provide more electronics-specific support.

Possible role for local government

When looking at the role of the local government and City of Tallinn more specifically, it could be stated that **most stakeholders seem to have rather limited expectations.** It is partly due to **limited contacts with local authorities and the low awareness of the readiness and capacities of the local governments to actually provide input to different cluster-related activities**. Partly it is so because most stakeholders have realised that the main policy tools lie in the hands of the central government and local authorities can only supplement their initiatives. It is also related to the limited effectiveness and scope of the majority of the well-known initiatives (incubators, science parks) as most enterprises for instance do not directly benefit from these initiatives and there seems to be certain scepticism about the thoroughness of these initiatives as well as the general administrative and knowledge capacities of local governments[135].

The concrete initiatives expected from local authorities can be summarised as follows:

- **Firstly, local governments are expected to increase their efforts in creating awareness of their competencies and willingness to support different initiatives, and in communicating their positions to different stakeholders**. Currently, enterprises seem to be mostly afraid of approaching different governmental units and are unaware of the competencies of different authorities. This is so mainly because traditionally this role has been performed by sectoral associations but currently there is no common ground for the interests to be gathered above the company level. Thus, there is a belief that authorities will not take the input from single companies seriously and therefore there is no communication and feedback between different parties.

  It can be solved by increasing the visibility of local government initiatives and involvement as most enterprises seem to be interested in local governments to take the first approach and present their interest and willingness to supplement the activities of the enterprises. This would also provide opportunities for local government authorities to create competencies concerning the needs and perspectives of the sector that are usually held by sectoral associations and communicate them to the central governmental level with clear commitment of providing its own activities along with the central government for finding solutions to current problems and needs.

- **This also applies to the relationship with R&D institutions and academia** as some parts of it (i.e. the Tallinn University of Technology and its institutes in the fields of ICT and electronics as well as ELIKO)

[135] I.e. science park and incubators turning into ordinary real-estate projects without providing any long-term incentives for clusters to form (science parks and incubators being located among market-oriented real-estate projects limiting the incentives for R&D institutions and other companies to locate in these areas).

seem to be unaware of the willingness or stance of local governments in providing input into their efforts. This has resulted in a more negative attitude towards local governments and in a situation where they actually do not expect much from local authorities. **The easiest way to bridge the gap would be for the local government to approach the university (on a structural unit basis) and indicate its intent to value the role of the academia in local development and show its willingness to cooperate with the academia.** Currently, the academia is well aware that as compared to the Western world, different authorities do not have high belief in them or value them as much (i.e. City of Tallinn not presenting universities in its website, not communicating directly with them etc.).

These expectations can be summarised as providing tools and mechanisms for reinforcing the emergence of necessary trust and the culture of cooperation that could lead to cluster emergence or higher effectiveness of cluster initiatives. Based on the conventional cluster theories, it could be counter-argued that local governments should not be involved in such activities and the seeds of and widespread need for cooperation should emerge from the entrepreneurial sector on its own. Yet, the sector of electronics is seen to be closely linked with ICT, biotechnology and other innovative fields that are seen as the ones with the highest potential for cluster-like development in Estonia. **The obstacles for the natural emergence of the need and demand for cooperation are not resulting from low willingness only, but also from transition-state characteristics (that conventional cluster theories do not take into account, i.e. low trust, the lack of institutions) as well as small state characteristics that prescribe a more active role for government or whoever is willing and competent enough to take leadership.** Thus, once again we can derive two kinds of tasks for the local government – ***cluster facilitator*** i.e. the agent creating the context for cluster emergence, and ***cluster developer*** i.e. the agent providing sufficient support for the development and advancement of existing initiatives and cooperation.

As a ***cluster developer***, the local government is expected to carry out the following roles and tasks:

- **As it was mentioned before, from the point of view of academics the centre of any cluster formation could be** (at least in the case of electronics) **the competence centre created in the field** (ELIKO) as it already holds the main engineering capacity (both skills and staff) and has links with some electronics enterprises either through ownership or through cooperation and mutual interest. It is expected that if the local government is willing or ready to provide supportive measures to the development of high-level academics-led cooperative initiatives, it should be done through supporting the work of the competence centre. Currently, it is unlikely that the academics (and the enterprises already linked with them) are willing to join other initiatives.

- For instance, it could be done through renting office space below market price for the competence centre to be located in the same facilities as some of the interested companies (with some of the owners of the competence centre and other enterprises who have shown their interest

in closer cooperation)[136]. This also supports the idea of the specialisation of different industries and sectors between the different science parks and incubators in Tallinn.

- In a more technology and R&D related perspective (as was the case with ICT), it has been brought out that local governments could be more active in ordering pilot project, solutions and applications (initially less with marketing intentions but still working towards it in the longer time-frame). This could happen for example through **public procurement possibilities** in order to create incentives for R&D and facilitate the specialisation of the sector. Tallinn needs to further develop its competencies in this field.

  This is closely related to another idea emphasising that currently the **competence centres** are financed in a "public-interest" related manner which excludes the possibility for the centres to develop more market-related products. At the same time, the system does not exclude the possibilities for extra financing (e.g. by local government general grants or support schemes) for developing more market related products or investing in increasing the product-development capacities in the sector. The importance of increasing the capacities in the latter field has been emphasised by most stakeholders.

- **In addition to the general organisational support mechanism, local government(s) could supplement the existing projects that are already on the way**. For example, ELIKO has initiated an *Enterprise Estonia* financed project "HEI" *Raising awareness about innovation in Estonia*[137] aimed at the modernisation of the industry, logistics and other enterprises in Estonia through the application of new technologies of ICT and electronics.

  So far, one of the obstacles for developing efficient programmes and events has been the centre's inability or difficulties in approaching the enterprises and institutions in other sectors to get in touch with the right people and in communicating its intentions. This could be reinforced by the broker's role of a local government. Local governments should have the information (or better access to information) for selecting and approaching the most promising sectors, associations and people for developing more efficient programmes. This kind of moderation and exchange of information could further increase the capacities of a local government for positioning itself among the different stakeholders and for communicating the needs and desires to the central government level and for supplementing or even reinforcing existing initiatives.

- **In addition, a local government seems also to be in the most favourable position for initiating or developing communication between different sectoral leaders**. It could lead to establishing a cross-sectoral initiative that could alleviate the problems caused by the absence of any active sectoral association in the field of electronics. Or, it could result in the emergence of clusterpreneurs for the electronics or a wider cross-sectoral initiative. Furthermore, it could potentially create synergies and boundary-crossing initiatives that could realise the idea of

[136] This is also in line with the general arguments that public authorities can only provide general support initiatives and projects i.e. relieve the academia from developing necessary infrastructure and environment for cooperation.
[137] For more detail, see: http://www.elin.ttu.ee/elikohei/.

electronics (and also ICT) being the enabler in the technological development of different sectors.

In summary, a local government should base its possible policy initiatives and programs on the notion of supplementing the existing initiatives within the limits of its capacities. It also requires from a local government to take into account the context specificity of the electronics sector, its potential for being an enabler (together with ICT) of other sectors in the economy as well as the context specificity of Estonia as a small transition state. **This requires a more flexible, innovative and customised approach to cluster initiatives.**

Still, as a prerequisite for successful cluster development initiatives that encompass all potential stakeholders and, more importantly, the most promising part of the limited human capital, the local government should initiate so called ***cluster facilitating initiatives***. These should aim to speed up the development of sufficient trust and the emergence of the tradition of cooperation and networking among different stakeholders that could potentially form a cluster in electronics or become partners of a wider cross-sectoral cluster.

It can be achieved only by the division of tasks, obligations (also financial) and accountability between a local and the central government. The City of Tallinn could give explicit indication of its willingness and intent to complement the government-led initiatives that reinforce cooperation and networking as well as clustering in the economy. This may also mean taking leadership in developing some of the cluster initiatives through providing up-to-date input to the central level. A local government should communicate this both to the level of the central government as well as to the possible stakeholders in its region (and beyond) to create larger ownership of the initiatives and to create an environment for mutual exchange of information. This could help a local government to create regional and sector-specific competencies that could be used for developing its own supportive initiatives. Further, this competence could be communicated to the central government level for providing input to government policy-making and influencing it towards suitable solutions for the region of Tallinn.

Electronics seems to be a field where there is a large dominant group of traditional (mainly foreign-owned, purely foreign-market-oriented, niche-oriented) enterprises that currently lack incentives for cluster-type cooperation. At the same time there are some initiatives between R&D institutions and more innovative (small) enterprises that realise the benefits of cooperation and networking. **The role for local government and public policy should be to develop the existing cooperative formations and facilitate the emergence of the understanding of the benefits of the cooperation in the more laggard (but still rather profitable) segment of the sector**. This can be the way to enhance the capacities of the sector for going through with structural change in order to overcome the future restructuring crisis that the loss of the low wage advantage will bring about.

Summary

Current state and potential of the electronics cluster

- no explicit cluster present
- understanding of the benefits of cooperation, but no willingness to initiate and develop it by the enterprises

- fragmentation of the market
    a) foreign ownerships as well as the management of companies
    b) or orientation to the foreign market only (sub-contracting)
    c) dominance of small companies
    d) competition for cheap input-factors
    e) no actual large companies with interest and resources to take the role of the centre of a cluster
    f) fragmentation of the companies into market niches – no cooperation and no competition

- industry association exists only formally – no benefit seen in sectoral association (free-riding and niche specialisation)
- weak links between (larger and foreign-owned or only foreign-market-oriented enterprises) and R&D institutions because communication barriers and alignment of priorities
- developing linkages between few companies and the *ELIKO Competence Centre in Electronics-, Info- and Communication Technologies*
- weak links between enterprises and public authorities because of the lack of previous cluster and sectoral policies, low awareness of each others activities and priorities
- low coordination between public administration institutions
- only emerging competencies of public authorities

Role for local government

- to communicate its willingness to act as a part of a cluster or in its evolution
- taking explicit responsibilities and (also financial) commitments
- complementing the central government's policies and supplementing them with its own inputs
- valuing R&D institutions as the core of regional development
    a) through web-sites
    b) official cooperation agreements
    c) official and planned inclusion of R&D institutions in policy planning
    d) supporting the existing initiatives of R&D institutions

- local government as the moderator of cluster evolution
- local government as the *facilitator of cluster emergence*
    a) providing a context or framework for uniting different cluster developers to form a sectoral initiative
    b) taking initiatives for cooperation and networking to emerge (public procurement, strategic planning etc.)

- local government as the *developer of existing cluster initiatives*
    a) analyse the possibilities for supporting the initiatives of the academia (ELIKO) by providing infrastructure, financing etc.
    b) supporting the programs and projects initiated by other stakeholders i.e. ELIKO's HEI project aimed at *Raising the awareness about innovation in Estonia* through moderating and communicating the project to other sectors by identifying and approaching the relevant stakeholders
    c) taking initiatives for cooperation and networking to emerge (public procurement, strategic planning etc.) and to bring together already existing engineering capacity of R&D institutions and companies

d) initiate and moderate the communication with other potential sectors to form a horizontal cluster perspective (ICT-electronics-and beyond)

Analysis of the potential health care cluster

Background information about the health care system in Estonia

It has been claimed that health care system is virtually one of the most knowledge-intensive sectors in every country that can significantly boost the socio-economic development of the whole country[138]. Further, research of the field increasingly indicates that healthy population has a positive impact on economic growth as well on productivity. This means that policymakers should seriously consider the role that health is playing in achieving overall economic policy goals. This is even more relevant in the Estonian context, where poor health has had a considerable negative impact on labour market and economics in general[139]. Today, the emphasis on the area as such has been gradually declining in Estonia as well as in the whole of Europe[140].

The problems to be tackled in Estonia as well as in Europe are rather similar: (1) the increasing health care costs; (2) increasing demand for health care services, fuelled by patients' expanding expectations, not just for more but for better services[141]; (3) scarcity of financial resources to sustain the achievements of health system objectives, due to which governments' regulations have grown out of the need to make health care systems and services more effective and cost-efficient (resulting often in higher out-pocket expenditures); (4) emergence of new business models (forced mainly by the cost calculations) from the side of the main health care providers like hospitals, primary care providers, pharmaceutical and medical technology companies; (5) improving the quality of information flow, and hence the transparency in systems; (6) and finally, higher life expectancy resulting in aging population, which in turn sets stronger pressure for social care services, like nursing homes, home nurses, long-term care, care service system, etc. To the latter, the increasing burden of non-communicable diseases, unhealthy lifestyle and environment should be added.[142]

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[138] Tiits, M., Kattel, R., Kalvet, T. 2006. *Made in Estonia*, Institute of Baltic Studies, Tartu, p. 85.

[139] *The economic consequences of ill-health in Estonia.* 2006. World Health Organization Regional Office for Europe, Ministry of Social Affairs, PRAXIS Center for Policy Studies, pp. 5-6, 19 - http://www.praxis.ee/data/economic_consequences_of_ill_health_estonia_2.pdf. From the user perspective and according to Euro Health Consumer Index 2007, however, Estonia is showing rather fast development, at least among medium-quality countries, see here *Euro Health Consumer Index 2007*. Health Consumer Powerhouse - http://www.healthpowerhouse.com/media/Rapport_EHCI_2007.pdf.

[140] Tiits, M., Kattel, R., Kalvet, T. 2006. *Made in Estonia*, Institute of Baltic Studies, Tartu, p. 85.

[141] Here, the developments in molecular biology, genomics, and medical technology have played their own role, together with overall advances in medicine. This has made previously untreatable diseases treatable, lethal diseases manageable, etc.

[142] *Health Care Regulation Across Europe: From Funding Crisis to Productivity Imperative* 2007. The Boston Consulting Group - http://www.bcg.com/publications/files/HealthCare_Regulation_Europe_Sept_2007.pdf; *Joint workshop to share experience in Health Policy development in Europe*. Draft Meeting Report. 2006. Ministry of Social Affairs in Estonia and World Health Organisation Regional Office for Europe - http://www2.sm.ee/tervisepoliitika/failid/Draft%20summary%20report-%20health%20policy%20seminar%20(March%207%202006).pdf;

In order to cope with the listed challenges, one of the main suggestions has been to initiate cooperation and networking while providing health care services. Derived from this, the cluster initiative should not be the goal in itself, but should enhance the feasibility and cooperation between different counterparts of the health care system. Further, it should enhance the cooperation between the health care sector and the related fields. The following is mainly based on the information gathered through the interviews conducted for the purpose of this study.

Cluster definition

This survey is based on NACE Rev.1.1 statistical division and its Estonian replication the *Estonian Classification of Economic Activities 2003.* Together with a definition for a regional health care cluster, three different levels should be distinguished:

(1) ***core providers of health care*** – include industries that employ personnel engaged in providing health care services, such as hospital activities, medical practice activities, dental practice activities; activities of ambulances and paramedics; physiotherapy and health rehabilitation; outpatients' and home health care centres, nursing care, continuing care and residential health care facilities; medical laboratories, blood, sperm and other similar banks;

(2) ***health care support products and services*** – include companies that manufacture pharmaceuticals, medicinal chemicals and botanical products; manufacture medical and surgical equipment or orthopaedic appliances; dispensing chemists and retail sale of medical and orthopaedic goods; medical laboratories and diagnostic services;

(3) ***regional institutions and resources that support core companies' advantage*** - such as research institutions, skilled workforce, regional economic development policies, advanced infrastructure, etc.[143]

Institutional set-up for the area

Starting with the last section, the main bodies responsible for the planning, administration, regulation and financing of health care in Estonia are the *Ministry of Social Affairs* together with the *Health Care Board*, the *State Agency of Medicines*, the *Health Protection Inspectorate* and the *Estonian Health Insurance Fund (EHIF)* (in the framework of this survey, particularly the EHIF Harju Department).

The ministry's general responsibilities include health policy formulation, monitoring population health and shaping the organisation of the national health system by determining the scope of primary, secondary, tertiary and public

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Eesti haiglate arengukava aastani 2015. Põhiseisukohtade kokkuvõte. 2000. - http://www.mv.parnu.ee/fileadmin/parkla/failid/areng/haiglad2000.pdf.

[143] This analysis handles the issues related to research institutions and skilled workforce in the other subchapters as it is foreseen by the model of Lendel, see Lendel, I. 2006. *The Healthcare Cluster in the Cleveland-Elyria-Mentor MSA 2000-2005*. The Center for Economic Development, Maxine Goodman Levin College of Urban Affairs, Cleveland State University, p. 8.

health services[144]. The prevalence of the ministerial level is expressed also by financing. In 2006, the primary funding agency of health services was the EHIF, which contributed to the total health care expenditure as much as of about 84.4%. The out-of-pocket expenditure is rather high and is continuously increasing (24%) in Estonia as well[145].

The responsibility for primary care planning is shared by the *Ministry of Social Affairs* at the national and county levels. The ministry regulates the overall number of family physicians per county based on population numbers and geographical density[146]. The county governor plans the division of geographical areas within the county[147]. The state influences specialised medical care and independent nursing care through standard-setting and public financing only[148].

According to the *Local Government Organisation Act* (RT I 2007, 44, 316) local governments are among other duties responsible for the organisation of care homes, health care institutions, and of social assistance and services (§ 6). Provision of health services and other expenses related to health care are financed from city budgets on the basis of the decisions of the city council[149].

According to the *Health Services Organisation Act* (since 2001) and the *Health Insurance Act* (2002), health care providers are autonomous and health care services are only provided by individuals or institutions operating as private legal entities (a limited liability company, a foundation or a private entrepreneur). As health care institutions are publicly owned by the state or municipalities only in rare cases, the Tallinn City Government's legal ability to control health care provision is very limited. As most hospitals belong to municipal governments, the legal ability to control health care provision is mainly accomplished through the representatives in hospital governance structures[150].

Several non-governmental organisations provide public health services as well. And EHIF is increasingly promoting public health services among health care providers (e.g., school health services and screening programmes)[151]. According to the legal status, the health care providers in Tallinn can be described as follows:

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[144] For the overview of the Estonian health care system see Jesse, M., Habicht, J., Aaviksoo, A., Koppel, A., Irs, A., and Thomson, S. 2004. *Health care systems in transition: Estonia.* Copenhagen, WHO Regional Office for Europe on behalf of the European Observatory on Health Systems and Policies, particularly the figure on the page 20; See also *Health Services Organisation Act* (RT I 2007, 25, 134) and *Public Health Act* (RT I 2007, 22, 114).

[145] Statistics by the Ministry of Social Affairs.

[146] *Health Services Organisation Act* § 34.

[147] *Health Services Organisation Act* § 58.

[148] Jesse, M., Habicht, J., Aaviksoo, A., Koppel, A., Irs, A., and Thomson, S. 2004. *Health care systems in transition: Estonia.* Copenhagen, WHO Regional Office for Europe on behalf of the European Observatory on Health Systems and Policies, pp. 16-17; see also Health Services Organisation Act § 20-26.

[149] *Health Services Organisation Act* § 53.

[150] Jesse, M., Habicht, J., Aaviksoo, A., Koppel, A., Irs, A., and Thomson, S. 2004. *Health care systems in transition: Estonia.* Copenhagen, WHO Regional Office for Europe on behalf of the European Observatory on Health Systems and Policies, pp. 16-24. See also *Health Services Organisation Act* § 15.

[151] Kalvet, T., Aaviksoo, A. 2007. *Next Steps in Developing Information Society Services in the New Member States: the Cases of e-Government and e-Health*. Report for Institute of Prospective Technological Studies (IPTS). Tallinn University of Technology and PRAXIS Center for Policy Studies, In press.

Figure 1. Health care providers in Tallinn based on the ownership structure

In 2007, the health care expenses comprised almost 4% of the total expenses of the city budget of Tallinn. Together with expenses for social care it was about 30%[152]. The largest share in the whole health care expenditures is comprised of the expenditures for the advancement of general medical care (about 14%). In 2006, the Tallinn City Government provided financial support to family physicians in the amount of 6.7 mln EEK[153]. The other great expenditure group are different projects and programmes, including the expenditures on home nurses and the financial support for *the Tallinn Paediatric Hospital Foundation* to build-up mental centre for children[154].

The role of associations has been very strongly oriented on certain professions, rather than organising cooperation between different counterparts of the field. In the latter case, however, there have been attempts to improve the information flow between family physicians and hospitals. A special working group has been set up for this purpose. In addition, there are special seminars held by hospitals to meet with family physicians, but they are mainly focused on finding cooperation partners rather than on networking as such.

The goal of the *Tallinn Family Medicine Association* has been to upgrade the overall quality of primary medical care, mainly through the provision of in-service training. Its other priority has been networking - to bring together individual physicians and provide them with some kind of basis for consultations, exchange of opinions etc. There is also some exchange of information with the *Professional Association of Doctors in Tallinn*. Yet, the role of the latter has not been seen to be very substantial.

The academic medical education is provided solely in Tartu (*the University of Tartu, Faculty of Medicine*). To a large extent, Tallinn has served as the basis for residents. The professional higher education is provided in Tartu and Tallinn: the Tallinn Health College (together with its department in Kohtla-Järve)[155]. The

[152] *Tallinn: Facts and Figures.* 2007. Tallinn City Enterprise Board, p. 30.
[153] The provision of the financial support is decided by the special commission involving both the representatives of Tallinn City Government as well of family physicians in Tallinn. See here Kedars, U. 2006. *Esmatasandi tervishoid – arutelu arengusuundadest Eestis.* Presentatsioon. Sotsiaalministeerium.
[154] Budget of Tallinn, 2007.
[155] This is the professional higher education institution, providing training for nurses, midwifes, dental technicians, assistant pharmacists and optometrists. See here also the web-page of the *Tallinn Health College* - http://www.ttk.ee/?lang=ee. A health protection programme and training of other lower- and mid-level health specialists is provided here as

institution has active cooperation with professional associations and hospitals in the territory of Tallinn, involving the representatives of respective unions and of special profession in training, curriculum building, reception, etc. The placement of practical training is well organised as well.

Despite of this, there is still considerable lack of nurses, midwives, physiotherapists and people for medical technical areas in the hospitals in Tallinn. **Therefore, many hospitals have stated that is necessary to seriously consider the possibility of entering into contracts with other licensed health-care organisations for specialised medical care or to consider cooperation with them and to take it as a serious future necessity**[156]. In addition, to date the schooling and training of nurses has been too much oriented on the preparation of nurses at hospital level, and not enough at primary care level.

The migration of doctors and nurses has not been as a significant issue in Tallinn. There has been constant inside flow from other cities. However, due to the wages and working conditions several doctors of specialised care have left for abroad. **The loss of professionals is considered to be a particular problem for sustainable development in the areas of specialised care**. The problem is further reinforced as the expectations towards medical care are constantly increasing.

Core providers of health care

The *Health Services Organisation Act* defines four different types of health care services in Estonia: general medical care, emergency medical care, specialised medical care[157] and nursing care. The reliance on the Act, due to its institutional approach, rather than on the NACE Rev.1.1 statistical division is considered to provide more feasibility for the analysis in this subchapter.

Proceeding from the hierarchical health care system as stated in the Health Services Organisation Act, **it can be said that the cooperation as such is written into the system**. The main barrier for closer cooperation and cluster building in the area is clearly related to the shortcomings in the proper functioning of the system, together with the provision of medical aid of very varied quality and inefficiency in resource management.

Today, the subsidy system for specific drugs by the EHIF has often resulted in the increased price of respective drugs. The inclusion of an ambulatory service provider (e.g. nose and throat clinic) into the price list of the EHIF has also resulted in the increased out-of-pocket expenditures. In addition, the price list of EHIF has created the situation that some services and hence also patients are considered to be more profitable than others. This in turn has restricted the cooperation between providers of primary and specialised medical care. Not to mention the fact that personal contacts are still used to get an appointment to a medical specialist in many cases.

In addition, the hospitals reliance on the price list of EHIF (80-90% of net sales concern the service delivery for EHIF) has lead to the situation where provision

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well, see Jesse, M., Habicht, J., Aaviksoo, A., Koppel, A., Irs, A., and Thomson, S. 2004. *Health care systems in transition: Estonia.* Copenhagen, WHO Regional Office for Europe on behalf of the European Observatory on Health Systems and Policies, p. 87.

[156] *Ida-Tallinna Keskhaigla funktsionaalse arengukava I etapp*, jaanuar-juuni, 2006.

[157] This analysis is focused on the provision of *stationary care,* if not stated otherwise.

of specialised medical care is uncoordinated and duplicated. Medical analyses are still carried through whether the hospital has or does not have the competence for the treatment. And, nowadays it is easier to do the analyses and tests once again, than to search for the transcripts of the old ones.

This leads to the third, but to the most profound problem: the availability of information. The information about a patient is often stuck in the system: it concerns, e.g., the possibility to have feedback about ambulatory care, activities of school doctors, activities of doctors carrying through health control paid by employers, activities of outpatients' departments etc. It should be brought out, as a positive example, that by now epicrisis and reports from emergency medical care units are sent electronically to family physicians. Likewise, considerable progress has been made in the IT-systems of medical care providers. However, these systems are often not interoperable to each other nor do they have common standards. It is expected to have better information flows in the aspects which consider organisation-administrative information (changes in doctors, their office hours etc).

In general, the ICT-based exchange of data is considered to have a great potential in facilitating communication and offering integrated care interoperability of health care organisations[158]. Hence, it is believed that the aforementioned problems will be solved to a great extent by the implementation of the Estonian e-health system.

The respective foundation for that is rather unique in its structure as it brings together the main stakeholders of the field (the Ministry of Economics Affairs and Communication, the North Estonian Regional Hospital, the Clinic of the University of Tartu, the East Tallinn Central Hospital, the Estonian Association of Hospitals, the Estonian Family Physicians' Association, the Union of Estonian Medical Emergency)[159].

The case of e-health is also a good example of how it is possible to support integration inside the health care system and at the same time to take advantage of the emerging high technology (ICT), through the amendment of already existing regulatory framework (the Health Services Organisation Act). On the one hand, the implementation of e-health system should make the health care system more open and transparent. It should provide favourable basis for the specialisation of hospitals and hence in a long-run perspective, support greater cooperation between them[160]. As the system sets common standards for the IT-systems currently used[161], it should enhance information flows in the health care system as a whole (interoperability of different system is solved through the usage of brokers). The exchange of data is also made easier for third counterparts, e.g. provision of statistics (preliminary data for pharmaceutical companies on whether to carry through a survey in terms of the number of patients).

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[158] Pirnejad, H., Bal, R., Stoop, A.P., Berg, M. 2007. "Inter-organisational communication networks in healthcare: centralised versus decentralised approaches". *International Journal of Integrated Care*, Volume 7(16), p. 1.

[159] See here also the web-page of *Estonian e-health Foundation* - http://www.digilugu.ee/DL_projekti_tutvustavad_materjalid_ENG.pdf.

[160] The greater cooperation but also efficiency is also hoped to be achieved through joining the boards of the East Tallinn and the West Tallinn Central hospitals – supported strongly by the Tallinn City Government.

[161] In the case of family physicians, the products from Medisoft Ltd have been particularly important.

On the other hand, it would bring the provision of health care services closer to the patient (e.g. registration) and would increase his possibilities for self-care (information on when he visited a doctor and what kind of doctor it was, what his diagnosis was, etc). The ideological question raised with pursuing of IT-systems has been about its effect on doctors and their logics of treatment.

The self-care is particularly relevant issue today, as there are serious problems and lacking in the adoption of healthy lifestyle and there is not enough information on how to take care of one's health[162] – so-called primary prevention. This is the area where local governments are potentially seen to have the greatest role to play in health care[163]. It also concerns the priorities set in the *Development Plan for Health Care in Tallinn 2007-2015*, which is oriented on patients rather than on the inhabitants of Tallinn generally. Today, special posts for health care officials have been created in each city district; the role of them, however, is not yet clear[164].

In general, the cooperation between city districts, medical care providers and certain educational institutions has been better than the one with the Tallinn City Government. **At the same time, the cooperation is usually based on single projects and does not provide any sustainability**. The reliance on single projects is the case also for other activities, e.g. rehabilitation activities. The lack of attention to primary prevention results in other issues, e.g. in the overload of family physicians, who in turn have to mainly deal with "putting out fires" than with active screening of their practice lists[165]. At the same time, it has been brought out that primary prevention and chronic care may overlap, create synergies and hence give greater improvement when treated together[166].

On the other side, the issues of long-term care, nursing care and social care have not been solved yet. The *Development Plan for Health Care in Tallinn 2007-2015* foresees the increase in the number of hospital beds in the nursing care (from 335 in 2007 to 520 (plus 150 hospital beds in geriatrics) by 2015). The question of how the so-called non-active care would be integrated with the health care system as a whole has not been answered yet either[167]. Most of all, it is a question about the sustainability in treatment.

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[162] A starting point for actions in this line is also the special web-page by the City of Tallinn, http://www.tervis.tallinn.ee/est/g23/.

[163] Not to mention that according to the Public Health Act (§ 10) a local government is responsible for organising and monitoring the implementation of health protection and for organising activities aimed at prevention of disease and health promotion among the population in the territory of the local government.

[164] See here also strategy "Tallinn 2025" - http://www.tallinn.ee/est/g2455/.

[165] The situation is escalated by the lack of nurses (only one nurse per the practice list) as well as administrative staff.

[166] Cifuentes, M., Fernald, D.H., Green, L.A., Crabtree, B.F., Stange, K.C., Hassmiller, S.B. 2005. "Prescription for Health: Changing Primary Care Practice to Foster Healthy Behaviors". *Annals of Family Medicine,* Volume 3(2).

[167] By now the general medical care system has been well described at the national level. See here *Esmatasandi tervishoiu arengusuunad aastateks 2006 - 2010* (working version of 2005) - http://www.sm.ee/est/HtmlPages/Esmatasandi_tervishoiu_arengukava_projekt_12_2005/$file/Esmatasandi_tervishoiu_arengukava_projekt_12_2005.pdf; The issues about integration, cooperation and prevention are also the key words of the *Rahvastiku tervise arengukava 2008-2015,* currently under preparation - http://www.valitsus.ee/failid/Rahvastiku_tervise_AK.pdf.

In a larger scale, the problems derive from the fact that today, contrary to various suggestions, the general medical care is not the duty of a local government[168]. **In Tallinn, however, the developments are often faster and the need for changes will appear sooner than the implementation of proper actions at national level.** At the same time, building up a system just for its own territory is not seen feasible, especially if there are plans at the national level (although in long-term perspective). For instance, this is a problem in building-up the IT-system for school medical care.

In overall, the *Development Plan for Health Care in Tallinn 2007-2015* is a step forward, as it describes all different levels of health care system in Tallinn. However, it does not concentrate on bringing out the most important barriers in the field and how they should be tackled in a systematic way. Previously, the health care issues have been very briefly dealt with in the *Development Plan for Tallinn 2006-2021*[169]. The only criterion was the satisfaction with the services provided by hospitals. The concentration on hospitals and their investment needs is the central idea in the new development plan as well.

In general, **the Estonian and Tallinn's health care system is very much hospital-centred.** Hospitals also spend the greater part of the resources allocated to health care sector. At the same time, hospitals together with ambulatory care providers, retail and other producers of medical goods (including chemists) are the largest service providers of the field[170]. It should be mentioned here that access to some services of specialised medical care is made easier for those who are registered as the citizens of Tallinn. This is a particular example of the cooperation between the Tallinn City Government and hospitals in the territory.

Further, **in several cases the agglomeration around the hospitals of Tallinn is quite explicit.** However, there are certain statements that the convergence around the hospitals is not relevant, because the transportation system in Tallinn is good, the city gives transport support to special groups, rental prices are rather high and increase gradually. The agglomeration mainly concerns family physicians and their practices. In general, 72% of the family physicians are renting office space from the other health care providers in Tallinn[171].

A positive example is the East Tallinn Central hospital together with its polyclinics that have provided favourable basis for several centres of family physicians or medical centres. This kind of converging often includes contracts between family physicians and hospitals. On the one hand, contracts provide access to the specialised medical care (e.g., to apply for discount in labs). On the other hand, they provide patient-flow to the hospital (non-monetary relationship). In general, financial relationships between family physicians and hospitals concern services like radiology and labs. In some cases, emergency medical care units serve hospitals as a platform for patient-flow (non-contractual relationship) as well.

The renting of working area in the territory of hospitals also concerns dentists, chemists, etc. In addition, the converging into one place concerns the hospitals

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[168] See here the portal for *Medical News* - http://mu.ee/?mid=11.
[169] *Development Plan for Tallinn 2006-2021* - http://www.tallinn.ee/est/g2455/.
[170] Jedomskihh-Eigo, N. 2006. *Estonian health accounts.* Tallinn University of Technology, p. 30.
[171] *Development Plan for Health Care in Tallinn 2007-2015* - http://tallinn.andmevara.ee/oa/page.Tavakasutaja?c=1.1.1.1&id=109569.

themselves. It often means, in turn, that the buildings, where family physicians are located are sold. This is a specific question where the local government is expected to intervene.

Although family physicians act as private entities, local governments should seriously consider the matters of supporting them, especially in physical conditions. While providing financial support for the infrastructure, it is possible for the local government to make some prescriptions for the family physicians (e.g. office hours) who are otherwise rather independent and cannot be easily controlled. Further, the coordination of extended primary care teams, including arrangements for "out of hours" primary care, has been seen as a great step forward while building-up integrated health care system[172].

As of today, **the establishment of medical centres (4-7 family physicians together) that get support from the local government has been foreseen** in two districts in Tallinn, in Nõmme and Haabersti. **Overall, the initiatives for these kinds of centres have come from bottom-up** (from the family physicians themselves) to handle the issues of vacations, replacements, maternity leave (approximately 90% of family physicians in Tallinn are women), etc. and to guarantee the ongoing provision of service for their patients.

If the local government decides to supports these initiatives, there may be danger that: (1) building-up of the centres serves the interests of real estate companies as the increased price of the working area would in turn result in the increased price of the services; (2) the centres are being built up without a sense of ownership structure behind the project. The role of the local government should be to guarantee the implementation of the stated priorities and, while doing so, to support synergy between the interested parts.

The Medical Centre Medikum in Lasnamäe that consists of several sub-companies that provide primary and specialised medical care and diagnostics, serves as a good example of modern business model in the health care sector.

<u>Entrepreneurship in the health care sector</u>

The provision of health care services, based on the number of enterprises in the field, is concentrated in the areas of medical consultations and treatment, general and specialised medicine and dental practice activities. During the last 5 years, the last two of the aforementioned activities have witnessed most significant growth in the number of enterprises. In both cases the growth has been more than 100 units.

The highest net sales are earned in the area of hospital activities, followed by the two previously mentioned activities. These activities are followed by the retail sale of pharmaceutical goods, the manufacture of orthopaedic appliances and parts thereof and the manufacture of medicaments. It should be mentioned that according to net sales **the East Tallinn Central hospital was ranked 145th in the TOP of 500 Estonia's leading enterprises in 2006**[173].

The number of employees and the growth in the number of employees has been the highest in the areas of hospital activities, medical consultations and dental care. The number of employees has also grown in the activities of ambulance

[172] Woods, K.J. 2001. "The development of integrated health care models in Scotland". *International Journal of Integrated Care,* Volume 1(1), p. 4.
[173] *Äripäev. TOP 100 Estonia's leading enterprises*. November 2007, p. 30.

and paramedics. The area of the manufacture of medicaments has suffered the greatest decrease in the number of employees.

Proceeding from the great number of employees (over 3000), it can be said that the area of hospital services is very labour-intensive, resulting in its own turn in rather substantial labour expenditures (the highest ones in the hospital activities). **Due to the creation of a large labour market, it is obvious that health care sector is an important part of the regional economy.**

The manufacturing of medicaments and the retail sale of pharmaceutical goods are the areas of the highest average net sales per enterprise. The most profitable activities in the health care sector are medical consultations, the manufacture of orthopaedic appliances, dental practice activities, and hospital activities. **The highest profits per enterprise are earned in medical laboratories**. The area of labs, diagnostics, and specialised medical care also contribute to the highest share of services supported by the EHIF. In other cases, the highest incomes in the health care sector are received from charge fees for visits, the provision of training and the sale of assets. On average, the profits are the lowest in the activities of ambulances and paramedics.

Table 8. Detailed information about the health care sector in Tallinn, 2006.

	Number of enterprises	Number of employees	Net sales	Net profit
Manufacture of basic pharmaceutical products (24411)	**1**	**1**	**413983**	**82988**
Manufacture of medicaments (24421)	**4**	**80**	**66926988**	**1578207**
Manufacture of other pharmaceutical preparations, including manufacture of dressing materials (24429)	**1**	**-**	**2088416**	**96754**
Manufacture of orthopaedic appliances and parts thereof (33102)	**22**	**224***	**117547575**	**19629632**
Manufacture of medical, surgical, dental or veterinary furniture and parts thereof (33103)	**2**	**13**	**7159586**	**675095**
Installation, technical maintenance and repair of medical equipment (33109)	**5**	**28**	**22126663**	**1961333**
Retail sale of pharmaceutical goods (52311)	**29**	**205**	**249772726**	**-6558973**
Retail sale of medical and orthopaedic goods (52321)	**5**	**-**	**7718461**	**473452**
Hospital activities (85111)	**6**	**3440**	**1008426715**	**13102323**
Medical consultation and treatment in the field of general and specialised medicine (85121)	**120**	**918**	**384769239**	**27297268**
Dental practice activities (85131)	**120**	**479**	**164891995**	**14588038**
Physiotherapy and health rehabilitation (85141)	**7**	**12**	**2368601**	**276439**
Activities of ambulances and paramedics (85142)	**1**	**52**	**8795066**	**-409453**
Activities of medical laboratories, blood, sperm and other similar banks (85143)	**1**	**18**	**22241130**	**10087736**
Other health activities i.e. (85149)	**23**	**51**	**30399154**	**2388751**
Social work activities without accommodation (85321)	**4**	**2**	**492965**	**-67769**

*Note: data is incomplete
Source: EMTAK, 2006.

The general trends in the health care sector indicate that the pharmaceutical cash flow equation has changed radically and pharmaceutical innovation is not

generating the same financial payback that it once did[174]. At the same time, returns in the medical device industry are to exceed pharmaceuticals and many other sectors. The trends are here reinforced by miniaturisation, faster IT processing, the opportunities of technological convergence and the possibilities of continuous health monitoring[175]. **Thus, in order to foster clustering in health care sector, Tallinn should significantly support this branch of health care sector**.

Health care support products and services

The linkages between core health care providers and providers of support products are not very extensive in the territory of Tallinn. **The strongest linkage of both family physicians and hospitals is to labs and diagnostics**, especially to *Quattromed HTI Laborid Llc* due to its high level of digitalisation. The provision of consultation service, e.g., in the field of radiology has been also there for hospitals in Sweden and Finland.

The cooperation with pharmaceutical companies, especially with local representatives and distributors, is particularly essential at the level of general medical care. The reason for this lies especially in the multidisciplinary character of the care. In addition, pharmaceutical companies are often behind the special funds for in-service training, conferences, etc. and provide financial support for carrying through single projects of the field. The collaboration with the representatives of pharmaceutical companies is often organised through special agreed meetings taking place once a week. These meetings are open to different counterparts (family physicians and nurses mainly).

Traditional discounts for pharmaceuticals are not available any more; it is believed that the environment has become more ethical. The financial resources for training and conferences of pharmaceutical companies are also important to hospitals. However, this kind of cooperation has been more focused on carrying through clinical surveys and the hospitals are acting as subcontractors in this respect.

The same can be said about the cooperation with special monitoring firms. Usually hospitals have set rather strict inside rules for participating in clinical surveys. Cooperation is possible only with those who are trustworthy. It means that in these cases the partnerships are rather definite and stable. Many hospitals have their own chemists. **The cooperation with the local R&D institutions** – the Tallinn University of Technology, and **especially in the field of biotechnology, has been and is very limited.**

At the same time, it is not feasible to carry out research in genomics, if it is not linked to phenotypes. **In this respect, hospitals would be essential "testing fields".** Yet, currently hospitals are more occupied with survival strategies and the development of infrastructure. **The main barrier for cooperation is the quite long time that is needed to reach some results, as after all medicine is an extremely fragmented field of study. The other problem that hinders cooperation derives from the share of the physicians who**

[174] "Payback: Making Innovation Count in Uncertain Times. Drug companies need to foster innovation based on their ability to generate cash returns". 2007. *IN VIVO: The Business and Medicine Report*, Windhover Information Inc, Volume 25(1).
[175] "Payback II: Medical Devices Ride the Cash Curve. Device companies have been able to innovate and generate cash returns, but will the good times last?". 2007. *IN VIVO: The Business and Medicine Report*, Windhover Information Inc, Volume 25(3).

are active in the academic sphere. Today this number is very limited. It means that internal R&D in hospitals is almost non-existent. The greatest exception here is the *East Tallinn Central Hospital*, where a respective unit was lately created. The current situation is fuelled by the fact that R&D is not a part of the price list of EHIF. In addition, Tallinn as a city does not have a teaching hospital and therefore the education and R&D outside of hospitals has few contacts and networks with hospitals.

On the other hand, the low number of academics in hospitals is also restricting external cooperation with R&D institutions. **Furthermore, by now different counterparts from the hospitals and R&D institutions are being brought together "under the umbrella" of *Technomedicum* (the Tallinn University of Technology.** Clearly, this is a development that the City of Tallinn should support as well.

The greatest progress in terms of intersectoral activities has been made in medical information technology. This concerns for instance the developments in the field of e-health, the possession of specific software, etc., as has been also brought out above. Besides the positive influence and pressure for the development from the central level, the efforts by the Tallinn City Government should be highlighted, as it has been seen as a particularly important centre of gravity behind the developments in the territory of Tallinn.

In addition, hospitals have worked out their own strategies in the field of ICT. The developments in the field, however, have been rather uneven as the respective processes are dependent on the hospitals' boards (a particular leader in the field has been again the East Tallinn Central Hospital).

As the value added tax on medical technology increased from 5% to 18% in 2007, hospitals heavily updated their medical equipment and infrastructure prior to the tax hike. However, **in the long term perspective it is believed to be more rational to come to a common agreement and concentrate on joint purchase of technology.** Another important aspect is that medical technology is bought in from foreign companies (through the local representatives). The most important factors while purchasing medical technology are its price, but also support services, like maintenance and consultations. Hospitals are also being used as platforms for new technologies, e.g. for testing new apparatus for a certain period. The cooperation of this kind does not provide any guarantee and hence no sustainability for producers (including the local actors).

Another emerging trend in medicine technology is increasingly personalised approach in product manufacturing. This should also mean a bigger local market in the long-run. The other question that should be looked at is what the main tendencies in medical technology market are and whether the respective local capabilities are present. One of the examples could be the manufacturing of orthopaedic appliances guided by bio censors, though the actual market for those may remain limited because of the pricing policy of the EHIF that would cover only 5-10% of the price. From specialised medical care, the intensity of technology and innovation in dental treatment is considered to be the most rapid one.

Based on this, it can be said **that today the linkages between potential local buyers and the local providers of medical technology, and especially with the providers of biomedical technology and local R&D institutions are very limited**. It shows first and foremost that there is no long-term strategy for the regional development. Today, the interconnection of different economic sectors of one geographic territory is not a top priority. As the result,

the health care sector has been very strongly concentrated on the provision of medical care only. Taking into account the total net sales of the health care providers we are talking about a rather essential potential local buyer.

In 2005, the net sales of the health care organisations under the responsibility of the Tallinn City Government amounted to 2.1 billion EEK and of the private sector 981 mln EEK – altogether 3 billion EEK. In addition, the exploitation of the EU Structural Funds for the development of hospitals' infrastructure (including equipment), as it is foreseen by the *Estonian Hospital Master Plan 2015* should also be taken into account. The total amount of investments into hospitals reaches about 389 mln EEK[176]. For a tentative overview of the potential pool of stakeholders for cluster building in Tallinn region refer to Appendix 9.

Policy recommendations

Priority setting in the health care is considered to be a public sector exercise[177]. The profound problem lies in the fact that there is no agreement on optimum structures, content and ways to achieve optimal health gain for the population[178]. **At the same time, there are strong implications that a strategy to improve health care delivery (particularly in general medical care) is becoming increasingly a strategy of collaboration, partnership, interdisciplinary teams, networks etc**[179].

The change is inevitable mainly because of the fragmentation of the health care systems that are not able to respond adequately to the growing demands of the community[180]. **The expectations for health services are continuously increasing in Estonia. Hence, there should a common agreement that the core criterion in providing health services is quality**. After all, individuals are more concerned with the provision of service than with the provider of service[181].

Further, there should be a common understanding and need for networking and understanding in the broadest sense of the importance of social capital (such as information sharing, trust, cohesion norms, reciprocity, support and social control and professional collaboration)[182]. **Although currently there is collaboration on some individual levels of health care providers, there is limited collaboration in professional matters between different levels of**

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[176] See here also the web-page of the *Ministry of Social Affairs* - http://www.sm.ee/eng/pages/index.html.

[177] *The World Health Report. Health Systems: Improving Performance*. 2000. World Health Organization, p. 61 - http://www.who.int/whr/2000/en/whr00_en.pdf.

[178] See here Atun, R. 2004. *Advisory Support to Primary Health Care Evaluation Model: Estonia PHC Evaluation Project. Final Report*. World Health Organization Regional Office for Europe, p. 5.

[179] Scott, C., Hofmeyer, A. 2007. "Networks and social capital: a relational approach to primary health care reform". *Health Research Policy and Systems,* Volume 5(9).

[180] See here e.g. Pirnejad, H., Bal, R., Stoop, A.P., Berg, M. 2007. "Inter-organisational communication networks in healthcare: centralised versus decentralised approaches". *International Journal of Integrated Care*, Volume 7(16).

[181] For international practice see here Woods, K.J. 2001. "The development of integrated health care models in Scotland". *International Journal of Integrated Care,* Volume 1(1).

[182] Scott, C., Hofmeyer, A. 2007. "Networks and social capital: a relational approach to primary healthcare reform". *Health Research Policy and Systems,* Volume 5(9); Woods, K.J. 2001. "The development of integrated health care models in Scotland". *International Journal of Integrated Care,* Volume 1(1).

health care providers. Also, the general interconnections between different levels of health care are rather problematic in Tallinn.

The role of a local government is to support the collaboration between different counterparts in the area. **The potential cluster building should not be seen as a goal in itself here, but rather as a way to improve the service delivery and further the economic progress in the field. The cluster initiative in the area would be a somewhat realistic undertaking. There is great proximity between the health care provision and the geographical territory. Further, certain financial resources are allocated for the area from the city budget**. However, the cluster building might be easier if local governments would have the responsibility for general medical care as well.

On the one hand, **local government should act as an intermediary to provide support for collaboration between different health care providers** – e.g. support for organising round tables for varied counterparts (e.g. to discuss what should be done so that the patient would not disappear to the health care system in Tallinn, etc). The organisation of round tables should not be the goal in itself but should be seen as a mean for setting priorities and their achievement.

Further, **local government should support information flows but also teamwork between disciplines and patient care (vertically integrated health system) and should also pursue the cooperation on horizontal levels (prevention issues, support for creation of medical centres or other integration, support for joint purchasing of technology, the local government acting as a counsellor and not as a controller, etc).** The need for local government's advice and recommendations on how to improve medical care provision is especially strongly felt on primary level.

For both horizontal and vertical level, it is necessary to come to a common local policy together with common standards (as it was the case in IT). Further, a local government's strategy accompanied by common standards (meaning most of all the organisation of joint procurement) should be worked out for the areas strongly related to health care, like waste management, food board, etc.

From the point of view of clustering, the question which needs to be solved is the creation of interdependence between local medical service, R&D institutions and medical industry[183]. Today the activities of the field are too strongly concentrated just on the provision of medical service. So far there have been very limited linkages with R&D institutions that operate in very promising scientific and economic fields like genomics and biomedical engineering. In order to create linkages between different aforementioned sectors, **the most realistic way for a local government to support the process is the use of procurement as a potential cluster building tool**.

The creation of new structures to pursue this kind of interconnection may also remain limited in its capacities and extensiveness, as is the case of *Technomedicum*. The small size of Estonia and limited human resources set their limits to different effective initiatives. However, **as *Technomedicum* is currently the only attempt and even a bottom-up attempt, the support by the Tallinn City Government is of utmost importance** (e.g. financial

[183] For the success story see here Ramlogan, R.M., Tampubolon, G., Metcalfe, J.S. 2006. *Networks of Knowledge: the Distributed Nature of Medical Innovation.* Discussion Paper 74. ESRC Centre for Research on Innovation and Competition, University of Manchester.

support for the infrastructure, office space, or even the creation of Tallinn's Development Fund). Also the role of the local government should be to act as a subscriber for potential new medical technology (e.g. through the involvement in hospital boards).

Today the lack of emphasis on creation of connections and linkages between different stakeholders is mainly dictated by the understanding that this is something only the central government is responsible for. However, a particular characteristic of Tallinn is that it develops faster than other parts of Estonia.

On the one hand, this presumes first-initiative actions from the local level. On the other hand, it also prescribes the establishment of good relationships at the national level. Another main barrier is the lack of competence for pursuing necessary developments with sufficient capacities. A special organisational structure with financial resources would be needed to take up the cluster building initiative.

Summary

Current state and potential of the health care cluster

- no explicit cluster or need for it present
- cooperation as such is written in to the health care system
- fundamental problems for stronger cooperation come from the current functioning of the health care system - there are considerable limitations for information flow, cooperation in professional matters between medical care providers of different levels, efficient resource management due to duplication, uneven quality in provision of medical care, sustainability in the provision of medical care from the patient's side, etc
- the health care system does not actively involve all counterparts of the area, e.g. school doctors, doctors carrying through health control, etc
- fragmentation of market
    a) activities in the health care sector are too strongly concentrated just on the provision of medical services
    b) too strong concentration on hospital activities as compared to other health care services
    c) no common strategies and standards foreseen for support areas in the health care system (e.g. waste management)
    d) health care system is too much patient-oriented, the lack of sufficient activities in the field of prevention
    e) much of the cooperation between different providers of medical care is still based on personal contacts
    f) limited linkages with promising scientific and economic fields like genomics and biomedical engineering
    g) limited linkages with local enterprises active in medical technology, the manufacture of drugs etc.; the orientation is rather on foreign companies and their products and services
    h) the main motivation behind cooperation with other actors of the health care sector is based on financial considerations
    i) local government is too much oriented on controlling as compared to putting emphasis on counselling
    j) no real institution with interest and resources to take the role of the centre of a cluster.

- strength of the professional associations is very different; the orientation is rather on enhancing developments in the specific segment of medical care than facilitating the cooperation with medical care providers of other levels
- favourable platform for cluster building is dependent on the possible positive effect derived from the emergence of ICT and health care sector
- a favourable basis for cluster building is the convergence of hospital activities into one centre and building up of centres for family physicians and medical centres, usually near hospitals
- development of linkages between hospitals, R&D institutions and a few enterprises through the foundation of *Technomedicum* and particularly through the foundation of *SmartImplant Ltd*.
- weak links between enterprises and public authorities because of the lack of previous cluster and sectoral policies, low awareness of each others activities and priorities
- weak coordination between public administration
- only emerging competencies of public authorities

Role for local government

- to communicate its willingness to act as a part of a cluster or its evolution
- taking explicit responsibilities and (also financial) commitments
- complementing central government's policies and supplementing them with own inputs
- valuing R&D institutions as the core of regional development
    a) through web-sites
    b) official cooperation agreements
    c) official and planned inclusion of R&D institutions in policy planning
    d) supporting the existing initiatives of R&D institutions

- local government as the moderator of cluster evolution
- local government as the *facilitator of cluster emergence*
    a) providing a context or framework for uniting different health care providers and other stakeholders to form a sectoral initiative
    b) providing financial support for bottom-up initiative like the creation of medical centres, converging of family physicians etc.
    c) taking initiatives for cooperation and networking to emerge (public procurement, strategic planning etc., particularly in non-medical care specific activities)

- local government as the *developer of existing cluster initiatives*
    a) analyse the possibilities for supporting the initiatives of the academia (especially *Technomedicum*) by providing infrastructure, financing etc.
    b) analyse and bring together already existing capacity of R&D institutions, companies and health care providers
    c) taking initiatives for cooperation and networking to emerge (public procurement, local government acting as a subscriber for potential new technology)
    d) initiate and moderate the communication with other potential sectors to form a horizontal cluster perspective (ICT-biotechnology-and beyond)

Analysis of the potential biotechnology cluster

The following is mainly based on the information gathered through the interviews conducted for the purpose of this study. During the preparation process of the study, it was revealed that there is a lack of comprehensive statistical information already at the level of the country, not to mention the level of Tallinn. The most comprehensive source for both qualitative and quantitative information for the field is the *Estonian Biotechnology Strategy* (working version as of January 9, 2008) which has served as a necessary fundamental basis for this survey.

Background information about the biotechnology sector in Estonia

Estonia has had a leading role in molecular biology in the world since the 19th century (thanks to Karl Ernst von Baer, (1792-1876)). Genomic studies in Estonia were launched already in 1960s. After significant public investments into the research of biotechnology in the 1970s, the discipline as such took off. The development of biotechnology in two centres of Estonia goes back to 1980s. The *Estonian Biocentre* was established in Tartu, followed by the opening (in 1984) of the *Laboratory of Molecular Genetics* in the *National Institute of Chemical Physics and Biophysics* in Tallinn[184].

The Estonian biotechnology sector is mainly working in and for the health care sector. The main competence, in both science and entrepreneurship, is found in biomedicine or so-called "red biotechnology"[185]. This is illustrated by the number of Estonian biotechnology firms and R&D organisations active in the fields like medical biotechnology, immunology, molecular medicine, proteomics, genomics and cancer research; diagnostics; pharmaceuticals; clinical research; laboratory services; biomedical engineering; laboratory equipment and reagents; antibodies; bioinformatics; biosensors; etc[186].

The overall number of R&D projects in the area of biotechnology is more than one third of the total number of R&D projects supported financially by the Enterprise Estonia (during 2002-2006). Mostly, these are projects of biotechnology and –medicine (20 projects), and medicine and diagnostics (16 projects). Altogether, biotechnology sector has been received grants from the

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[184] See here web-page of Estonian Genome Foundation – http://www.genomics.ee; Merirand, M. „Biotechnology in Estonia" – http://www.investinestonia.com.

[185] Tiits, M., Kattel, R., Kalvet, T. 2006. *Made in Estonia*, Institute of Baltic Studies, Tartu, p. 30; Muuli, V. 2005. *Biotehnoloogia sektori ülevaade Eestis 2004-2005*. Eesti Geenikeskus - http://www.genomics.ee/files/menu/biotehnoloogia_eestis_2004-2005.pdf.

[186] See here the list of Estonian biotechnology companies and research institutes in *BiotechEstonia*. 1/2007 (4) – website of the Estonian Biotechnology Association. See also, Sydow, J. 2007. *Potential to Network Innovative Clusters in the Baltic Metropoles Regions Present State and Perspectives.* Freie Universität Berlin., p. 70. While evaluating the quality of science in the area, according to the *ISI Essential Science Indicators database* (of 2002), the largest number of high-impact papers (4,429) and citations of them (22.274) belong to the fields of chemistry, clinical medicine, and biology and biochemistry, notwithstanding Estonia's investments in R&D being comparable to those among the EU member countries with the lowest R&D investments, such as Greece and Portugal. See here Allik, J. 2003. "The Quality of Science in Estonia, Latvia, and Lithuania after the First Decade of Independence", *TRAMES,* 7(57/52), 1, p. 41.

Enterprise of Estonia in the amount of 124 mln EEK and from the 6th EU Framework program in the amount of 133 mln EEK.[187]

Furthermore, at the international level (the EU and the US) human medicine and health care are seen as the most prominent fields of applications of modern biotechnology. The reasons for this stem from particularly unique and superior therapeutic and diagnostic solutions. These have contributed to the progress in the monitoring and control of communicable diseases, to increasing the effectiveness of medical intervention. But also to prevention that reduces the burden of disease, and hence to improving the quality of life of those suffering from diseases as well as to reducing health care costs by virtue of cost-effectiveness over alternative products, although a new drug or technology can put over- proportional strains to health care resources as well[188]. In addition, the predominance of health care sector in biotechnology is visible from the increasing high turnover (especially in the area of biopharmaceuticals) and from the distribution of dedicated firms by sector[189].

It is possible to bring out several periods in establishing biotechnology companies in Estonia: the late 1980s and 1990s, 2002-2004, and 2005-2007[190]. Today, the number of them is reaching to around 55. **Thus, the biotechnology sector is still in an embryonic stage and it is too early to speak about strong biotechnology companies**[191].

According to the *Estonian Biotechnology Strategy,* the main overall pitfalls of the sector concern scientific, human and financial resources as well as environmental and regulation framework. Derived largely from the strategy, the current state in Estonia can be described as follows[192]:

- During the recent years there has been a boom in establishing enterprises active also in R&D. Today the number of those is about 30. At the same time, there are only 17 companies with turnover over 1 mln EEK. The total turnover of the sector was estimated to be 280 mln for the year 2006. This means that the growth is produced by a small share of companies, and arguably by those not active in R&D as the main field. **It could be said that today the share of so-called "lifestyle**

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[187] *The Estonian Biotechnology Strategy* (working version).

[188] Zika, E., Papatrylon, I., Wolf, O., Gomez-Barbero, M., Stein, A.J., Bock, A.-K. 2007. *Consequences, Opportunities and Challenges of Modern Biotechnology for Europe.* JRC Reference Reports. European Commission, Joint Research Centre Institute for Prospective Technological Studies, p. 6, 128-129.

[189] Modern biotechnology market values are the strongest in biopharmaceuticals (11.3 billon EUR), followed by modern biotechnology diagnostics (1.7 billion EUR) and recombinant vaccines (0.3 billion EUR). While looking at the distribution of companies by sectors, the leading role is in the hand of companies active in human health care (37%), services (34%), biodiagnostics (18%) and bio and environmental issues (11%). Zika, E., Papatrylon, I., Wolf, O., Gomez-Barbero, M., Stein, A.J., Bock, A.-K. 2007. *Consequences, Opportunities and Challenges of Modern Biotechnology for Europe.* JRC Reference Reports. European Commission, Joint Research Centre Institute for Prospective Technological Studies, p. 23, 46, 120; the European Association for Bioindustries. 2006. *Biotechnology in Europe: Comparative Study*, p. 5. - http://www.europabio.org/CriticalI2006/Critical2006.pdf.

[190] See here also Talpsep, T. 2005. *Strategic Archetypes of Estonian Biotechnology Companies*. MA, University of Tartu, pp. 47-48.

[191] *The Estonian Biotechnology Strategy* (working version).

[192] *The Estonian Biotechnology Strategy* (working version).

companies" is still considerably high in Estonia.[193] At the same time, biotechnology sector is considered to be the economic sector showing the greatest growth and the highest value added in Estonia.

One reason is the lack of financial resources, especially of seed capital. Thus, the main activity, i.e. R&D, is dependent on sub-activities, like sales, the provision of consultation, etc. Today, the companies are still too small to provide sufficiently strong financial basis for fundamental and applied research. In general, the share of government expenditures on research and development has been constantly declining during the period of 1998-2004. According to the RD&I strategy *Knowledge-based Estonia,* natural sciences have received most support from the state budget in 1998-2004 (32% as of 2004) At the same time, medical sciences have been supported the least (11% from total expenditures on R&D in 2004)[194]. So, when taking into account that biotechnology is stated as one of the key technologies, the state funding for this purpose has not been very significant. The shortage of financial capital has increasingly been relieved by the availability of EU structural funds, but extensive reliance only on these funds can not be seen to be a sustainable policy option.

Another problem is the current ratio of expenditures, where fundamental research is represented very strongly while applied research and technological development are comparatively underfinanced. **This means that the public sector has been playing the leading role in funding basic as well as applied research and infrastructure. The funding of prototypes, design and development has to be mostly covered by private funding**[195]. The attention to private sector R&D investments is supported by the observation that firms that conduct their own R&D have also more capabilities of exploiting external information[196].

- The number of persons active in the R&D in biotechnology is believed to be around 300. The number of people employed in the biotechnology companies in 2006 was 410, with 209 being involved in R&D related companies. In the latter case, the usage of contract agreements is relatively high[197].

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[193] See here also Talpsep, T. 2005. *Strategic Archetypes of Estonian Biotechnology Companies*. MA, University of Tartu, p. 30, 56.

[194] Estonian Research and Development and Innovation Strategy 2007-2013 *"Knowledge-based Estonia"* – http://www.akadeemia.ee/_repository/File/ALUSDOKUD/Knowledge-based%20Estonia%20II.pdf.

[195] For the data (as of 2004) see Talpsep, T. 2005. *Strategic Archetypes of Estonian Biotechnology Companies*. MA, University of Tartu, p. 79; for the formulas describing the shares of Estonian investments into fundamental, applied and product development which today is 11:5:1 compared to the international practice of 1:10:100 respectively, see the *Estonian Biotechnology Strategy* (working version), but also Mets, T. 2006. "Developing the Sectoral Innovation System of Estonian Biotechnology". *Engineering Economics*, No 5 (50), p. 73.

[196] Aharonson, B.S., Baum, J.A.C., Feldman, M. 2004. "Industrial Clustering and the Returns to Inventive Activity: Canadian Biotechnology Firms, 1991-2000". *DRUID Working Paper* No 04-03 - http://www.druid.dk/.

[197] There may be overlapping in these figures. For the historical overview of the developments in the area in terms of the number of R&D institutions and enterprises active in the area (together with employment indicators), see Menrad, K. et. al. 2002. *Research on the Estonian biotechnology sector innovation system.* Final report submitted to Enterprise Estonia, Tallinn, Fraunhofer Institute for Systems and Innovation Research (Fraunhofer ISI)

- Although the springboard for the area is rather stable and people employed in the sector are highly qualified (in terms of having scientific degree)[198], **the lack of people having specific knowledge in marketing, general management, sales and patenting is rather striking**. It is especially relevant, as in more than two thirds of the companies more than 75% of the production is oriented on export. Further, as the domestic market is small, biotechnology companies have to find a way to international markets and for this purpose, they need to come out with their own niche. The prerequisite for it is the in-house intellectual property strategy. Today Estonian biotechnology companies are not capable of it. The main barrier is their size as they are mostly SMEs. This in turn means that the companies are in the early start-up stage and have to cope with limited human as well as financial resources. Another challenge in patenting is to make money out of the portfolio. There is not enough competence in patenting at the state level either.

  Another aspect in the field is the high reliance on the competence of individuals, leaders of the field. As a positive example one should mention T. Neumann and his company that is showing rather promising growth potential. Largely, the success of the firm derives from Neumann's international experience, offering substantial contacts and providing different business culture.

- Biotechnology companies are oriented to technology and innovative solutions as well as lower price. In terms of molecular diagnostics, the previous innovativeness is now having a positive impact on prices (decreasing). Further, as in Quattromed Ltd much of the development and research is not automated, the company is able to respond rather quickly to market demands and work out new innovative products.

- Although biotechnology is directed to international markets, it has not influenced the structure of ownership. The share of foreign owners is rather limited.

Research and development activities

As mentioned above, from the regional perspective, research institutions and companies of the field have mainly converged around Tallinn and Tartu. Among the most central 15 biotech research institutions in Estonia the ones located in Tallinn are: the *National Institute of Chemical Physics and Biophysics*; the *Tallinn University of Technology* together with the *Gene Technology Institute of the Tallinn University of Technology* (out of which several spin-off companies and the Competence Centre for Cancer Research have emerged); and *Technomedicum,* together with the *Institute of Biomedical Engineering*. See Appendix 10 for further detailed description of main institutions and their characteristics

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- www.riigikantselei.ee/failid/Research_on_Estonian_Biotechnology_Innovation_System_Frau.pdf.

[198] For the latest data see the *Estonian Biotechnology Strategy* (working version), but also Muuli, V. 2005. *Biotehnoloogia sektori ülevaade Eestis 2004-2005*. Eesti Geenikeskus – http://www.genomics.ee/files/menu/biotehnoloogia_eestis_2004-2005.pdf; and the web-page of the *Estonian Genome Foundation* - http://www.genomics.ee.

The ones located in Tartu are: the *Estonian Biocentre*; various institutes of the *University of Tartu* (e.g., the *Institute of Molecular and Cell Biology*, the *Institute of Organic and Bioorganic Chemistry*, the *Faculty of Medicine*, and the *University Clinics*); and the *Estonian University of Life Sciences* with its *Institute of Agricultural and Environmental Sciences*.

The most essential characteristic in the academic sphere is the rivalry between the two biotechnology centres in Estonia: Tallinn and Tartu. At the same time, both centres have claimed to be rather independent from each other in their activities, meaning that **there is neither cooperation nor competition.** This is particularly expressed by different projects, different partners (including foreign partners), and different scientific issues that are relevant to either side. In other words, the sector is fragmented. Proceeding from this, it is questionable whether in the end there should be one cluster of biotechnology in Estonia as has been often suggested and presupposed. The existence of two clusters could be also supported by the empirical research, revealing that the innovative output of biotechnology firms located in clusters that are strong in their own specialisation is greater than the innovative output of those located in clusters strong in other specialisation[199].

However, a distinction should be made here between different forms of cooperation. The first concerns the development of new products or services. Although Tallinn and Tartu are at large active in the same fields, the specific scientific questions tackled in the two centres differ. This means that it might be more reasonable to collaborate with those who are scientifically interested in the same agenda, but in a narrower way. Usually, the partners of this kind of collaboration come from abroad.

The other form of collaboration concerns united efforts in the methodology. In this framework we can speak of cooperation because of rather uniform standards used in biotechnology. Yet, in many cases the support from foreign partners is used as well. As local actors are largely engaged in broader collaboration and the local market is small, **it is suggested that the discussion should not be about an Estonian biotechnology cluster, but rather about a biotechnology cluster for the whole area of the Baltic States or ScanBalt**. The Estonian scientists' activities in seeking collaboration and joining international scientific consortia, including hosting international conferences, etc. can be considered as an approach in this line, and Estonian post-docs are a common feature in Scandinavia (as well in North-America)[200].

Today, the *Estonian Biotechnology Association* is a member of three international networks: *ScanBalt*, *EuropaBio* and *Council of European BioRegions*[201]. While looking at the developments on an even broader scale, it can be argued that biotechnology should not be an objective in itself. **Rather, it should be seen through the perspective of the integration with ICT and nanotechnology**. Already the diagnostics companies like Quattromed Ltd and Asper Biotech Ltd are increasingly emphasising biotechnology and its embeddedness with nanotechnology, ICT and engineering.

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[199] Aharonson, B.S., Baum, J.A.C., Feldman, M. 2004. "Industrial Clustering and the Returns to Inventive Activity: Canadian Biotechnology Firms, 1991-2000". *DRUID Working Paper* No 04-03 - http://www.druid.dk/.

[200] See here also O'Neill, M. 2007. "Biotech Focus: Estonia: small country, big ambitions". *Drug Discovery Today,* Volume 12 (17/18), pp. 683-684.

[201] See the web-page of *Estonian Biotechnology Association* – http://www.biotech.ee.

The key problem between Tallinn and Tartu derives from the competition for financial resources and it has lead to distrust between the actors of both sides. On the one hand, the current relationships are dependent on singular cases and concern the small circle of academics in a particular field. Problems like these have created distrust, especially towards leaders of different projects, programmes, etc.

On the other hand, the lack of collaboration is allegedly influenced by national policies, particularly of the Ministry of Education and Research. With its policies of rationality, it has still given hope to both sides for holding the monopoly in biotechnology in Estonia. As long as this kind of hope exists, it is not possible to create synergy between the centres.

However, there are also examples of the cooperation between Tallinn and Tartu: common lectures series, participation in development of curricula, personal contacts, etc. More cooperation is needed in terms of technological equipment. The very fundamental questions to be solved in this matter are: where to build special laboratories etc., and how to divide resources between the centres. First and foremost, the respective agreement must assure efficiency in resource management.

Another challenge for the R&D area is to get over the attitude of self-indulgence that considerably limits the collaboration with industry. In comparison with other developed countries, R&D is believed to be too academic in Estonia and hence in Tallinn as well. The problem results from the lack of financial resources that can be used for experimentations, tests, etc. A specific case in this respect is applied research, where scientific problems are often solved by a university in a stage when the output is not yet acceptable by industry. In addition, universities tend to concentrate on very narrow aspects in their research. This in turn results in too specific inventions that are unable provide sufficient platforms for product development. **For a local government this primarily means a possibility to support public procurement as a cluster building tool.**

For the industrial sphere, it is important that the product should be well-described, transportable, stable, etc. Broadly, this is a question of the lack of public financial resources for product development. Due to the smallness and limited turnover of the companies, the financial resources of private companies are not substantial either. Another problem is different speed of work and different objectives. Universities are active in the fields that do not often have measurable outputs/outcomes (like science and education). They are also seeking more (academic) stability. Hence, universities are more interested in receiving grants from the state, rather than from the collaboration with industry. The objective of enterprises is, in brief, an actual product.

At the same time, according to O'Neill (has written a series of articles about biotechnology regions), the emphasis on basic research has been the key factor in promoting the growth of a strong bioregion. The role of academic institutions here is to provide intellectual property and intellectuals for the area. Based on this, "governments can do as much in promoting entrepreneurship and helping companies to start and grow, but if the science is not there, these measures quickly run out of steam"[202]. It means that due to the lack of emphasis on

[202] O'Neill, M. 2007. "Biotech Focus: Estonia: small country, big ambitions". *Drug Discovery Today,* Volume 12 (17/18), p. 683.

fundamental research, universities and the area as a whole will eventually find themselves in lock-in situations[203].

The sustainability of human resources and capital (in terms of low wages as compared to knowledge intensity of the area) is an issue not yet fully comprehended in Estonia[204]. The reliance on cheap (underpaid) labour in science will not produce favourable conditions for cluster building. The exceptions in this respect are visiting professors and their comparatively higher wages. However, visiting professors are not believed to create strong enough bases for the future developments of the area due to their limited period of stay.

Entrepreneurship in the area

Approximately half of the biotechnology companies are converged in Tallinn[205]. The most successful companies in terms of turnover have been *Quattromed Ltd*, *Asper Biotech Ltd*, *Solis BioDyne Ltd*, *Celecure Group*[206], half of them are located in Tallinn. The main reason why they are located in Tallinn is closeness to clients or potential clients in Scandinavia. The biggest companies in terms of the number of employees in Tallinn (as of 2007) are *Quattromed Ltd* (particularly *Quattromed HTI Laborid Llc* in the case of Tallinn) (73 employees), *Inbio Llc* (23) and *ProSyntest Ltd* (19). However, most of the larger companies in terms of persons employed are converged in Tartu. Most of the companies in the area of biotechnology are active young start-up SMEs with the average of less than 10 employees (as of 2007). [207] For the list and the description of biotechnology firms in Tallinn refer to Appendix 11.

According to the progress by economic fields, the most successful companies are related to diagnostics[208]. Diagnostics is also gaining importance for health care, constituting an invaluable set of tools for diagnosis, but also for more precise prognosis and prevention of diseases. This means that the impact of the field is to be experienced in both health outcomes as well as in health care delivery and costs[209].

As mentioned above, biotechnology companies are mainly of a "supplier" type in Estonia: providing laboratory services, diagnostics and small production for a specialised niche in the health care or research and academic market. This kind of economic structure in the field has been existing since the beginning of the

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[203] "Building a Business: The Pre-eminence of clusters". *Nature Biotechnology,* Volume 25 (11), November 2007, p. 1208.
[204] See here wages in R&D, Rõõm, T. 2007. *"Haridus ja tööturg Eestis",* Bank of Estonia Working Papers, 12/2007.
[205] Mets, T. 2006. "Developing the Sectorial Innovation System of Estonian Biotechnology". *Engineering Economics*, No 5 (50), p. 75.
[206] *Potential to Network Innovative Clusters in the Baltic Metropoles Regions Present State and Perspectives*. 2007. Funded by TSB Innovationsagentur Berlin GmbH with financial support of Baltic Sea Region INTERREG III B program in the context of the Baltic Metropoles Innovation project. Freie Universität Berlin, p. 71.
[207] *Estonian Biotechnology Strategy* (working version).
[208] Muuli, V. 2005. *Biotehnoloogia sektori ülevaade Eestis 2004-2005*. Eesti Geenikeskus – http://www.genomics.ee/files/menu/biotehnoloogia_eestis_2004-2005.pdf.
[209] Zika, E., Papatrylon, I., Wolf, O., Gomez-Barbero, M., Stein, A.J., Bock, A.-K. 2007. *Consequences, Opportunities and Challenges of Modern Biotechnology for Europe.* JRC Reference Reports. European Commission, Joint Research Centre Institute for Prospective Technological Studies, p. 38.

1990s[210]. The other range of research and services is concerned with bioinformatics and other computational biosciences due to the strong grounding of local science in genomics and ICT[211].

There are no companies of a "fully integrated" type that operate from research to final market. However, two to three companies of this kind have started to emerge in this decade. A noteworthy example among the "developers" is Celecure Ltd. The company has achieved success through relying on the international cooperation (partners mainly from the US, Sweden, Finland), as is shown by patenting search[212].

R&D in enterprises is strongly related to the research activities in universities. Hence, public and private actors (universities and biotech companies) seem to be partners in a large scale [213]. This is mainly expressed by the number of academics who are also active in the entrepreneurial side. Furthermore, it is rather usual that biotechnology companies are at the start-up phase based on licenses from a university that is followed by the development of their own technologies protected by patents. In general, license sales are still in the initial phase: Estonian biotechnology research institutions have very few license sales, 2-4 deals per year and their profits are low in comparison with expenses[214].

It is rather common that innovative ideas for the biotechnology sector in Estonia originate from universities, but the initiatives to develop some kind of product based on them often from the private sector. In addition, there are not many cases where the initiatives for collaboration have come from a university. There are several schemes of taking over the output created by universities: before publishing, a company has the right to apply for a patent; there are project groups involving different counterparts of the field to deal with product development issues; the need for research comes from outside (from medical sphere).

The cooperation between universities and companies has been considerably improving during the last 5 years due to the programs of the *Enterprise Estonia*. **However, it can be argued that collaboration between R&D institutions and industry is based on personal contacts rather than on institutional cooperation.** This is for example illustrated by the fact that the private sector is more often related to universities through the SPINNO companies (grown out of university) than directly to university departments. The weaker university-

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[210] Mets, T., Leego, M., Talpsep, T. and Varblane, U. 2007. "The Role of Intellectual Property Protection in the Business Strategy of University Spin-Off Biotech Companies in a Small Transition Economy." *Review of Central and East European Law*, Volume 32, p. 36.
[211] O'Neill, M. 2007. "Biotech Focus: Estonia: small country, big ambitions". *Drug Discovery Today,* Volume 12 (17/18), p. 687.
[212] Mets, T., Leego, M., Talpsep, T. and Varblane, U. 2007. "The Role of Intellectual Property Protection in the Business Strategy of University Spin-Off Biotech Companies in a Small Transition Economy." *Review of Central and East European Law*, Volume 32, p. 36.
[213] See here also Mets, T. 2006. "Developing the Sectorial Innovation System of Estonian Biotechnology". *Engineering Economics*, No 5 (50), p. 75.
[214] Mets, T., Leego, M., Talpsep, T. and Varblane, U. 2007. "The Role of Intellectual Property Protection in the Business Strategy of University Spin-Off Biotech Companies in a Small Transition Economy." *Review of Central and East European Law*, Volume 32, p. 35.

industry links is a common characteristic in Europe in general, at least in comparison with the US biotechnology[215].

The relationships between university and industry are often regulated by contracts: to carry through some kind of analysis, survey etc. because enterprises do not have means of their own (human resource, hardware, etc) or vice versa. Contractual relationships do help in overcoming simple problems, as university staff and infrastructure/labs are used in an unregulated way and usually for no fee.

As everything has its own price in an enterprise, informal cooperation with them is not believed to be either feasible or an effective possibility. At the same time, it is believed that reliance on contracts does not prevent the emergence of synergy between the counterparts.

As an example of an emerging micro cluster, one can take the *Tallinn University of Technology* where 3 buildings for mathematics and natural sciences are located and functioning together at Akadeemia Street. In other words, this is a case, where academics and enterprises are brought together in physical terms (into the same buildings). Physical closeness in itself is considered to be a particular factor for facilitating the innovative output of biotechnology firms[216]. The building complex at Akadeemia Street is to be completed by the construction of another new building for the Technomedicum, where private medical practices are to be located as well. The reason is the current limited cooperation, especially in scientific matters, with hospitals and doctors. The main restrictions for the cooperation in this field are written into the price list of the *Health Insurance Fund* (R&D not included), and into doctors' educational background (very strongly oriented on practice). At the same time, a need for the development of several products has been expressed by doctors (especially in the case of diagnostics). The use of joint infrastructure (renting office space, labs etc.) in a university campus by private companies can be said to be another, though limited, form of cooperation.

In the area of biomedicine technology, R&D has been carried through rather separately at university and in the private sector, even despite the similarity of technological solutions (e.g. devices based on bio-impedance measurement). Due to this, the university-driven input has not been relevant for the industry in the field.

In overall, biomedicine technology as an area is in a very early development stage. There are only a couple of such firms in Estonia and they are active in very different fields. The reasons for this are:

- Small local market for the products, especially due to the considerably higher price of technological application as compared to labour costs in the heath care sector. It means that the savings from a couple of hospital days, which are very cheap as compared to develop countries, are not substantial enough for purchasing technology instead[217].

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[215] Mets, T., Leego, M., Talpsep, T. and Varblane, U. 2007. "The Role of Intellectual Property Protection in the Business Strategy of University Spin-Off Biotech Companies in a Small Transition Economy." *Review of Central and East European Law*, Volume 32, p. 23.

[216] Aharonson, B.S., Baum, J.A.C., Feldman, M. 2004. "Industrial Clustering and the Returns to Inventive Activity: Canadian Biotechnology Firms, 1991-2000". *DRUID Working Paper* No 04-03 - http://www.druid.dk/.

[217] For the price list of hospital days see *Eesti Haigekassa Tervishoiu Teenuste Loetelu, RTI 2007, 18, 91.*

- The area is strongly regulated and presupposes extensive surveys. Estonia is not yet capable of doing it in comparison with large corporations like Siemens, Philips that have extensive budgets for product development, marketing, etc.

- However, it does not mean that local universities (especially the Tallinn University of Technology) should not try providing inputs for international market. **Especially, because the provision of ideas by universities is more easily accepted abroad than is the case with the private sector**.

- The provision of biomedicine devices is concentrated into Tallinn.

In another area of biotechnology – drugs – the entrepreneurial activities are not very extensive. Only a couple of firms have been established. The main reasons are the lack of access to major pharmaceutical companies, and the smallness of domestic market for creating larger companies without international sales. E.g. in the US, red biotechnology is mainly working for bigger companies and industries like pharmacy and health care and accounts for up to 46% of innovations in pharmaceuticals[218].

Another reason lies in the 3rd phase of clinical research which is too expensive to be carried out in Estonia. However, the respective research is being carried out (subcontracting) for foreign companies. As it is believed that Estonia's potential to be a host country for investments into pharmaceutical industry is currently not very substantial, Estonia could offer relatively favourable conditions for the manufacture of generic drugs[219]. As the nearest companies are in Sweden and Denmark, the only possibility to do something in this area is to be a part of the Scandinavian biomedicine cluster[220].

As the biotechnology companies are increasingly realising the need to act for a common purpose, the cooperation between them is considerably greater than between R&D institutions in Estonia. Certain trends in the private sector collaboration should be noted:

- Collaboration is often based on single projects, for what the best team is compiled, notwithstanding the city people are from. The cooperation between R&D institutions and biotechnology companies has been better with the University of Tartu from where many technologies have been derived.

- Cooperation is greater between companies that belong to one owner group, which usually means that the respective firms do not compete with each other. This is particularly the case behind the cooperation of *Celecure Group* (together with its Cancer Clinic Ltd and InbioLabs Ltd) doing research on mutations in genomics in Estonian population - patient

[218] Tiits, M., Kattel, R., Kalvet, T. 2006. *Made in Estonia*, Institute of Baltic Studies, Tartu, p. 30; Mets, T., Leego, M., Talpsep, T. and Varblane, U. 2007. "The Role of Intellectual Property Protection in the Business Strategy of University Spin-Off Biotech Companies in a Small Transition Economy." *Review of Central and East European Law*, Volume 32, pp. 36-37.
[219] Tiits, M., Kattel, R., Kalvet, T. 2006. *Made in Estonia*, Institute of Baltic Studies, Tartu, p. 85.
[220] O'Neill, M. 2007. "Biotech Focus: Estonia: small country, big ambitions". *Drug Discovery Today,* Volume 12 (17/18), p. 684. See also Tiits, M., Kattel, R., Kalvet, T. (2006). *Made in Estonia*, Institute of Baltic Studies, Tartu, p. 85.

basis is provided by the Cancer Clinic Ltd, tests are done by InbioLabs Ltd, and analysis are carried through by Celecure Ltd. However, in overall, the cooperation is project–based rather than permanent even in this case. The same applies to international projects[221].

- A very positive trend in the private sector is the creation of common competence labs or centres. The special equipment is bought in, and in order to take a full advantage of the lab, certain services are provided under contract to others as well. This is the first sign that there is a common understanding that it is not rational for everyone to have a hyper centre that is very expensive and depreciates quickly without finding its full usage by one group only.

- As the Estonian biotechnology sector is rather small and still in the installation phase, all actors know each other quite well.. **However, as the Estonian biotechnology sector is heterogeneous in its essence, the cooperation between the companies developing different products is not believed to create any added value.**

The main barrier for cooperation in this field is competition, but also some attributes of human nature, like distrust, envy etc. **As the market is very small and the possibilities to enter international markets quite restricted, firms are trying to expand their activities at horizontal level rather** (developing their own capabilities for the product or service previously bought in) **than at vertical level – through specialisation**.

The collaboration at horizontal level should be of utmost importance as the entering on international market is to a great extent dependent on such factors as image and trust, etc, that realistically cannot be pursued by single independent companies. In broader context, the issue of "trust" is particularly relevant in Estonia due to its image as a transition country, visible linkages to the Central and Eastern Europe and their image. Even more, trust is a particular peculiarity of marketing in the biotechnology sphere – "*Fundamentally, biotechnology is a business built on the exception of trust and optimism*"[222] –, meaning in turn that people who are responsible for marketing should have rather wide list of contacts.

The role of industry associations

The *Estonian Biotechnology Association* (http://www.biotech.ee) is located in Tallinn. The association was founded in 2003 on the initiative of 15 biotechnology research institutions and companies. Today, the association unites about 20 members, both enterprises as well as research institutions. The aim of the association is to support the development of biotechnology in Estonia; and to introduce the sector to decision-makers, the general public, and to the biotechnology sector abroad.

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[221] According to empirical research, the case for asymmetric firms, which can develop friendly attitudes towards each other, is the same as they are not competing in the same market or product segment, see here for specific conclusions how competition and cooperation influence innovativeness Bengtsson, M., Sölvell, Ö. 2004. "Climate of competition, clusters and innovative performance", *Scandinavian Journal of Management,* Volume 20, p. 240.

[222] *OECD Case Study on Innovation: The Finnish Biotechnology Innovation System*. 2004. Turku School of Economics and Business Administration, p. 5.

The association offers information and networking services (e.g. mediating contacts and partnerships); organises conventions such as seminars and conferences, biotechnology roundtables, biotechnology career days; provides financial support for networking like foreign assignments, visits to professional fairs, exporting, joint research and commercial projects[223].

One of the most essential activities of the association has been the process of composing the Estonian biotechnology strategy. It was foreseen in the research and development strategy "*Knowledge-based Estonia 2002-2006*" that for each key area (one of them is biotechnology) a national strategy should be worked out together with respective programmes. To date, there are no strategies prepared by the state. The initiative in this issue has been taken over by the association.

It means, on the one hand, that the *Ministry of Economic Affairs and Communication* has not fulfilled its legal task and this has not contributed to the building up of the respective competence at the central level.

On the other hand, as the association performs the tasks of the central government and is working out the national strategy for the sector, it can be argued to what extent the different business strategies of the field have been integrated in it. In other words, it has to be further analysed to what extent the Estonian biotechnology strategy that is currently under preparation can be used for facilitating better networking in the area and to what extent the strategy is capable of creating a more holistic view of interconnections of the currently separate entities.

Table 9. List of key investment and networking organisations in Estonia.

Name	Field of activity
Ambient Sound Investments	Estonian high technology investment fund. One of the biggest investors in early stage companies in Estonia is *Ambient Sound Investments*, the group which was founded by four founding engineers of Skype. Their have began to fund a range of investments in high technology and biotechnology companies.
Baltics Small Equity Fund	Venture capital fund for SMEs in the Baltic region
Connect Estonia	Networking organisation within Estonia. Promotes Estonian biotech internationally
Estonian Biotechnology Association	The purpose of association is to represent the Estonian biotechnology sector both outside the sector as outside Estonia, and to support the development of the sector.
Estonian Genome Foundation	Organizing, coordinating and promoting R&D activities, training and promotional activities in the field of gene and biotechnology. Regional Branch Office of the European Federation of Biotechnology
Estonian Genome Project Foundation	A non-profit foundation founded by the Government for the preparation and implementation of the Estonian Genome Project

[223] *Potential to Network Innovative Clusters in the Baltic Metropoles Regions Present State and Perspectives*. 2007. Funded by TSB Innovationsagentur Berlin GmbH with financial support of Baltic Sea Region INTERREG III B program in the context of the Baltic Metropoles Innovation project. Freie Universität Berlin, p. 70; the web-page of *Estonian Biotechnology Association*.

Name	Field of activity
Estonian Society of Human Genetics	Network for people involved in the field
Scanbalt	Promotes trade and cooperation across Scandinavian and Baltic regions
Tartu Biotechnology Park	Infrastructure and related services for biotechnological development activities and entrepreneurship to Estonian and foreign biotechnology companies

Source: O'Neill, M. 2007. "Biotech Focus: Estonia: small country, big ambitions". *Drug Discovery Today,* Volume 12 (17/18), pp. 685-687; the web-page of *Estonian Biotechnology Association*.

Some organisations, such as the *Tartu Biotechnology Park* and the *Estonian Genome Foundation* provide support for the development of the field as well. A mention should be maid here of the biggest biomedical and health care project in Estonia – the *Estonian Genome Project*, launched in 1999.

Policy recommendation to the local and central government

Taking into account the current competence in the field of biotechnology, both in terms of R&D and entrepreneurship, it can be argued that the support from the national as well local level should not be about chasing "white elephants", as the case in high technology fields quite often is due to the over-ambitious plans of policymakers[224].

As the biotechnology sector in Estonia is still in its infancy and, on the other hand, the method of clustering for building up sector's competitiveness is also new to Estonia, it is doubtable whether this is the way of supporting biotechnology sector in Estonia.

The keywords for the cluster initiative in the biotechnology are as follows: favourable conditions of research traditions, supportive infrastructure and geographic proximity. In other words, biotechnology is a type of industrial activity that would most benefit from knowledge spillovers (much of that is tacit and not codifiable) and information exchange that are facilitated by spatial clustering. The clusters, due to their core competitive advantage, may also provide favourable basis for start-ups to establish themselves before they are ready to move further to international markets[225].

From financial side it is brought out that it is hard to create an organisation that is ready for the next level funding without having an active collaboration and a very close partnership with the professional investors who are going to take

[224] Andersson, T., Serger, S.S., Sörvik, J., and Hansson, E.W. 2004. *The Cluster Policies Whitebook*. International Organisation for Knowledge Economy and Enterprise Development, p. 50.

[225] Mets, T., Leego, M., Talpsep, T., and Varblane, U. 2007. "The Role of Intellectual Property Protection in the Business Strategy of University Spin-Off Biotech Companies in a Small Transition Economy." *Review of Central and East European Law*, Volume 32, pp. 22-23; "Building a Business: The Pre-eminence of clusters". *Nature Biotechnology,* Volume 25 (11), November 2007, p. 1207; Casper, S. 2007. "How do technology clusters emerge and become sustainable? Social network formation and inter-firm mobility within the San Diego biotechnology cluster". *Research Policy*, Volume 36, p. 440.

these companies to the next level[226]. Further, international practice has shown that the emergence of clusters in biotechnology has become an important source of economic development[227] and has supported developments in the most: "it is a sort of as a casino: the house always wins"[228].

This notion is supported by the empirical research showing that (1) clustered firms are eight times more innovative than geographically remote firms, (2) clustered firms apply for patents at more than twice the rate of other firms, (3) clusters are showing increasing returns to R&D investment[229]. However, it should be understood from the previous research that there are very few clusters in the US (like in San Francisco, San Diego, Boston) or in Europe (Cambridge in the UK, Munich in Germany) that perform well in overall opinion. This raises the question whether Estonia has the necessary competence to manage the cluster organisation and through this guarantee the sustainable development of the field that the clusters are claimed to bring along[230].

Proceeding from the European practice that is being accused of having too many cluster initiatives in biotechnology (an obvious risk of over-supply)[231]**, it could argued that the emphasis should be put upon the creation of one biotechnology cluster in Estonia as a whole or, to seek for an international framework**. **After all, the objective of a cluster initiative is not the creation of a cluster in itself, but economic development and growth derived from it**[232].

The role of the state in clustering should be mainly to coordinate and support the processes both within and outside the possible cluster: to build interconnection between different counterparts of the sector and between different sectors. **In other words, the role of the state is to provide a broader vision and goals for the area as this is not to be achieved and is not a capacity of single actors by themselves**[233]. Therefore, it is of utmost importance that policy-makers, both national and regional, increase their knowledge about the sector and its opportunities.

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[226] "Building a Business: The Pre-eminence of clusters". *Nature Biotechnology,* Volume 25 (11), November 2007, p. 1207.
[227] Casper, S. 2007. "How do technology clusters emerge and become sustainable? Social network formation and inter-firm mobility within the San Diego biotechnology cluster". *Research Policy*, Volume 36, p. 438.
[228] „Building a Business: The Pre-eminence of clusters". *Nature Biotechnology,* Volume 25 (11), November 2007, p. 1208.
[229] Also patents, which contain codified knowledge, exhibit a strong geographic element to their diffusion, Aharonson, B.S., Baum, J.A.C., Feldman, M. 2004. "Industrial Clustering and the Returns to Inventive Activity: Canadian Biotechnology Firms, 1991-2000". *DRUID Working Paper* No 04-03 - http://www.druid.dk/.
[230] See here particularly Casper, S. 2007. "How do technology clusters emerge and become sustainable? Social network formation and inter-firm mobility within the San Diego biotechnology cluster". *Research Policy*, Volume 36, pp. 438-455.
[231] Andersson, T., Serger, S.S., Sörvik, J., and Hansson, E.W. 2004. *The Cluster Policies Whitebook*. International Organisation for Knowledge Economy and Enterprise Development, p. 92.
[232] Andersson, T., Serger, S.S., Sörvik, J., and Hansson, E.W. 2004. *The Cluster Policies Whitebook*. International Organisation for Knowledge Economy and Enterprise Development, p. 134.
[233] Andersson, T., Serger, S.S., Sörvik, J., and Hansson, E.W. 2004. *The Cluster Policies Whitebook*. International Organisation for Knowledge Economy and Enterprise Development, p. 90.

The state-supported common platform is of utmost importance in terms of making it more feasible to enter international markets. As it is derived from empirical research, it could be said that the support for cooperation on horizontal level - especially **market experience sharing** - has been brought out as the most effective instrument to catalyse regional cluster creation, even more than the attention on commercialisation of university science[234]. Most likely, the current and possible future activities of the Estonian Biotechnology Association in this area will remain limited in this respect as it does not have enough financial resources, nor does it include all the enterprises active in the field[235].

The previous approach is to be supported by the understanding that the main attributes of biotechnology are science, networks and the division of innovative labour[236]. The geographical proximity is here of utmost importance for creating favourable basis for informal interaction and for bringing together critical mass of information and knowledge to support creativity and capabilities of working environment. Derived from this, it is suggested that **if to develop clusters in the area at all, it should be done through the framework of some of the already existing structures.**

So, the other possible way to promote clustering is to rely on the basis of already existing growth promoters like competence centres, industrial parks, etc. Further, as these centres have brought together the highest human competence in the area, additional human and other resources would be needed for the alternative, maybe even artificial structures. **Not to mention that the lack of resources is a particular problem of Estonia due to its small size**.

The need to promote clustering should come from bottom up – the state or the EU organised events to enhance collaboration are not believed to be very effective here. Furthermore, in a small country like Estonia and in a small area like biotechnology there is nothing that would not be carried through just because of the lack of a meeting place[237].

Leadership in networking and further in clustering should be held by those who are very closely related to the project itself. **The most important factor is that the leader should not have vested interests**[238].

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[234] Casper, S., 2007. "How do technology clusters emerge and become sustainable? Social network formation and inter-firm mobility within the San Diego biotechnology cluster". *Research Policy*, Volume 36, p. 454.

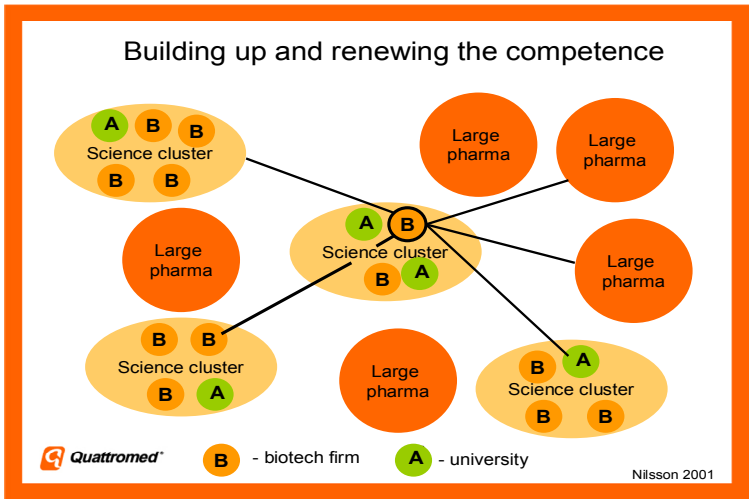
[235] Further, though there has been financial support available from the Enterprise Estonia, it has not been very extensive as only 22% of applicants have received funding (see more the *Estonian Biotechnology Strategy* – working version*)*. This alone can not be sufficient for solving the problems in the area.

[236] Mets, T., Leego, M., Talpsep, T. and Varblane, U. 2007. "The Role of Intellectual Property Protection in the Business Strategy of University Spin-Off Biotech Companies in a Small Transition Economy." *Review of Central and East European Law*, Volume 32, p. 23.

[237] In these terms also the EU framework plans have set rather violent criteria's for putting together scientists from different countries and/or public and private sector.

[238] Andersson, T., Serger, S.S., Sörvik, J., and Hansson, E.W. 2004. *The Cluster Policies Whitebook*. International Organisation for Knowledge Economy and Enterprise Development, p. 85.

Figure 2. A possible approach for cluster building in the biotechnology



Source: Modified by Talpsep, T based on Nilsson, A. 1998. *Role and strategy of biotechnology firms in Sweden*. Stockholm, p. 76. See also Nilsson, A. 2001. „Biotechnology Firms in Sweden", *Small Business Economics,* Vol. 17, p. 99.

In order to create enough critical mass and front-line research in biotechnology - which is very complex and involves many different counterparts, together with rather long lead time from invention to innovation and hence a high demand for long-term, but high-risk funding, **the support by the national rather than by regional policies is needed**[239].

Hence, one of the most important means of the state is to provide additional financing, e.g. seed money; the funding of infrastructure (these should not be only as real estate projects, but should be oriented on the creation of synergies in the field). The latter is an extremely important aspect to be understood by the local government, as there are claimed to be cases where this has not been taken into account while building up infrastructure. It also means that the improper regional policies could have a rather negative influence on already existing converging as such.

The other key role for public policies, while pursuing the developments in biotechnology, should be in the creation of linkages to health care system besides the ones to venture capital and universities. The interconnections between biotechnology and the health care system should not be pursued because of biotechnology in itself, but rather for the possibilities that biotechnology would bring about - cost efficiency and effectiveness in treatment[240].

As biotechnology is mainly serving the Estonian health care system, **the role of a local government would be to support the developments through the creation of a need or a market**. The one possible way the Tallinn City

[239] See also Blankenfeld-Enkvist, G., Brännback, M., Söderlund, R., Petrov, M. 2004. *OECD Case Study on Innovation: The Finnish Biotechnology Innovation System*, Turku School of Economics and Business Administration, pp. 4-5; Andersson, T., Serger, S.S., Sörvik, J., and Hansson, E.W. 2004. *The Cluster Policies Whitebook*. International Organisation for Knowledge Economy and Enterprise Development, p. 106.

[240] Mets, T., Leego, M., Talpsep, T. and Varblane, U. 2007. "The Role of Intellectual Property Protection in the Business Strategy of University Spin-Off Biotech Companies in a Small Transition Economy." *Review of Central and East European Law*, Volume 32, p. 23;

Government can subscribe for in the output is through the involvement in the boards of the two central hospitals in Tallinn. Not to mention that the net sales in the health care system are rather substantial and we are talking about rather big potential local buyer. The other possible way for the Tallinn City Government to intervene is through the public procurement process as a tool for network building. One possible way the associations can support the undertakings in their related area is to stand for e.g. a new drug, diagnostics method, medicine technology, etc. to be added into the price list of the EHIF. Although, the side gains of these demands may be of short-term, they are believed to bring along positive side effects as collocation, congestion results and incumbents reaction together with intensified competition[241].

Together with cluster-initiatives, general measures should be taken in order to overcome more fundamental problems both in R&D and entrepreneurship as well as in the respective environment. As many fundamental issues still need to be tackled today, the developments in the direction of stronger cooperation, networking and clustering have been inhibited. Not to mention that the so-called "lifestyle company" is a specific characteristic of poor entrepreneurial climate together with little available capital within and outside firms and limited sources for social learning. In addition, the relatively poorly developed business environment is a common characteristic of transition countries[242].

In the case of Estonia it is magnified by the lack of sector and cluster specific policies that have also reduced the potential development of specific competences at the central level. The need for the state support is foreseen as follows:

- Financial and expert support in applying for international patents. The patents themselves are not solutions, but would contribute for stronger competitiveness[243]. Partial public funding would be especially essential in this respect, if we take into account the difference in the cost of living in Estonia and the EU.

- To support favourable investment climate. Today, the tax releases are not seen to have any effect as profits in private biotechnology enterprises are often quite limited. This is particularly the case with the biotechnology companies that are SMEs. The changes in the framework of regulations should promote the situation where public and private investments into R&D are comparable to each other.

  Further, there is a need to provide favourable taxation for incomes derived from inventions – tax releases for license agreements, market protection for a certain period. To date there has been too much emphasis on institutional solutions to enhance the entrepreneurship in Estonia, e.g. the Development Fund, which in turn is oriented on strong enterprises rather than on those in a start-up phase.

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[241] Aharonson, B.S., Baum, J.A.C., Feldman, M. 2004. "Industrial Clustering and the Returns to Inventive Activity: Canadian Biotechnology Firms, 1991-2000". *DRUID Working Paper* No 04-03 - http://www.druid.dk/.

[242] Mets, T., Leego, M., Talpsep, T. and Varblane, U. 2007. "The Role of Intellectual Property Protection in the Business Strategy of University Spin-Off Biotech Companies in a Small Transition Economy." *Review of Central and East European Law*, Volume 32, p. 24.

[243] Mets, T., Leego, M., Talpsep, T. and Varblane, U. 2007. "The Role of Intellectual Property Protection in the Business Strategy of University Spin-Off Biotech Companies in a Small Transition Economy." *Review of Central and East European Law*, Volume 32, p. 23

- **The role for a local government should be to more value the R&D institutions and companies of high technology in its territory**. Local government should provide extra funds for the area of education and R&D in parallel to those at the national level. It means that a local government should have its own financial strategy (with precise sums brought out for every year) of promoting education, R&D and entrepreneurship.

  A positive example in this respect is the Local Government of Helsinki, on whose web-page there is a parallel link to the local government next to the one of the University of Helsinki.

- The **financial support for acquiring specialised education is allocated** from the local as well as the national level (e.g. to have specialists with education both in economics and biotechnology).

As the processes of networking and clustering are demanding both time (it takes in average 15 years for sustainable social networks to emerge)[244] and long-term financial commitment[245], the **cluster building initiative requires some kind of stability**, especially from the political pendulum swings. It means that a wish to create a new technology cluster does not follow the logics of short electoral cycles.

It is particularly essential that the activities at the local level would be in line with the national strategies and supported by them. **The individual initiatives of a local government will not pay off if the support from the national level is not provided.** Further, in the case of biotechnology it is essential that there is active cooperation between different local governments, particularly between Tallinn and Tartu.

When speaking about the biotechnology cluster building, the main barriers today are the limited state support for the area and the lack of trust between the actors of the field. In broad terms the latter is also a matter of political culture. In addition, it is also believed that limits in networking and further in cluster-building seem to be hampered less by the initial density of trust and ties at the micro level than by the difficulties involved in „scaling up" e.g. bridging different stakeholders of the process[246]. **A strong and capable state (both at the central and local level) has been seen as a key factor in cluster building, the current shortages in this matter may become a rather strong barrier for the future developments in biotechnology.**

Summary

Current state and potential of a biotechnology cluster

[244] Casper, S., 2007. "How do technology clusters emerge and become sustainable? Social network formation and inter-firm mobility within the San Diego biotechnology cluster". *Research Policy*, Volume 36, p. 454.

[245] "Building a Business: The Pre-eminence of clusters". *Nature Biotechnology,* Volume 25 (11), November 2007, p. 1208.

[246] Evans, P. 1997. „Government Action, Social Capital and Development: Reviewing the Evidence on Synergy", in P. Evans (ed.), *State-Society Synergy: Government and Social Capital in Development*. University of California International and Area Studies Digital Collection, Research Series 94.

- emerging micro clusters but no explicit cluster present
- low trust and limited cooperation among stakeholders
- country's image related to the countries in transition phase or of East and Central Europe – a serious restriction for entering foreign markets
- existence of two rival centres in R&D together with their own partners (including the ones from private sector and/or foreign countries)
- fragmentation of the market
    a) heterogeneity in the activity of local companies – no cooperation and no competition,
    b) concentration on different scientific fields in a narrow way in the two R&D centres,
    c) limited number of enterprises in the field (especially in the area concerning biomedical engineering),
    d) domination of SMEs,
    e) cooperation higher among companies belonging to the same ownership structure,
    f) in a great extent orientation to the foreign market,
    g) enlargement of market share on horizontal than vertical level – specialisation,
    h) concentration on sub-activities (including subcontracting) rather than on main activities (often R&D intensive),
    i) no real company or people with interest and resources to take the role of the centre of a cluster or facilitate cluster building.

- considerably strong industry association, which does not, however, cover all enterprises in the field and is rather a joint platform of larger and successful companies; it is too much oriented on fulfilling the tasks of the state at the moment
- different counterparts are well known to each other as the sector is small and still emerging
- due to the specificity of the field links between R&D and industry, at present, however, the cooperation is rather based on personal than on institutional level
- although the sector is mainly working in and for health care sector, the respective cooperation has been very limited
- developing linkages between few enterprises and hospitals and *Technomedicum* and *Competence Centre for Cancer Research* and *Centre of Excellence in Electronics an Bionics EBIT*
- weak links between enterprises and public authorities because of the lack of previous cluster and sectoral policies, low awareness of each others activities and priorities
- coordination between public administration non-existent
- only emerging competencies of public authorities (at the central level)

Role for local government

- to communicate its willingness to act as a part of a cluster or its evolution
- taking explicit responsibilities and (also financial) commitments
- complementing central government's policies and supplementing them with own inputs
- creating cooperation and networking with other local authorities for the development of the field
- valuing R&D institutions as the core of the regional development
    a) through web-sites
    b) official cooperation agreements

c) official and planned inclusion of R&D institutions in policy planning
d) supporting the existing initiatives of R&D institutions

- local government as the moderator of cluster evolution
- local government as the *facilitator of cluster emergence*
    a) providing a context or framework for uniting different cluster developers or "clusterpreneurs"
    b) supporting the programs and projects initiated by the industry associations and by the Enterprise Estonia (e.g. joint stands at international conferences, forums etc)
    c) taking initiatives for cooperation and networking to emerge (public procurement, strategic planning etc.)

- local government as the *developer of existing cluster initiatives*
    a) analyse the possibilities for supporting the initiatives of the academia (Technomedicum, competence centre and centre of excellence) by providing infrastructure, financing etc.
    b) through reinforcement of mentoring programmes and providing new services in incubators and science parks (providing support for bringing in foreign consultants and experts with international expertise and contacts, especially in the areas of patenting and marketing)
    c) through the stipendiary support for acquiring specialised knowledge required in the area (marketing, patenting, etc) in abroad or through financial support for building up local programs
    d) initiate and moderate the communication with other potential sectors to form a horizontal cluster perspective (biotechnology ICT-health care-and beyond).

Conclusions and a tentative framework for approaching other possible cluster-areas

The aim of the study was to analyse the current state of clusters in the Tallinn region. Based on the framework of the BaltMet Inno project, the pre-selected "case clusters" were: a) information and communication technologies; b) electronics; c) biotechnology and health care. As it appeared that biotechnology and health care represent two sectors that are in a very differing development stage in Estonia, it was more reasonable to treat them in separate sections.

The more theoretical part of the study revealed that in the mainstream cluster approaches there is not much special attention paid to specific characteristics that describe the current state of the Estonian economy and public administration. As every economic system and every cluster (and cluster development initiatives) is unique, there are no clear-cut or one-size-fits-all policy tools and solutions that can be transferred from the experience of other countries.

Special attention has to be paid to the general contextual factors that dictate suitable solutions.

Estonia has to be very aware of the unique characteristics and prior (policy) legacies that it has in developing its cluster policies and initiatives. The more important contextual characteristics are as follows:

- smallness of the economy, openness to the foreign investments (and high level of foreign ownership in the economy);
- dominance of SMEs and micro-enterprises in most economic sectors;
- dependence on the short-term cost advantage of the labour as the main catalyst of economic development;
- low need for and awareness of the potential positive effects of cooperation and networking between economic actors;
- lack of prior experience and use of cluster policies resulting in weak presence of cluster-like formations and limited know-how among all cluster stakeholders;
- limited public sector experience in participating or initiating cluster-like cooperation and networking;
- policy coordination of different innovation and education policy areas is almost non-existent;
- generally, public sector's administrative capacity in designing and implementing policies has serious deficiencies, almost all Estonian innovation policy initiatives and measures are a part of the EU structural funding schemes and thus developed largely as a reaction to the European Commission's suggestions;
- transition state characteristics emphasising the lack of trust between the government and the private sector, between different cluster stakeholder segments;

- limited knowledgeable and competence-based development of different aspects brought out as possible policy subject on the *cluster initiative target board*: cluster expansion; innovation and technology; education and training; commercial cooperation; policy action; research and networking;

A universal prerequisite of any cluster-related public policy in the conscious long-term strategic management of issues like entrepreneurial environment, education and training, urban planning and development, social cohesion and social capital etc. The current most popular cluster approaches just presume the existence of this understanding. At the same time, transition state and small state peculiarities taken together dictate the need for a conscious policy-level approach to these issues. **Processes of catching-up and policy learning require context specific adaptation of the ideal-type models proposed based on the experiences derived from more developed context**. Thus, the general spatial-economic policies of local governments should be seen as an integral part of any cluster policy.

In the case of Tallinn, the spatial-economic conditions largely reflect the structural problems the entire country is facing. **At the same time, Tallinn as the capital region has considerable "competitive advantages" in comparison with other regions.** Tallinn has better entrepreneurial climate, better educational level and provision, better labour market condition, better location etc. Thus, Tallinn seems to be a logical test-ground for cluster initiatives in a small state like Estonia. **This also provides Tallinn with better potential for bringing the EU's Structural Funds to the region and absorbing them**, including programs for the development of spatial-economic conditions as well as specific cluster programs. But this requires better coordination and alignment of local and central government policies.

Thus, Tallinn has to take into account the following principles:

- **Firstly, there needs to be a conscious long-term strategic development of the general spatial-economic conditions of the local government area**. There should be clear priorities for the development of entrepreneurship, urban planning, transport, social cohesion etc. These are the areas that condition the success of every more sophisticated initiative i.e. cluster programs etc.

  A clear distinction should be made between issues that belong mostly to the competencies of local authorities and the issues in which the central government has more mandate for policy making (i.e. higher education and research). The former areas require strong internal planning and management capacities. The latter also need supplementary general competencies for policy coordination with the central government and skills to influence the central government's policy making in a suitable direction. For this, Tallinn has the best starting position.

- **Secondly, there needs to be an understating that any specific policy initiative has to be in line with the overall central government's policies**. In the end the central government's and local government's policies should add up to state policies.

  As Tallinn is the most influential local government region, it is obvious that most central government's policies should take Tallinn as the

reference point in one way or another. The role for a local government should be to create competencies for supplementing central government's initiatives with suitable (or rather) context-specific policies**. As a small state, there is not enough financial and human capital and potential to have complementary policies and initiatives between different levels of government.**

- **Thirdly**, the analysis of this study leads to a general hypothesis that as a small transition state that is on the threshold of conscious sectoral and cluster-based policy development, the first policy initiatives should encompass as wide a pool of stakeholders as possible. It would help create the necessary capacities among all the potential stakeholders. **Naturally, this presumes that more emphasis should be put on knowledge intensive potential cluster areas as well as on maintaining sufficient flexibility for including new fields and also traditional industries within the initiatives**.

  In a small state there are limited capacities and a limited level of internationally recognised competitive skills in most fields. **Thus, to create new competencies, all existing resources need to be included in the policy initiatives.** Otherwise, there is a threat that potential capacities are fragmented and some of the main competencies are excluded from policy development and learning experience.

  This naturally means the inclusion of academia and scientific competencies. **Logically, it would lead to a more knowledge-based cluster approach.** Still, it does not have to mean sole concentration on inventions, fundamental innovations etc. as the core of clusters. The academia may also have complementary competencies for more enterprise-centred initiatives. It is important not to exclude the academia from possible initiatives. Eventually, the goal of the economic policies is to induce structural change of the economy and increase the added value of economic activities. This has to be based on general scientific progress, if it is to be sustainable in the long run.

This framework has enabled this study to approach the clustering process in a manner not used in Estonia before. The framework has enabled to map the current state of clustering from the perspective of cooperation and networking among all the relevant stakeholders of the possible cluster formations**. It has to be reiterated once again that this kind of cooperation and networking is the absolutely fundamental prerequisite of any clustering process**. Its importance can not be disregarded or its presence taken for granted, especially considering the context-specificity of the Estonian economy and public administration. The following conclusions can be made on the current state of clustering in these four potential cluster areas:

<u>Current state and potential of the ICT cluster</u>

- no distinguishable cluster or need for it present
- low trust and tradition of cooperation among stakeholders
- fragmentation of the market –
  a) foreign ownerships
  b) or concentration on the foreign market only (sub-contracting)
  c) dominance of small companies,
  d) no actual large companies with interest and resources to take the role of the centre of a cluster

e) high competition between companies for low-cost input factors

- weak industry association
- presence of few leaders who could carry the role of clusterpreneurs
- low awareness of the competencies and specialisation between enterprises in the sector
- weak links between enterprises and R&D institutions because of barriers to communication and alignment of priorities
- weak links between enterprises and public authorities because of the lack of previous cluster and sectoral policies, low awareness of each others activities and priorities
- low coordination between public administration institutions
- only emerging competencies of public authorities

Current state and potential of the electronics cluster

- no explicit cluster present
- understanding of the benefits of cooperation, but no willingness to initiate and develop it by the enterprises
- fragmentation of the market
    a) foreign ownerships and also management of companies
    b) or concentration on the foreign market only (sub-contracting)
    c) dominance of small companies
    d) competition for cheap input-factors
    e) no actual large companies with interest and resources to take the role of the centre of a cluster
    f) fragmentation of the companies into market niches – no cooperation and no competition

- only formal industry association present – no benefit seen in sectoral association (free-riding and niche specialisation)
- weak links between (larger and foreign-owned or only foreign-market-oriented enterprises) and R&D institutions because of barriers to communication and alignment of priorities
- developing linkages between a few companies and the *ELIKO Competence Centre in Electronics-, Info- and Communication Technologies*
- weak links between enterprises and public authorities because of the lack of previous cluster and sectoral policies, low awareness of each others activities and priorities
- low coordination between public administration institutions
- only emerging competencies of public authorities

Current state and potential of the health care cluster

- no explicit cluster or need for it present
- cooperation as such is written in to the health care system
- fundamental problems for stronger cooperation come from the current functioning of the health care system - there are considerable limitations for information flow, cooperation in professional matters between medical care providers of different levels, efficient resource management due to duplication, uneven quality of the provision of medical care, sustainability of the provision of medical care from the patient's side, etc.
- the health care system does not actively involve all counterparts of the area, e.g. school doctors, doctors carrying through health control, etc
- fragmentation of market

a) activities in the health care sector are too strongly concentrated on the provision of medical services only
b) too strong concentration on hospital activities compared to other health care services
c) no common strategies and standards foreseen for support areas in the health care system (e.g. waste management)
d) health care system is too much patient-oriented, the lack of sufficient activities in the field of prevention
e) much of the cooperation between different providers of medical care is still based on personal contacts
f) limited linkages with promising scientific and economic fields like genomics and biomedical engineering
g) limited linkages with the local enterprises active in medical technology, the manufacture of drugs etc.; the orientation is to a great extent on foreign companies and their products and services
h) main motivation in the cooperation with other actors of the health care sector is based on financial considerations
i) local government is too much oriented on controlling as compared to putting emphasis on counselling
j) no actual institution with interest and resources to take the role of the centre of a cluster.

- strength of the professional associations is very different; the orientation is rather on enhancing developments in the specific segment of medical care than on facilitating the cooperation with medical care providers of other levels
- favourable platform for cluster building is dependent on the possible positive effect derived from the emergence of ICT and health care sector
- a favourable basis for cluster building is the converging of hospital activities into one centre and building up of centres for family physicians and medical centres, usually near hospitals
- development of linkages between hospitals and R&D institutions and few enterprises through the foundation of *Technomedicum* and particularly through the foundation of *SmartImplant Ltd*.
- weak links between enterprises and public authorities because of the lack of previous cluster and sectoral policies, low awareness of each others activities and priorities
- weak coordination between public administration
- only emerging competencies of public authorities

Current state and potential of the biotechnology cluster

- emerging micro clusters but no explicit cluster present
- low trust and limited cooperation among stakeholders
- country's image related to the countries in the transition phase or of East and Central Europe – a serious restriction for entering foreign markets
- existence of two rival centres in R&D together with their own partners (including the ones from private sector and/or foreign countries)
- fragmentation of market –
    a) heterogeneity in the activity of local companies – no cooperation and no competition,
    b) concentration on different scientific fields in a narrow way in the two R&D centres,
    c) limited number of enterprises in the field (especially in the area concerning biomedical engineering),

d) domination of SMEs,
e) cooperation higher among companies belonging to the same ownership structure,
f) orientation to foreign market to a great extent,
g) enlargement of market share on horizontal rather than vertical level – specialisation,
h) concentration on sub-activities (including subcontracting) rather than on main activities (often R&D intensive),
i) no actual company or individuals with interest and resources to take the role of the centre of a cluster or facilitate cluster building.

- considerably strong industry association, which however does not cover all enterprises in the field and is rather the joint platform of larger and successful companies; too much oriented on fulfilling the tasks of the state at the moment
- different counterparts are well known to each other as the sector is small and still emerging
- due to specificity of the field links between R&D and industry present, however the cooperation is based rather on personal than on institutional level
- although the sector is mainly working in and for health care sector, the respective cooperation has been very limited
- developing linkages between few enterprises and hospitals and *Technomedicum* and the *Competence Center for Cancer Research* and the *Centre of Excellence in Electronics an Bionics EBIT*
- weak links between enterprises and public authorities because of the lack of previous cluster and sectoral policies, low awareness of each others activities and priorities
- coordination between public administration non-existent
- only emerging competencies of public authorities (at the central level)

The overviews of the current state and the development potential of these four cluster areas confirm the implications of the contextual factors (small state and transition state characteristics) on clustering in Estonia. **There are no explicit clusters in these areas in Estonia. Cluster has to be seen as a tentative or heuristics concept** that can be used to describe the emerging seeds of cooperation and networking that can eventually lead to cluster emergence. **There is also clear indication that there needs to be a rather active involvement of both local and the central government's institutions in cluster development.**

Both local as well as the central government needs to increase the competence in cluster and sector specific policies. This has to be achieved through competence-based policy planning and through trial and error.

The specific context of the Estonian economy and public administration implies that there are now clear-cut programs that can be adopted without context-specific analysis. **This requires a flexible approach to clustering and cluster development. It is quite possible that a potential cluster will form from specific but complementary segments of all the sectors studied in this project.** This is in fact a general trend that seems to be developing. Thus, there needs to be a flexible and open approach to clustering that allows for different cooperative formations to develop, transform,

restructure etc. **This can be defined as the context-specific approach to the concept of innovative clusters**[247].

The study of each of the potential cluster areas allowed making more or less specific policy recommendations for each of the areas. These can be found under the specific case studies.

At the same time, based on these analyses and policy recommendations it is possible to make conclusions that provide a **tentative framework for public policy actions and for approaching other areas where similar clustering potential is seen as necessary.** This framework takes the perspective of possible policy initiatives from a local government's perspective. It also has to be realised that Tallinn may be one of the few local governments in Estonia that has considerable interest and capacities for cluster initiatives.

Potential role for local government in clustering

- **taking the leadership and the role of the moderate in a clustering process by explicitly communicating its willingness to act for achieving clearly stated and financially guaranteed responsibilities and commitments,** this communication has to be directed towards other stakeholders and within the ranks of the public administration i.e. towards the central government;

- **creating competencies for carrying out sectoral and cluster-related policies as well as making strategic choices on potential cluster areas and sectors that have the potential for clustering;**

- **complementing central government's policies and the initiatives of other stakeholders (the academia, enterprises, industry associations etc.) and supplementing them with own inputs;**

- **explicitly valuing and emphasising R&D institutions as the core of regional development by advertising them and including them in local government's policy-making;**

- **local government in the role of the *facilitator of cluster emergence***
    a) providing a context or framework for gathering together stakeholders to form a sectoral initiative
    b) providing a context or framework for uniting different cluster developers or "clusterpreneurs"
    c) supporting the programs and projects initiated by industry associations, government agencies etc.
    d) taking initiatives for cooperation and networking to emerge (public procurement, strategic planning etc.)

- **local government in the role of the *developer of existing cluster initiatives***
    a) analysing the possibilities for supporting the initiatives of the academia and other stakeholders by providing infrastructure, financing etc.
    b) taking initiatives for cooperation and networking to emerge (public procurement, local government acting as a subscriber for potential new technology)

[247] Andersson, T., S. S. Serger, J. Sörvik, E. W. Hansson. 2004. *The Cluster Policies Whitebook*, IKED.

c) providing competence-based support and complementary services to programs and initiatives lead by other stakeholders of the process
d) reinforcing of mentoring programmes, scholarships, other existing services and providing new services in incubators and science parks (providing support for bringing in foreign consultants and experts with international expertise and contacts, especially in the areas of patenting and marketing, product development etc.)
e) initiating and moderating communication with other potential sectors to form a horizontal cluster perspective (biotechnology, ICT, health-care and beyond)

Appendices

Appendix 1. List of organisations and people interviewed

	Organisation	No. of people
General public policy institutions	Ministry Education and Research	2
	Ministry of Economics and Communications	2
	Tallinn City Government	3
ICT cluster area	Tallinn University of Technology	1
	Estonian Association of Information Technology and Telecommunications	1
	Enterprise representatives	1[248]
Electronics cluster area	Tallinn University of Technology	1
	ELIKO Competence Centre in Electronics-, Info- and Communication Technologies	1
	Enterprise representatives	1[249]
Biotechnology cluster area	Tallinn University of Technology	2
	Estonian Biotechnology Association, enterprise representative	1
	Enterprise representative	1
Medicine cluster area	North Estonian Regional Hospital, representative of the Association of Doctors in Tallinn	1
	East Tallinn Central Hospital	1
	Representative of the Tallinn Family Medicine Association	1
	Tallinn Medical College	1
	PRAXIS Center for Policy Studies	1
Total number		**22**

[248] Interviewee was chosen based on the past experience of conducting similar cluster-related studies in Estonia. The main task was to interpret the results of the desk-based research and comment on the recent studies in the context of local government capacities and possibilities for action.

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Appendix 2. ***Synthesis of different studies on clusters and the conclusions that can be drawn on the position and current state of the Estonian clusters.***

Name of the study	**Concentration of the study**	**Cluster definition**	**Approach to clusters (or approach relevant to clusters) in Estonia**	**General conclusion on clusters (or relevant to clusters) in Estonia**
Clusters in the EU-10 new member countries, 2006	- comparative study of regional clusters in EU-10; - regions defined based on NUTS 2 classification;	- "geographically co-located end producers, suppliers, service providers, research laboratories, educational institutions in a given economic field" (Porter's definition); - cluster categories (38) are derived from NACE rev. 1.1. classification; - clusters and regions are compared based on size (employment), specialisation and dominance;	- no regional differentiation between clusters i.e. all cluster categories are analysed encompassing the entire country (like Cyprus, Lithuania, Latvia, Malta, Slovenia); - At the same time, for example Poland is divided into 16 regions, Czech Republic into 8 clusters;	- "*Estonia ranks relatively low among EU-10 countries on measures of cluster presence, largely driven by its small size. /…/ The country ranks much stronger on the quality of its general business environment conditions. It seems that the country focused largely on a cross-cluster based economic strategy. Some clusters have developed naturally, taking advantage of these overall improvements, but clusters have not been central to economic policy."*
State of the Region Report. The Baltic Sea Region – Top of the	- uses Global Competitiveness Index as its main comparison	- "regional specializations of companies and	- Most of the comparative listings based on	- tasks for government: a) tax reduction on R&D;

Name of the study	**Concentration of the study**	**Cluster definition**	**Approach to clusters (or approach relevant to clusters) in Estonia**	**General conclusion on clusters (or relevant to clusters) in Estonia**
Europe in Global Competition, 2006	tool for bringing out the general economic environment of the region and places the countries of the region in comparative rankings; - does not give specific information on cluster intensity or presence as such, but gives indication of the current comparative state of the different cluster components and their long-term development;	institutions in economically related fields" (Porter's definition); - more company centred approach;	macroeconomic indicators, indicators for economic sustainability, quality of education, quality of public administration, science rankings, innovation capacity rankings; - Estonia places below the EU-15 countries of the BSR (Finland, Sweden, Norway, Denmark, Germany), but above other EU-10 countries of the region (Latvia, Lithuania, Poland);	b) information transfer; c) facilitate administrative processes; - same general conclusion as in *Clusters in the EU-10 new member countries*;
2006 Innobarometer on cluster's role in facilitating innovation in Europe	- dealing with the characteristics of firms existing in a cluster-like environment (opinion-poll among company managers); - comparison across Europe on different cluster aspects	- company clusters as the main focus; - clusters in innovation intensive industry sectors; - emphasis on companies with over 20 employees;	- includes Estonia in EU-10 categorisation that compared to EU-15 represents considerably lower; a) cluster intensity (28% of companies in EU-15 working in cluster	- Estonian companies in a cluster-like environment rank as the second lowest (above Hungary) in using innovative activities; this indicates that clusters have a very different role in different parts of

Name of the study	Concentration of the study	Cluster definition	Approach to clusters (or approach relevant to clusters) in Estonia	General conclusion on clusters (or relevant to clusters) in Estonia
	(intensity, awareness, role of public policies etc.);		environment compared to 9% in EU-10 and Estonia as well); b) cluster awareness (62% in EU-25 and 41% in EU-10); c) demand for public intervention in cluster development;	Europe; - from being in a cluster benefits most marketing, sales and R&D departments of Estonian firms; - Estonian companies are ranked together with EU-10 countries as more sceptical towards public sector role in supporting clusters (with 30% of companies seeing no role for public authorities while in the EU-10 the proportion is 23% and EU-25 it is 15%); - statistically Estonia has more public sector cluster support mechanism in use than in EU-10 but it is still considerably behind the EU-25 rate; - Most important support

Name of the study	Concentration of the study	Cluster definition	Approach to clusters (or approach relevant to clusters) in Estonia	General conclusion on clusters (or relevant to clusters) in Estonia
				mechanisms that the public sector should improve are: a) tax reduction on R&D b) information transfer c) facilitating administrative procedures.
Potential to Network Innovative Clusters in the Baltic Metropoles Regions Present State and Perspectives, 2007	- reinforcement of collaboration in cluster development work; - identification and improvement of transferable cluster elaboration tools; - comparison between Berlin, Öresund, Helsinki Stockholm, Riga, Tallinn;	- Porter's definition; - Special emphasis on regional dimension of the term; - clusters have considerable internationality and interconnectivity levels; - clusters include high concentration of SME's, R&D, and also large companies and represent high level of close cooperation between the stakeholders – this differentiates clusters	- distinguishes the following clusters as relevant for both Estonia and the region as a whole (based on the quantity, quality and sustainability criteria's of clusters): a) optics & photonics/ microsystems-/nanotechnology b) information and communication technology; c) biotechnology; - the study provides initial mapping of the clusters in Estonia and also SWOT analysis of each of the clusters;	- there is no real evidence of clusters in Porter's sense to be present in the region because of different reasons: a) Estonian biotechnology is still in embryonic stage and it is developing in 2 geographical centres (Tallinn and Tartu); at most the cluster is emerging; b) in ICT there has not been real cluster development as the companies are mostly small with no dominant leaders and are

Name of the study	Concentration of the study	Cluster definition	Approach to clusters (or approach relevant to clusters) in Estonia	General conclusion on clusters (or relevant to clusters) in Estonia
		from centre of excellence (competence centres), competency fields and innovation fields;		diffuse in the fields of application; at most the cluster is emerging; c) in optics, photonics and nanotechnology the companies do not form a notable agglomeration or cluster because of the smallness of the companies and orientation towards sub-contracting for foreign companies;
The Cluster Initiative Greenbook, 2003	- international comparison of different cluster initiatives with the aim of making general evaluation on the success and failure factors of cluster initiatives; - develops cluster initiative performance model (CIPM) that helps to map and put into the general context the relevant	- cluster initiatives (CI) are organised efforts to increase growth and competitiveness of clusters within a region, involving cluster firms, government and/or the research community; - sees clusters mainly in the Porter's sense; - encompasses both	- does not explicitly analyse the case of Estonia, but provides special attention to transition state characteristics (using the case of Slovenia); - in general, the transition state characteristics are also applicable to Estonia (as the closest approximation): a) low trust in	- most CI's concentrate on one or some (but not all) of the following targets: a) cluster expansion b) innovation and technology c) education and training d) commercial cooperation e) policy action f) research and networking;

Name of the study	Concentration of the study	Cluster definition	Approach to clusters (or approach relevant to clusters) in Estonia	General conclusion on clusters (or relevant to clusters) in Estonia
	aspects of cluster development;	local, regional and national clusters;	government b) little industry collaboration experience c) weak clusters with little local competition and foreign investment d) low awareness of clusters and CI's e) obstacles to entrepreneurship i.e. bureaucracy and lack of venture capital f) government long term commitment to CI's questioned because microeconomic programmes (FDI, education) not supporting CI's;	- every CI is unique and has to take into account the context specificity; - government plays a pivotal role in (co-) developing and (co-) financing CI's; - national social, political and economic conditions (trust in government initiatives, presence of influential policy- and decision-makers) determine the success of CI's; - CI's are a response to government initiatives (government-led) or crisis (industry-led); - CI's depend on the legacies before the initiatives and presence of a few clusterpreneurs;

Name of the study	**Concentration of the study**	**Cluster definition**	**Approach to clusters (or approach relevant to clusters) in Estonia**	**General conclusion on clusters (or relevant to clusters) in Estonia**
The Cluster Policies Whitebook, 2004	- recognises the core pivotal role of the private sector and enterprises in clustering and emergence of clusters, but tries to distinguish the possibilities and reasons for policy intervention in clustering dependent of the specific context and conditions that can be found in different settings; - distinguishes 2 generic roles of public policies a) acceleration of existing clusters i.e. *cluster developer*; b) providing the basis for the emergence of new ones i.e. *cluster facilitator*;	- based on Porter's definition of clusters; - elements seen as key to the notion of clusters: geographical concentration, specialisation, multiple actors, competition and co-operation, critical mass, life cycle, innovation (not all of the elements have to be present at all times); - innovativeness (of clusters themselves) as a key aspect of dynamic clusters and as the main policy concern; - cluster initiatives are conscious actions taken by various actors to create or strengthen clusters; - cluster policies are linked to cluster	- brings out relevant context factors that are of importance in relation to cluster policies in Estonia: a) size of the country; b) level of centralisation of the government; c) the company size differentiation of economies; d) the specificity of clustering in rural areas; e) specificity of transition economies; - distinguished four phases of clustering that are sequential and dependent on the advances of the prior phases: a) creating trust and building social capital; b) developing strategic linkages;	- the smallness of the country and it economy means fewer clusters, less resources in absolute terms, more narrow spectrum of specialised workers, disproportionately higher costs in maintaining institutions, fewer areas were innovators are likely to meet receptive business firms and competent financers; - countries with high level of centralisation of public administration and decision-making powers are characterised by more important role of the national government in cluster policies that brings about the need for coordination and harmonisation across administrative units;

Name of the study	Concentration of the study	Cluster definition	Approach to clusters (or approach relevant to clusters) in Estonia	General conclusion on clusters (or relevant to clusters) in Estonia
		initiatives; - cluster approach has a distinct focus and practical orientation (does not have to be as extensive as an innovation system approach) that allows it to make and important and operational contribution to analytical work as well as to the realms of policy-making;	c) defining a vision and strategic direction; d) undertaking action; - *"there is a need for policymakers to take into account specific characteristics of clusters and tailor competencies and learning processes to the specific needs of these clusters at the given development stage";* - *"a common pitfall is for public agencies to promote "high-tech" clusters even when the necessary preconditions for their success are lacking in a region. i.e. chasing "white elephants". Not only are policymakers often over-ambitious in support of high-tech sectors; the seem to choose the same clusters – ICT, medial*	- there is potential for clustering in economies with vast population of SMEs because of their heterogeneity, flexibility and potential for entrepreneurship and benefits of division of labour and specialisation (countries or regions where the majority of firms are directly linked to one company may not be well-suited for deploying cluster strategies because the large company may become too dominant and dictating); - sectoral differences dictate different approaches and priorities in cluster policies; - transition state characteristics (especially the classic weaknesses of SMEs –

Name of the study	Concentration of the study	Cluster definition	Approach to clusters (or approach relevant to clusters) in Estonia	General conclusion on clusters (or relevant to clusters) in Estonia
			technology or biotechnology – resulting in ever higher global costs;	reliability, access to resources and professional services, technology absorption etc.) dictate context-specific policies starting with careful trust-building between stakeholders;

Appendix 3. Selected comparative rankings of cluster-related policy fields

Table 1. Science rankings, Baltic Sea Area

Science	University/industry research collaboration		Intellectual property protection		Patenting intensity	Quality of scientific research institutions		Local availability of spec research & training services		Availability of scientists and engineers	
	Rank	Change	Rank	Change	Rank	Rank	Change	Rank	Change	Rank	Change
Germany	5	-2	1	1	12	5	0	4	-1	11	9
Finland	4	-2	3	2	8	8	-2	8	-1	4	-1
Denmark	16	-6	7	2	4	15	0	11	-6	14	-1
Sweden	3	1	8	3	13	9	2	9	8	10	4
Iceland	19	0	9	-1	7	31	-4	20	11	15	1
Norway	18	3	12	4	18	18	8	14	1	27	7
Estonia	31	4	33	1	29	29	0	28	-5	56	-8
Lithuania	54	-4	69	2	39	42	-2	47	-14	51	-15
Latvia	59	-2	71	-13	40	61	8	52	-5	97	3
Poland	40	2	56	-3	46	57	5	40	-8	61	-31
Russian Federation	58	-12	113	-10	37	35	-3	72	-22	50	-6
BSR overall	10		10		11	13		14		16	

Source: Baltic Development Forum. *State of the Region Report 2006***,** p. 40.

Table 2. Skill rankings, Baltic Sea Area.

	BCI	Extent of staff training	Availability of scientists and engineers	Quality of primary education	Quality of management schools	Quality of math and science education
Finland	3	12 (-9)	3 (2)	1 (0)	12 (-2)	3 (8)
Denmark	5	1 (3)	11 (10)	9 (2)	8 (13)	19 (18)
Sweden	4	2 (-1)	7 (5)	22 (-1)	16 (-8)	35 (-1)
Iceland	16	16 (-5)	16 (0)	16 (-5)	18 (5)	36 (-9)
Germany	2	7 (-1)	18 (-10)	25 (-5)	26 (-5)	34 (5)
BSR		16	20	22	27	30
Estonia	26	29 (0)	69 (-15)	20 (4)	32 (-4)	22 (-3)
Norway	13	11 (7)	24 (2)	21 (5)	22 (-4)	52 (3)
Lithuania	39	36 (22)	43 (-7)	37 (5)	42 (11)	17 (13)
Latvia	54	51 (-1)	101 (-12)	35 (5)	48 (2)	43 (-2)
Poland	56	64 (3)	60 (-22)	44 (-2)	43 (5)	40 (-9)
Russia	71	94 (1)	34 (-4)	48 (1)	85 (-11)	42 (-9)

Source: Baltic Development Forum, *State of the region Report 2007*, p. 52.

Appendix 4. Economic activities in Estonia based on the number of enterprises, the number of persons employed, and highest added value.

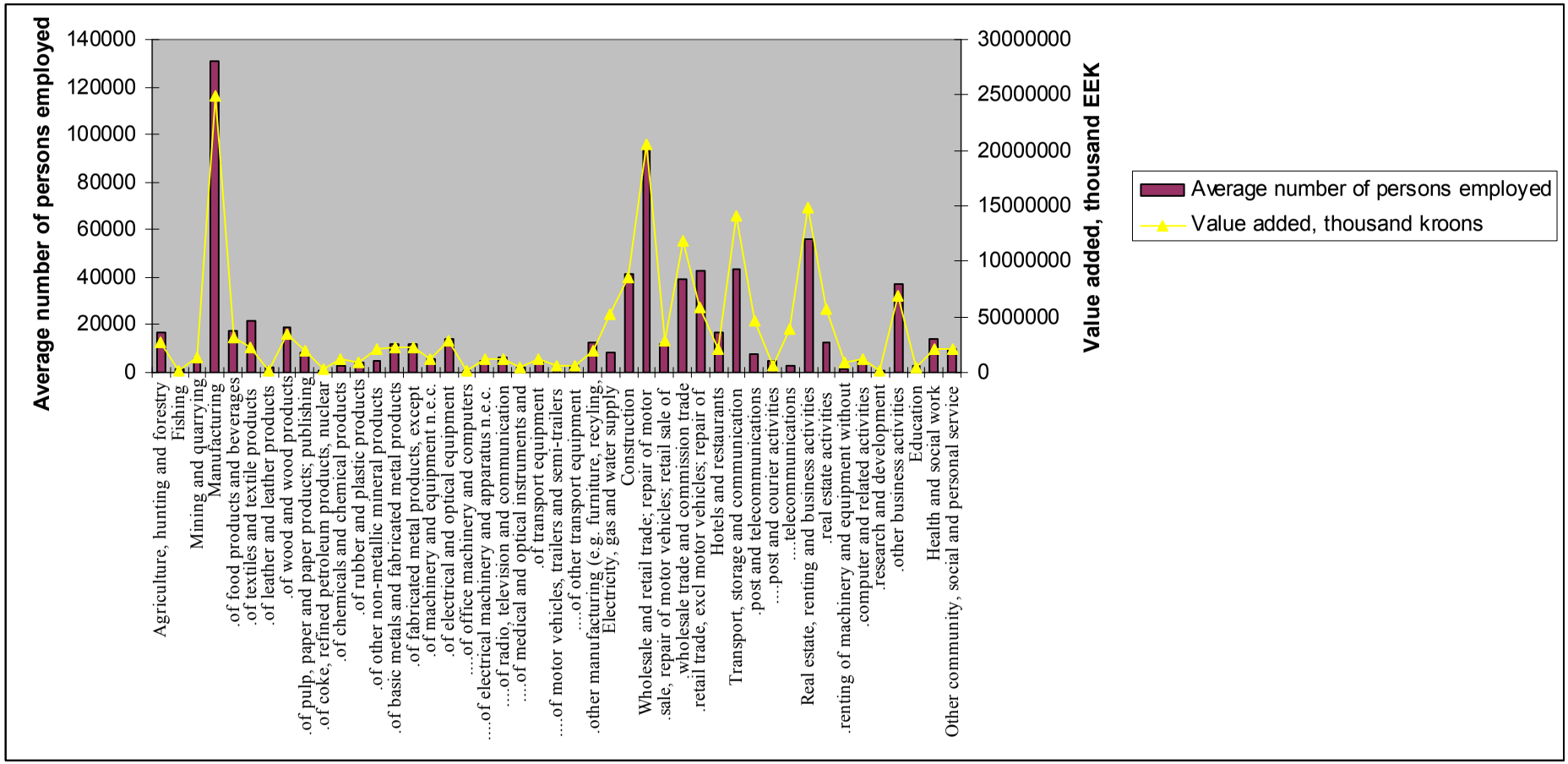
The list of economic activities according to the number of enterprises		**The list of economic activities according to the number of persons employed**		**The list of economic activities of the highest value added**	
Wholesale and retail trade; repair of motor vehicles etc.	13363	Manufacturing	130943	Manufacturing	24908916
Real estate, renting and business activities	10756	Wholesale and retail trade; repair of motor vehicles etc.	94127	Wholesale and retail trade; repair of motor vehicles etc.	20602345
..wholesale trade and commission trade	7659	Real estate, renting and business activities	56120	Real estate, renting and business activities	14841181
..other business activities	5849	Transport, storage and communication	43667	Transport, storage and communication	14092631
Manufacturing	5141	..retail trade, excl motor vehicles; repair of household goods	42840	..wholesale trade and commission trade	11888572
..retail trade, excl motor vehicles; repair of household goods	3974	Construction	41179	Construction	8556748
Construction	3742	..wholesale trade and commission trade	39302	..other business activities	6951916
..real estate activities	3384	..other business activities	36851	..retail trade, excl motor vehicles; repair of household goods	5825832
Transport, storage and communication	3240	..manufacture of textiles and textile products	21432	..real estate activities	5661603
..sale, repair of motor vehicles; retail sale of automotive fuel	1731	..manufacture of wood and wood products	18995	Electricity, gas and water supply	5263123
Hotels and restaurants	1605	..manufacture of food products and beverages	17365	**....telecommunications**	3939333
Agriculture, hunting and forestry	1393	Hotels and restaurants	16913	..manufacture of wood and wood products	3479515
Other community, social and personal service activities	1308	Agriculture, hunting and forestry	16753	..manufacture of food products and beverages	3149043
..manufacture of wood and wood products	1042	..manufacture of electrical and optical equipment	14182	**..manufacture of electrical and optical equipment**	2896969
..computer and related activities	962	Health and social work	14055	..sale, repair of motor vehicles; retail sale of automotive fuel	2887941
Health and social work	843	..manufacturing n.e.c.	12884	Agriculture, hunting and forestry	2686815
..manufacture of basic metals and fabricated metal products	743	..real estate activities	12526	..manufacture of basic metals and fabricated metal products	2304701
..manufacture of fabricated metal products, except machinery	732	..manufacture of basic metals and fabricated metal products	12240	..manufacture of textiles and textile products	2302271
..manufacture of textiles and	596	..sale, repair of motor vehicles; retail	11984	..manufacture of fabricated metal products,	2250265

The list of economic activities according to the number of enterprises		**The list of economic activities according to the number of persons employed**		**The list of economic activities of the highest value added**	
textile products		sale of automotive fuel		except machinery	
..manufacturing n.e.c.	571	..manufacture of fabricated metal products, except machinery	11880	Hotels and restaurants	2126343
..manufacture of pulp, paper and paper products; publishing	546	Other community, social and personal service activities	9807	Other community, social and personal service activities	2117783
..renting of machinery and equipment without operator	502	Electricity, gas and water supply	8553	Health and social work	2065772
....publishing, printing and reproduction of recorded media	494	..manufacture of pulp, paper and paper products; publishing	8147	..manufacture of other non-metallic mineral products	2046196
..manufacture of food products and beverages	425	**....manufacture of radio, television and communication equipment**	6639	..manufacturing n.e.c.	1909519
Education	404	....publishing, printing and reproduction of recorded media	6310	..manufacture of pulp, paper and paper products; publishing	1892671
..manufacture of electrical and optical equipment	329	Mining and quarrying	5655	....publishing, printing and reproduction of recorded media	1519580
Electricity, gas and water supply	262	..manufacture of machinery and equipment n.e.c.	5251	Mining and quarrying	1370647
..manufacture of machinery and equipment n.e.c.	254	**....manufacture of electrical machinery and apparatus n.e.c.**	5226	**..computer and related activities**	1230379
..manufacture of other non-metallic mineral products	170	..manufacture of other non-metallic mineral products	5205	..manufacture of chemicals and chemical products	1228887
..manufacture of rubber and plastic products	153	..manufacture of transport equipment	4999	**....manufacture of electrical machinery and apparatus n.e.c.**	1184938
..manufacture of transport equipment	138	**..computer and related activities**	4686	....manufacture of radio, television and communication equipment	1158161
....manufacture of medical and optical instruments and watches	136	..manufacture of rubber and plastic products	4443	..manufacture of transport equipment	1142063
Fishing	121	**....telecommunications**	3069	**..manufacture of machinery and equipment n.e.c.**	1137799
....telecommunications	109	Education	2951	..renting of machinery and equipment without operator	913155
....manufacture of other transport equipment	104	....manufacture of other transport equipment	2921	..manufacture of rubber and plastic products	890208
....manufacture of electrical machinery and apparatus n.e.c.	103	..manufacture of chemicals and chemical products	2898	....manufacture of motor vehicles, trailers and semi-trailers	581128
..manufacture of chemicals and	97	....manufacture of motor vehicles,	2078	....manufacture of other transport equipment	560935

The list of economic activities according to the number of enterprises		**The list of economic activities according to the number of persons employed**		**The list of economic activities of the highest value added**	
chemical products		trailers and semi-trailers			
Mining and quarrying	76	..manufacture of leather and leather products	1900	**....manufacture of medical and optical instruments and watches**	462929
..manufacture of leather and leather products	71	**....manufacture of medical and optical instruments and watches**	1886	Education	429915
....manufacture of radio, television and communication equipment	70	....manufacture of pulp, paper and paper products	1837	....manufacture of pulp, paper and paper products	373091
..research and development	59	..renting of machinery and equipment without operator	1693	..manufacture of coke, refined petroleum products, nuclear fuel	345780
....manufacture of pulp, paper and paper products	52	Fishing	1110	..manufacture of leather and leather products	183293
....manufacture of motor vehicles, trailers and semi-trailers	34	..manufacture of coke, refined petroleum products, nuclear fuel	1004	Fishing	182885
....manufacture of office machinery and computers	20	**....manufacture of office machinery and computers**	431	**....manufacture of office machinery and computers**	90942
..manufacture of coke, refined petroleum products, nuclear fuel	7	..research and development	364	..research and development	84128

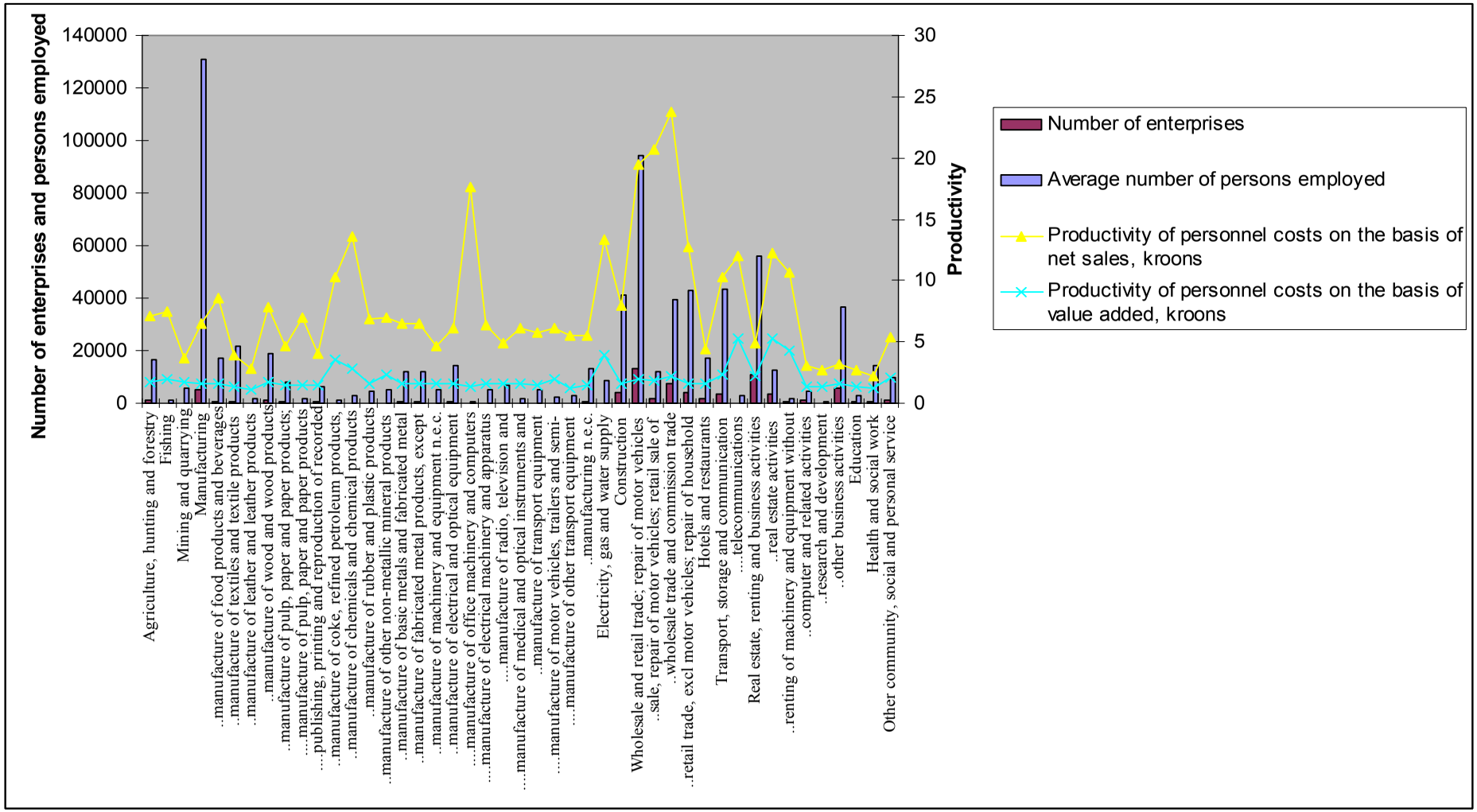
Source: Statistical Office of Estonia.

Appendix 5. ***Economic activities by average number of persons employed and created value added (thousand EEK), in 2005***



Source: Statistical Office of Estonia

Appendix 6. ***Economic activities by number of enterprises and persons employed and productivity (thousand EEK), in 2005.***



Source: Statistical Office of Estonia

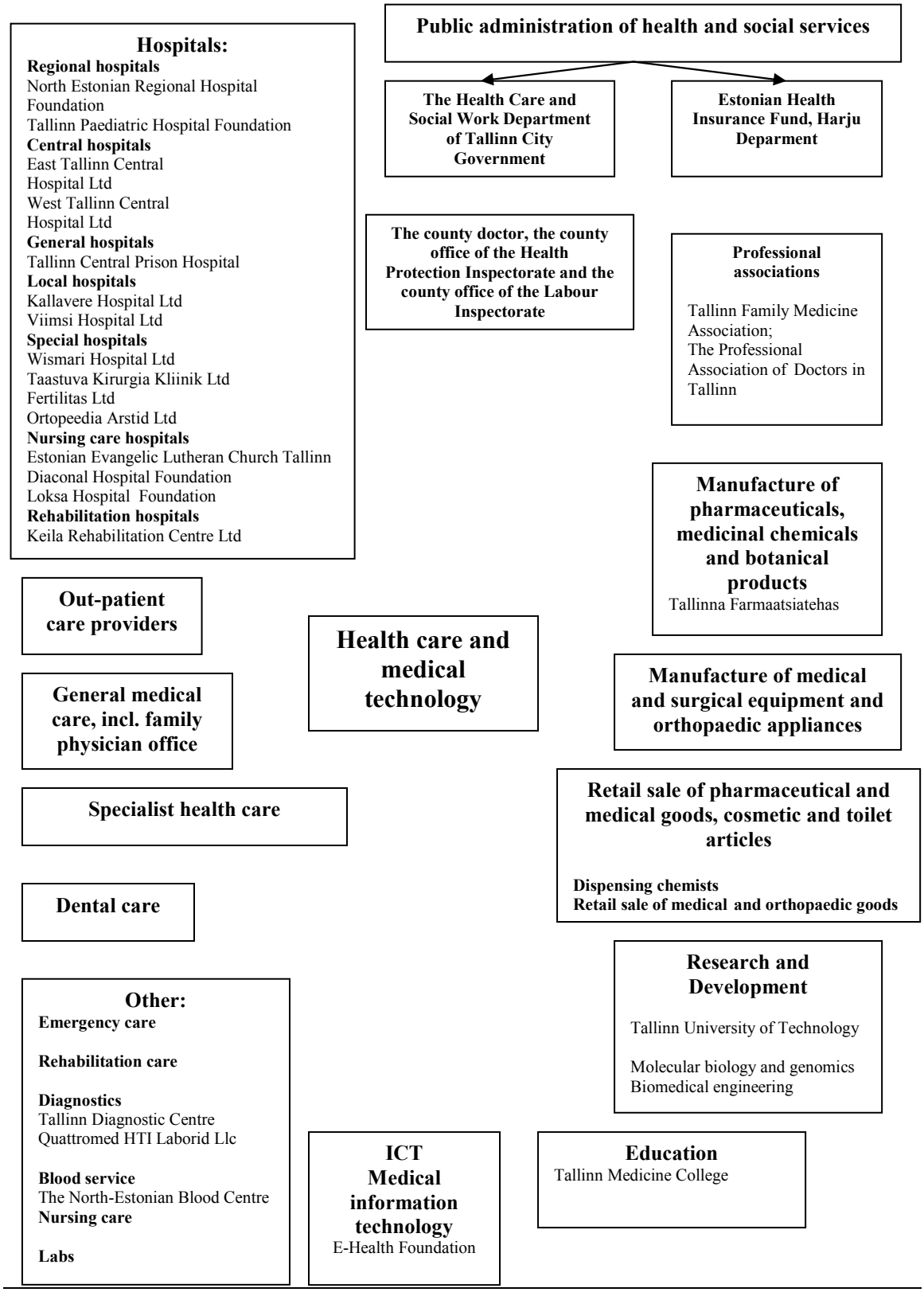
Appendix 7. ICT companies in the Äripäev TOP500 in 2006.

Name	Main activity	Year of establishment	Location	Turnover (thousand kroons)	Number of employees (2006)	Ownership	Management (CEO)
MicroLink Eesti AS	IT – software, maintenance, consultation	1996	Tallinn	280 150	260	Mixed	EST
Ordi AS	IT – assembly, sales and maintenance of computers	1992	Tartu	486 819	163	EST	EST
MarkIT.ee OÜ	IT – sales and advertisement	2003	Tallinn	299 930	23	EST	EST
Datel AS	IT – information and communication systems	1990	Tallinn	164 704	62	EST	EST
ML Arvutid AS	IT – sales and assembly of computers	1997	Tallinn	318 782	62	EST	EST
Elion Ettevõtted AS	Telecom.	1992	Tallinn	2 929 821	1323	Mixed	EST
Elisa Eesti AS	Telecom.	1997	Tallinn	239 559	-	FOR	FOR
Starman AS	Telecom.	1992	Tallinn	234 732	222	FOR	EST
Siemens AS	Telecom.	1994	Tallinn	427 673	-	FOR	EST
STV AS	Telecom.	1991	Tallinn	163 179	248	EST	EST
Ericsson Eesti AS	Telecom.	1996	Tallinn	358 879	92	FOR	EST
General DataComm International OÜ	ICT wholesale	2002	Tallinn	824 188	5	FOR	
GNT Eesti AS	IT wholesale	1992	Tallinn	954 661	47	FOR	EST

Appendix 8. Electronics companies in the Äripäev TOP500 in 2006.

Name	Main activity	Year of establishment	Location	Turnover (thousand kroons)	Number of employees (2006)	Ownership	Management (CEO)
Efore AS	Electronics	2003	Pärnu	378 528	224	FOR	FOR
Stoneridge Electronics AS	Electronics	1998	Tallinn	448 555	187	FOR	EST
Elcoteq Tallinn AS	Electronics	1993	Tallinn	1 034 211	2584	FOR	FOR
Scanfil OÜ	Electronics	1997	Pärnu	439 440	288	FOR	FOR
Incap Electronics Estonia OÜ	Electronics	2000	Kuressaare	168 941	126	FOR	EST
Tarkon AS	Electrotechnics	1996	Tartu	561 976	506	FOR (85%)	FOR
JOT Eesti OÜ	Electrotechnics	1991	Tallinn	381 660	198	FOR	FOR
Alstom Estonia AS	Energetics and electrics	2000	Tallinn	249 493	565	FOR	EST
Arrow Electronics Estonia OÜ	Wholesale - electronics	1997	Tallinn	310 466	19	FOR	EST
Schneider Electric Eesti AS	Wholesale	1995	Tallinn	161 715	37	FOR	EST

Appendix 9. The fundamental basis for cluster building in the health care and medical technology in Tallinn



Appendix 10. The list of biotechnology-related R&D institutions in Tallinn

National Institute of Chemical Physics and Biophysics	The National Institute of Chemical Physics and Biophysics is an autonomous public research institution. NICPB, located 8 km west of the centre of Tallinn, is divided into laboratories of bio-organic chemistry, bioenergetics, molecular genetics and chemical physics. The research activities range from studying fundamental aspects to applications. Strong emphasis is given to the deployment of modern physical methods in chemistry and biochemistry. *Areas of Research:* ☐ molecular neurobiology ☐ fundamental cancer biology ☐ molecular diagnostics ☐ genetic plant engineering ☐ plant virology ☐ cell metabolism and engineering ☐ immunology ☐ macromolecular structural analyses
Technomedicum	Was founded in Tallinn University of Technology in 2006 as a study, research- and development centre (http://www.ttu.ee/?id=1150). The aim of the institution is to connect to each other medical and technical knowledge for human health and well-being. This is the innovative and interdisciplinary institution involving the Institute of Biomedical Engineering, Institute of Medical Physics, and Cardiology Center.
Biomedical Engineering Centre of Tallinn University of Technology	Biomedical Engineering Centre is a research centre for interdisciplinary studies engaged in under and post-graduate studies (http://www.cb.ttu.ee/). The Centre is a structural unit within the Tallinn University of Technology Faculty of Science, incorporating chairs inside its nucleus structure and other research and medical institutions as associated members, engaged in biomedical engineering research. *Areas of Research:* BME integrates physical, mathematical and life sciences and engineering principles for the study of biology, medicine and health systems and for the application of technology to improving health and quality of life. More specifically: ☐ Interpretation of bio signals (e.g. EEG, ECG) ☐ Bioelectrical signals, visual cognitive processes and external modulated microwave field ☐ Optical methods in medical diagnostics. This is a Centre of Excellence in Research and financed by the EU Structural Funds in the framework of the Centres of Excellence in Research program of Enterprise Estonia.
Centre of Excellence in Electronics an Bionics EBIT	*Areas of Research:* ☐ Modelling, simulation, and design of structures and devices based on wide band gap semiconductor materials (SiC, GaAs, GaN, C (Diamond)), including developing of metallization technologies for their fabrication ☐ Circuits and systems for medical electronics, including implantable devices for cardiac monitors and pacemakers, and means for surveillance of transplanted organs and tissues This is a Centre of Excellence in Research and financed by the EU Structural Funds in the framework of the Centres of Excellence in Research program of Enterprise Estonia.
Institute of Gene Technology of Tallinn University of Technology	The mission of Tallinn University of Technology is to provide educational, research and innovation services in the fields of engineering and entrepreneurship, which are internationally competitive and significant for Estonia's sustained development. *Areas of Research:* ☐ gene technology ☐ genomics and proteomics ☐ molecular biology ☐ molecular diagnostics
Centre for Biotechnology and Gene Technology of Tallinn University of Technology	The main aim of the centre is to offer high-quality infrastructure and additional know-how for the efficient and effective use of the intellectual potential of Tallinn and its nearby cities (incl. Tartu, Helsinki, Stockholm) for a solid basis of high-level research and development work in biotechnology and biomedicine. Centre was founded in 2002. The centre targets its activities to the following areas: ☐ Project promotion and monitoring ☐ Support to the development of common infrastructure for all companies and projects under the centre

	☐ Establishment of core facilities providing service and access to hard equipment both for projects functioning within the centre as well as for academic structures of the Faculty of Science of Tallinn University of Technology ☐ Investment promotion ☐ Training and consulting in business development ☐ Reinforcement of education and additional training in relevant areas ☐ Networking with scientific institutions, business community and third sector organizations, especially in the nearby cities and countries.
National Institute for Health Development	The mission of the institute is the consistent promotion of the health of the Estonian population and the permanent rise of the quality of life through the knowledge-based development and applied research activities.

Source: the web-page of *Estonian Genome Foundation* – http://www.genomics.ee; the web-page of *Tallinn University of Technology* - http://www.ttu.ee; *Biotech Estonia*. 1/2007 (4) – the web-page of *Estonian Biotechnology Association*; Merirand, M. "Biotechnology in Estonia" – http://www.investinestonia.com; *Estonian Biotechnology Strategy*.

Appendix 11. The list of biotechnology companies in Tallinn

Name	Field of activity	Foundation year
Bestenbalt LLc	Proteomics-related services including production, purification and identification. Specializes on production and analysis of recombinant and natural proteins, peptides, and other naturally occurring bioactive compounds. The research is focused on drug development for major diseases such as diabetes and Alzheimer's disease.	2002
BimKemi Eesti Ltd	BimKemi Eesti Ltd is specialized on pulp, paper and board industries. Our activities are conducted with product quality, environment protection and resource savings.	1998
Bioexpert Ltd	Activities for food processing industry, laboratory equipment and sale of chemicals.	1996
Cancer Clinic Ltd	Cancer Clinic specializes on prevention and diagnostics in the field of oncology and supporting treatment and counselling of cancer patients.	2005
Celecure Group (IBCC Holding Ltd)	The group joins research and development companies Celecure Ltd, Inbio Ltd and Cancer Clinic Ltd.	1999
Celecure Ltd	Celecure is the leading Estonian biotech R&D company that develops new anticancer drugs and diagnostic methods. Current business strategy is to perform discovery and pre-clinical studies of new generation anticancer drug candidates and research and development of breakthrough diagnostic methods.	2002
CeMines Estonia Llc	Cancer biomarker research.	2004
Competence Centre for Cancer Research (CCCR)	The centre (http://www.vtak.ee/) has emerged from the Institute of Gene Technology of Tallinn University of Technology. CCCR is a competence centre, where cancer research projects are carried out in the fields of developing and implementing new technological platforms for early diagnostics of cancer and developing new generation cancer drugs. The project portfolio of CCCR currently includes 8 projects – 5 in drug development and 3 in diagnostics. A competence centre was set up in 2005 in co-operation between 8 different partners, involving Tallinn University of Technology, North Estonian Regional Hospital and companies in Estonia and abroad (Trial Form Support TFS AB, CeMines Estonia Ltd, Prosyntest Ltd, Kevelt Ltd, Celecure Ltd, Inbio Ltd. CCCR is financed by the founding partners and EU Structural Funds in the framework of the Competence Centres program of Enterprise Estonia.	2005
Competence Center of Food and Fermentation Technologies Llc	Apply and develop modern methods to improve food quality, functionality and storage properties; development and application of novel cultivation techniques.	2005
IBCC Holding Ltd	Research and development in the field of biotechnology.	2004
Inbio Ltd	Custom antibody services and peptide synthesis; research and development in the field of cell-membrane penetrating antibody technologies. Distribution of supplies and devices to research and clinical laboratories in Estonia. InbioLabs is a fast growing biotechnology company with 2 separate business units: - Custom services of peptide synthesis and antibody production. - Research and development of Entrybody technology and EntryPEP Kit.	1999
Kevelt Ltd	Production of sterile pharmaceuticals and bioactive eicosanoids for scientific purposes). Another activity is drug development and manufacturing.	1998
Labema Eesti Llc	Labema Eesti is a subsidiary of a Finnish company specializing in importing, marketing and delivering quality products for microbiology and clinical diagnostics.	1996
LabExpert Llc	Sales and Service of Laboratory Equipment for chemical and microbiology laboratories. Lab Expert is sales and Service agent of FOSS Electric (Denmark), FOSS Tecator(Sweden),	2000
Mikrolabor Llc	Production and sales of laboratory equipment and accessories.	2001
MoleCode Ltd	Delivers highly expert consultations and research on the computational modelling of chemical reactivity and molecular properties, and on the molecular design of new chemical compounds, drugs and materials.	2004

Name	Field of activity	Foundation year
ProSyntest Ltd	Manufacturing of fine chemicals and developing of chemical processes and new synthetic procedures as well as manufacturing pharmaceutical active ingredients and advanced intermediates.	1998
ProtoBioS Llc	Stem cell based cell therapy (generative medicine), drug design based on treatment of transcriptional mechanism.	2003
Quattromed HTI Laborid (partially)	Medical diagnostics, laboratory diagnostics, molecular diagnostics, magnetic resonance tomography. Quattromed Ltd, the spin-off company of the University of Tartu, acquired 80% of the shares of HTI Laboriteenused Ltd. This transaction laid the foundation for Estonia's largest company that offers biomedical products and services.	2006
Riistakast Llc	Genomic toolbox	2004

Source: *BiotechEstonia*. 1/2007 (4) – the website of *Estonian Biotechnology Association*; *Estonian Biotechnology Strategy*; Merirand, M. „Biotechnology in Estonia" – http://www.investinestonia.com. For the latest information see the *Estonian Biotechnology Strategy* that has been in preparation for the duration of the currents study.