Analysis of Estonian Business Structure and Competitiveness:

Present situation and future development challenges

Report prepared for the Estonian Ministry of Finance

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and

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1 Introduction

The present report arose out of a project undertaken for the Ministry of Finance that consisted of four separate assignments:

i. The analysis of business structure and competitiveness at the macro-sectoral level

ii. The analysis of business structure and competitiveness at the firm level

iii. Analysis of the impacts of the Estonian NDP

iv. Exploration of alternative Estonian development scenarios

The material in this report deals with the combination of topics (ii) and (iv) above, and the other two aspects are the subject of separate reports (see Bradley, 2006a and 2006b). The report on Assignment 1 presented the updating of the HERMIN-HE4 model of the Estonian economy together with a new HERMIN-HEN model that contained disaggregated manufacturing and market services sectors. The report on Assignment 3 presented a detailed SPD macro-evaluation methodology, together with analysis of the impacts of SPD 2004-2006, both in the case of the planned SPD expenditures for the full three years and for the actual expenditures for the years 2004-2005.

The present report combines Assignments 2 and 4 of the original contract and was intended to provide a deeper background to the macroeconomic modelling analysis. The report is structured as follows. In chapter 2 we make use of the macro-sectoral database from the HERMIN-HE4 and HERMIN-HEN models to examine the structure and performance of the Estonian economy over the 1990s, up to the year 2004, the date for which the most recent data are available. Although some useful insights can be obtained from this analysis, we conclude that it is necessary to examine structure and performance at the level of individual firms to understand better the development potential of the economy.

In chapter 3 we describe the framework that we will use for the examination of the competitiveness of Estonian manufacturing, from the perspective of individual firms. Two issues are examined in detail: first, the nature of the capability triad of production capabilities, business models and skill formation; and second, the issues of specialization and clusterization, two mutually reinforcing processes. We identify a series of development challenges that face Estonian firms as the country integrates further into the EU single market.

Our main presentation of firm-based competitiveness is given in chapter 4, where we identify seven categories of firms: mass production outsourcing; technology specialization outsourcing; flexible specialization; multi-business networks; leveraging of natural resources; knowledge-intensive clusters; and non-tradeables.

In chapter 5 we summarise our main conclusions, using a standard SWOT framework in order to identify the most important issues. Our main policy recommendations are presented in terms of ten proposals that should serve as a guide to Estonia’s evolving industrial strategy.

Chapter 6 takes up issues related to EU investment aid and the role that EU Structural Fund development assistance can play in underpinning the implementation of Estonian industrial development strategy. We use the case of Ireland (an economy that has similarities to
to illustrate the complex, dynamic nature of these relationships, and suggest that the path that Ireland followed may supply some interesting insights for Estonian policy makers, at least in terms of the strategic intent, if not the detailed choices, since these will be specific to Estonia’s development needs.

Our concluding Chapter 7 takes up the broad themes of catch-up and convergence, key goals for Estonian policy makers. In the case of Estonia, we are aware that the preparations for SPD 2007-2013 are taking place within the context of the Lisbon Agenda for the European Union and, in particular, the *Estonian Action Plan for Growth and Jobs*, published in October 2005. The present report argues that a good approach to ensuring that SPD 2007-2013 is appropriate, efficient and effective, and prepares the infrastructural and human capital groundwork for the implementation of the Lisbon Agenda in Estonia, would be to build it upon a deeper firm-specific knowledge of the existing state of Estonian competitiveness. The report emphasizes the critical importance of shifting from a science-push to a enterprise-led approach to innovation anchored in new product development and technology management capabilities, and provides guidelines as to how this might be achieved.

2.1 Introduction

The key challenge of policy making in any small nation can be characterised as that of blending the techniques and insights of the conventional economic analysis of what one might call the outer business environment with those of the more focused business analysis of the middle ground of strategy. These two areas are often studied in isolation from each other by non-overlapping groups of researchers. When cross references are made between the two areas of research, each separate group tends to focus on the inadequacies of the other’s methodology. Seldom if ever are the two different perspectives looked at as being entirely complementary and mutually supportive.

Business policy research tends to be focused on the performance of individual firms or groups of firms. Economic policy research, on the other hand, and in particular strategic trade and macroeconomic research, tends to be directed at issues and challenges that arise at the level of regions, nations or even groupings of nations such as the EU. For example, this distinction has been made in the analysis of the competitive advantage of nations, where it is seen to be more helpful to consider firms as competing in industries, not in nations (Porter, 1990:619, 682). This insight lies at the heart of the tensions that can arise between the mainly firm-based perspective of business researchers and the mainly regional/national-based perspective of economists, particularly in matters concerning the design and execution of industrial policy.

At the risk of over simplification, one might stylize conventional economic theories (such as serve to underpin the Estonian HERMIN model) as being useful for the study of how a “representative” firm is likely to behave when subjected to changes in the wider external policy environment. Business research frameworks, on the other hand, tend to be focused on the analysis of the consequences of management actions that are intended to improve the prospects of a “specific” firm within a given (usually fixed) external policy environment. Because of this very basic difference in the main emphasis of their disciplines, economic and business researchers often tend to discount or ignore each other, but can sometimes adopt dismissive attitudes towards each others’ methodologies and insights. This is unfortunate, since the two groups ideally should have interests that are entirely complementary. In this report we take a small step towards integrating these two perspectives in our examination of competitiveness in Estonia.

This chapter is organised as follows. In the next section we set out a very simple representation of the “portfolio” of industrial activities in Estonia, starting in the year 1997 (the first for which we have access to sub-sectoral data in manufacturing), and concluding in the year 2004 (the most recent data). Against this background, we then present an overview of the performance of the Estonian economy, paying particular attention to manufacturing activities. We start with the aggregate economy, where the growth performance of GDP has been impressive. We then move down to the level of four-sector disaggregation that is used in the HERMIN-HE4 macro model (manufacturing, market services, agriculture and government). We then disaggregate manufacturing further into the six sectors that are

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1 Business researchers tend to disparage as irrelevant the older approaches to trade and growth theory and to ignore the major advances that have been made in recent decades. Economists tend to criticize the lack of formal testing of the validity of business frameworks (Kay 1983).
currently used in the larger HERMIN–HEN macro model. We conclude with some observations on performance at the highest level of disaggregation (16 sectors).

2.2 The Estonian portfolio of manufacturing activities

In a large economy like the USA, Japan or Germany, one expects to find most manufacturing sectors broadly represented in what one might call the economy's sectoral portfolio. In small open economies like Estonia, however, producers need to specialize in a narrow range of products, sell in highly competitive export markets, and consumers as well as producers import the goods not produced at home. By way of illustrative example, in the Irish economy, the degree of sectoral concentration by the end of the 1990s was extreme, and had been evolving in this way since the early 1960s. Based on the Census of Industrial Production data for the year 1998, Ireland's manufacturing portfolio is shown in Table 2.1, where the two digit NACE sectors are ranked in descending order of their share of gross output.

Some key characteristics of the Irish manufacturing portfolio in the year 1998 stand out:

i. Electrical and Optical Equipment (NACE 30-33) was the predominant sector in terms of gross output share (29 per cent), and in terms of employment share (25 per cent). This sector experienced a high average real output growth of about 16 per cent per year over the seven year period 1991-98.

ii. Chemicals (including pharmaceuticals) and Man-made Fibres (NACE 24) had the second largest output share (24 per cent), but a lower employment share (9 per cent), since it is capital intensive and displays high labour productivity. This sector also experienced very high output growth (about 24 per cent per year in real terms over 1991-98).

iii. Food Products, Beverages and Tobacco (NACE 15-16) was the third largest sector in terms of output share (21.4 per cent), with a similar employment share (19 per cent). However, average annual real output growth was relatively modest (about 5.5 per cent per year over 1991-98).

iv. The only other sector with a double digit output share was Pulp, Paper and Paper Products, Publishing and Printing (NACE 21-22), with output share of 10.4 per cent and employment share of 9.6 per cent. This is also a high growth sector (14.5 per cent per year for real output over 1991-98).

v. For all the other sectors, output shares were very small, ranging from a high of 2.7 per cent (Basic Metals and Fabricated Metal Products, NACE 27-28) to a low of 1 per cent (Wood and wood products, NACE 20), with real output growth rates considerably lower than the manufacturing average of 14 per cent per year.

---

2 Defined in terms of the ratio of exports and imports to GDP, Estonia has one of the most open economies in the world.

3 We select 1998 rather than the latest available CIP data for 2003, since this was the peak year of the influx of (mainly US) high technology foreign direct investment into Ireland.

4 It should be noted that an element of the output of the software sector is classified in NACE 21-22, and includes such items as computer manuals and the production of CD-ROMS.
### Table 2.1: Sectoral portfolio in Irish manufacturing: 1990-1998

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical &amp; Optical Equipment</td>
<td>13831</td>
<td>28.6</td>
<td>3848</td>
<td>16.3</td>
<td>59830</td>
<td>24.6</td>
</tr>
<tr>
<td>Chemicals &amp; Man-made Fibres</td>
<td>11728</td>
<td>24.2</td>
<td>2685</td>
<td>24.1</td>
<td>21432</td>
<td>8.8</td>
</tr>
<tr>
<td>Food, drink &amp; Tobacco</td>
<td>10381</td>
<td>21.4</td>
<td>7807</td>
<td>5.4</td>
<td>46286</td>
<td>19.1</td>
</tr>
<tr>
<td>Paper &amp; Printing</td>
<td>5018</td>
<td>10.4</td>
<td>1645</td>
<td>14.5</td>
<td>23237</td>
<td>9.6</td>
</tr>
<tr>
<td>Basic Metals &amp; Fabricated Metal Products</td>
<td>1301</td>
<td>2.7</td>
<td>869</td>
<td>1.7</td>
<td>14920</td>
<td>6.1</td>
</tr>
<tr>
<td>Other Machinery &amp; Equipment</td>
<td>1196</td>
<td>2.5</td>
<td>732</td>
<td>8.0</td>
<td>14352</td>
<td>5.9</td>
</tr>
<tr>
<td>Other Manufacturing n.e.s.</td>
<td>1207</td>
<td>2.5</td>
<td>771</td>
<td>5.1</td>
<td>12164</td>
<td>5.0</td>
</tr>
<tr>
<td>Other Non-Metallic Mineral Products</td>
<td>917</td>
<td>1.9</td>
<td>582</td>
<td>8.2</td>
<td>9947</td>
<td>4.1</td>
</tr>
<tr>
<td>Rubber &amp; Plastics</td>
<td>855</td>
<td>1.8</td>
<td>515</td>
<td>4.1</td>
<td>10516</td>
<td>4.3</td>
</tr>
<tr>
<td>Textiles, Clothing &amp; Leather</td>
<td>777</td>
<td>1.6</td>
<td>808</td>
<td>-2.7</td>
<td>15620</td>
<td>6.4</td>
</tr>
<tr>
<td>Transport Equipment</td>
<td>749</td>
<td>1.5</td>
<td>406</td>
<td>5.3</td>
<td>9286</td>
<td>3.8</td>
</tr>
<tr>
<td>Wood &amp; Wood Products</td>
<td>469</td>
<td>1.0</td>
<td>230</td>
<td>6.7</td>
<td>5092</td>
<td>2.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>48429</strong></td>
<td><strong>100.0</strong></td>
<td><strong>20127</strong></td>
<td><strong>13.9</strong></td>
<td><strong>242772</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Source: Census of Industrial Production, 1991 and 1998

In summary, by the late 1990s Irish manufacturing was very heavily concentrated into a few sub-sectors. The predominant specialization was in two high growth, high technology sectors (Electrical and Optical Equipment - NACE 30-33 - and Chemicals, Chemical Products and Man-made Fibres - NACE 24) and one traditional, fairly capital intensive, slow growth sector (Food Products, Beverages and Tobacco - NACE 15-16). These three sectoral groupings accounted for 74 per cent of gross output and 53 per cent of employment in total manufacturing. Although the remaining sectoral groupings in manufacturing had a low output share (26 per cent), they were more labour intensive and accounted for 47 per cent of employment.

The situation in Estonia today is very different, for many reasons. First, the period of liberal market development has been brief, compared to the four decades of Irish sectoral specialisation and evolution. Not all the patterns of sectoral allocation inherited from the previous Soviet system of central planning have been removed. Second, the concept of industrial strategy is relatively new in Estonia, and sectoral evolution does not yet benefit from the kind of sustained high level public sector investment in physical infrastructure and human resources that has characterised development in the cohesion countries of the “old” EU (i.e., Greece, Ireland, Portugal and Spain).

In Table 2.2 we set out a sectoral portfolio of Estonian manufacturing, drawing on the available data from 1997 to 2004. The purpose is to identify any trends towards specialisation over this seven-year period, although the task is hampered by the short run of data.
Table 2.2: Sectoral portfolio in Estonian manufacturing: 1997-2004

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Food products, beverages &amp; tobacco</td>
<td>3683.9</td>
<td>15.9</td>
<td>2367.9</td>
<td>1.8</td>
<td>21,300</td>
<td>15.1</td>
</tr>
<tr>
<td>Wood and wood products</td>
<td>3456.8</td>
<td>14.9</td>
<td>975.3</td>
<td>16.5</td>
<td>22,900</td>
<td>16.3</td>
</tr>
<tr>
<td>Electrical and optical equipment</td>
<td>2226.9</td>
<td>9.6</td>
<td>832.1</td>
<td>14.1</td>
<td>12,900</td>
<td>9.2</td>
</tr>
<tr>
<td>Basic metals &amp; fabricated metal products</td>
<td>2169.4</td>
<td>9.4</td>
<td>624.7</td>
<td>18.5</td>
<td>14,400</td>
<td>10.2</td>
</tr>
<tr>
<td>Manufacturing n.e.c.</td>
<td>1935.7</td>
<td>8.4</td>
<td>903.6</td>
<td>8.6</td>
<td>15,300</td>
<td>10.9</td>
</tr>
<tr>
<td>Other non-metallic mineral products</td>
<td>1409.4</td>
<td>6.1</td>
<td>528.2</td>
<td>9.0</td>
<td>4,100</td>
<td>2.9</td>
</tr>
<tr>
<td>Machinery &amp; equipment n.e.c.</td>
<td>1317.5</td>
<td>5.7</td>
<td>282.1</td>
<td>21.9</td>
<td>3,400</td>
<td>2.4</td>
</tr>
<tr>
<td>Transport equipment</td>
<td>1273.3</td>
<td>5.5</td>
<td>554.2</td>
<td>12.4</td>
<td>7,300</td>
<td>5.2</td>
</tr>
<tr>
<td>Publishing and printing</td>
<td>1268.4</td>
<td>5.5</td>
<td>436.3</td>
<td>1.9</td>
<td>7,000</td>
<td>5.0</td>
</tr>
<tr>
<td>Wearing apparel, fur</td>
<td>1053.3</td>
<td>4.6</td>
<td>638.1</td>
<td>2.9</td>
<td>11,500</td>
<td>8.2</td>
</tr>
<tr>
<td>Textiles</td>
<td>1039.7</td>
<td>4.5</td>
<td>598.7</td>
<td>8.0</td>
<td>10,400</td>
<td>7.4</td>
</tr>
<tr>
<td>Rubber and plastic products</td>
<td>817.5</td>
<td>3.5</td>
<td>263.0</td>
<td>20.5</td>
<td>3,600</td>
<td>2.6</td>
</tr>
<tr>
<td>Coke, petroleum prods, chemicals</td>
<td>742.6</td>
<td>3.2</td>
<td>446.8</td>
<td>5.2</td>
<td>3,400</td>
<td>2.4</td>
</tr>
<tr>
<td>Pulp, paper, paper products</td>
<td>332</td>
<td>1.4</td>
<td>173.7</td>
<td>11.9</td>
<td>Incl in pub.</td>
<td>Incl in pub.</td>
</tr>
<tr>
<td>Leather and leather products</td>
<td>143.1</td>
<td>0.6</td>
<td>134.4</td>
<td>-3.3</td>
<td>3,200</td>
<td>2.3</td>
</tr>
<tr>
<td>Total manufacturing</td>
<td>23133.6</td>
<td></td>
<td>9987.6</td>
<td>9.1</td>
<td>140,900</td>
<td></td>
</tr>
</tbody>
</table>

Source: Unpublished data from the Estonian Statistics office

Some key characteristics of the Estonian manufacturing portfolio in the year 2004 stand out:

i. Food Products (NACE 15-16) is the largest sector in terms of GDP share (15.9 per cent), and second in terms of employment share (15.1 per cent). This sector experienced a very low average real output growth of about 1.8 per cent per year over the seven year period 1997-2004.

ii. Wood and Wood Products (NACE 20) had the second largest output share (14.9 per cent), but had the highest employment share (16.3 per cent). This sector experienced very high output growth (about 16.5 per cent per year in real terms over 1997-2004).

iii. After the above two sectors, with their double digit GDP shares, all the rest are in single digits. Three sectors are clustered in terms of GDP share, ranging from 9.6 per cent (Electrical & Optical Equipment: NACE 30-33); 9.4 per cent (Basic metals: NACE 27-28); and 8.4 per cent (Manufacturing n.e.c.: NACE 36-37). The first two experienced high average growth rates (14.1 per cent and 18.5, respectively), and the last as more modest 8.6 per cent. The employment share in all three was in the range 9-11 per cent.

iv. The next group of sectors have GDP shares ranging from 6.1 per cent (Other Non-metallic Mineral Products: NACE 26) down to 3.2 per cent (Coke, Petroleum Products,

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5 Tiits (2006; 32) suggests that a considerable part of manufacturing n.e.c. is actually manufacturing of furniture. Taking this into account he calculates that the ‘wood cluster’ contributed 37% of manufacturing value added in 1993 and 52.2% in 2003.
The employment shares fluctuated between a high of 8.2 per cent (Wearing Apparel: NACE 18) to a low of 2.4 per cent (Machinery & Equipment n.e.c.: NACE 29; and Coke, Petroleum Products and Chemicals: NACE 23-24).

The comparison of the Irish and Estonian sectoral portfolios is interesting for a few reasons. First, the degree of specialisation is considerably more advanced in the case of Ireland, and can be traced back to a very deliberate aim of Irish industrial strategy (i.e., to attract a large share of foreign direct investment in the two high technology areas of Computers and of Pharmaceuticals) or to the optimal use of the modernising agriculture sector (e.g., high quality food products, often with foreign participation). The high share of Printing & Publishing in Ireland partially reflects the demand for specialised printing services in the two high technology areas of specialisation (e.g., computer manuals and high quality labelling).

Second, the range of smaller sectoral shares in Estonia suggests that manufacturing is still in a period of transition from the previous areas of specialisation towards new areas. For example, the high share of GDP and employment but the low average growth rate in Food Products suggests that this sector may be poised to make a similar transition to the Irish case. The high and almost equal shares of GDP and employment in Wood and Wood Products suggests that this sector is still organised along traditional lines, but may also be poised for change. This issue will be taken up in the following sections of the chapter.

The case of Clothing and Textiles is also interesting. Together, these two sectors account for 9.1 per cent of GDP and 15.6 per cent of employment, suggesting very labour intensive structures. In the case of Ireland, the output share has fallen to 1.6 per cent, and the employment share is at 6.4 per cent. But this conceals the fact that the textiles subsector in very small, while the clothing sector had mutated towards a high fashion, high value-added niche.

Of course, such aggregate analysis can only yield weak insights. Indeed, the use of NACE categories often conceals the fact that subsectors that are often regarded as “traditional” can often harbour individual firms, or small clusters of firms that make optimum use of state-of-the-art technology and modern management strategies. These aspects will also be explored in the following sections.

2.3 The performance of the manufacturing sector over time

The analysis of the previous section was static, in that it looked at the manufacturing portfolio at a point in time (the year 2004), and only noted movement from the initial year of the data sample (1997). In this section we examine the aggregate and disaggregated time series properties of the manufacturing sector, drawing on the database that was constructed to support the HERMIN-HEN model. We also make limited use of the econometric analysis that was carried out in the course of constructing and implementing that model.

2.3.1 Aggregate economic growth

The database used in constructing the HERMIN-HE4 model extends from the year 1994 to 2004. Table 2.3 summarises the broad pattern of growth in the Estonian economy over this period.
This period is interesting, since it followed the process of post-transition collapse and restructuring that was repeated in all the post-Communist countries. After the major institutional changes were put in place in Estonia – such as the Currency Board, privatisation, constitutional limits on public sector deficits, price deregulation, etc. - Estonia faced the daunting medium-term challenge of convergence to EU average living standards, starting from a low base. These challenges had been previously faced by Greece, Ireland, Portugal and Spain, but the convergence gap was not as large in their cases as it was in Estonia. Nevertheless, the process of Estonian convergence is very similar to that of the older EU cohesion countries, and having benefited form the year 2004 from the first major programme of Structural Fund assistance, will soon benefit from access to even larger Structural Fund assistance during the next SPD that will operate for the seven year period 2007-2013.

Over the period 1994-2004, it is clear from Table 2.3 that aggregate growth of GDP (GDPFCDOT) was strong for all years except 1999, the year of the Russian crisis. Towards the end of the period, growth was at about twice the EU average, so the Estonian economy was converging strongly towards the EU average level of GDP, albeit from a very low base. Perhaps it is not surprising that employment growth (LDOT) was very weak and negative for the first seven years. Unusually, investment growth (IDOT) was lower in the second half of the period compared to the first half.

Overall productivity growth (LPRODDOT) was very high, and peaked at 12.3 percent in the year 1997. The aggregate investment/GDP ratio (IRAT) was also high. Although price inflation (PGDPFCDT) was very high in the years 1994 to 1999, it declined rapidly after 1999 and ended at not much higher than the EU average by 2004. However, aggregate inflation in average annual earnings (WNADOT) remains high, and ended the period at 10.6 percent. But due to the overall high growth rate of productivity (LRODDOT), inflation of unit labour costs (ULCNADOT) was modest, and real unit labour costs (RULCNADT) declined.

The level of unemployment (UR) remained stubbornly high and ended the period at 11.4 percent of the labour force. Finally the public sector borrowing requirement (in its national accounting definition) was modest (and was approximately in balance in its GFS definition), but the net trade balance was heavily negative, peaking at 10.9 per cent of GDP in the year 1996, and ending the period at 7.8 per cent of GDP in 2004.
## Table 2.3: Aggregate growth processes in Estonia

<table>
<thead>
<tr>
<th>Date</th>
<th>GDPFCDOT</th>
<th>LDOT</th>
<th>IDOT</th>
<th>LPRODDOT</th>
<th>IRAT</th>
<th>PGDPFCDT</th>
<th>WNADOT</th>
<th>ULCNADOT</th>
<th>RULCNADOT</th>
<th>UR</th>
<th>GBORR</th>
<th>NTSVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>-1.6</td>
<td>-3.4</td>
<td>9.2</td>
<td>1.8</td>
<td>25.8</td>
<td>36.7</td>
<td>54.4</td>
<td>52.9</td>
<td>11.8</td>
<td>7.1</td>
<td>-1.6</td>
<td>-10.3</td>
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### Notation:

GDPFCDOT : Growth rate of real GDP at factor cost  
LDOT : Growth rate of total employment  
IDOT : Growth rate of total real gross fixed capital formation  
LPRODDOT : Growth rate of economy-wide labour productivity  
IRAT : Total investment, expressed as a percentage of total GDP  
PGDPFCDT : Inflation rate of deflator of aggregate GDP at factor cost  
WNADOT : Inflation rate of average annual earnings in the non-agriculture sector  
ULCNADOT : Inflation rate of nominal unit labour costs in the non-agriculture sector  
RULCNADOT : Inflation rate of real unit labour costs in the non-agriculture sector  
UR : Unemployment expressed as a percentage of the total labour force (ILO definition)  
GBORR : Public sector fiscal balance, expressed as a percentage of GDP (national accounting definition)  
NTSVR : Net trade balance, expressed as a percentage of GDP
2.3.2 Broad sectoral growth

It is difficult to interpret aggregate growth without looking at the growth patterns and processes at a level of sectoral disaggregation. The first stage of disaggregation is the one used in the HERMIN-HE4 model of Estonia, and involves four broad sectors: manufacturing (T), market services (N), agriculture (A) and government (G). Table 2.4 displays the evolution of the shares of GDP over time.

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The share of manufacturing (OTSHR) started the period in 1994 at only 14.9 per cent, due largely to the massive shedding of manufacturing capacity in the immediate aftermath of liberalisation in 1992. However, by the year 2004, the share of manufacturing output in total GDP had increased to just below 20 per cent, a figure that is close to the average for similar small EU member states. The share of market services (ONSHR) remained fairly steady, at 65 per cent of total GDP, as did the share of the public sector (at about 12-13 per cent of GDP). Finally, the share of agriculture fell steadily, from 7.3 per cent in 1994 to 3.9 per cent by 2004.

Tables 2.5(a) and (b) show the evolution of sectoral employment and investment shares. The fact that the share of employment in manufacturing (ranging from 21-24 per cent) is larger than the share of GDP (ranging from 15-20 per cent) suggests that the sector is not yet fully modernised, and has a preponderance of labour intensive, low productivity sub-sectors. The collapse of the share of agricultural employment is clear. The two service sectors of HERMIN-HE4 (i.e., market services and non-market services) had very stable employment shares.

Investment shares fluctuated in manufacturing, between a low of 12.9 per cent in the year 2002 to a high of 19.2 per cent in the pre-Russian crisis year 1998. Investment shares in agriculture showed a tendency to rise, from 3.5 per cent of total investment in the year 1994 to 5.7 per cent in the year 2004. Shares in the market service sector were relatively stable, fluctuating between a low of 62 per cent to a high of 70 per cent. The public sector investment share declined from high shares of 17 per cent in the 1990s to the present rather lower share of 10 per cent.6

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6 It should be noted that the data for 2004 contains very little of the SPD 2004-2006 public investment expenditures, since these have been very slow in getting off the ground (see Assignment 3 Report of this
Table 2.5(a): Shares of employment by broad sector

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Table 2.5(b): Shares of investment by broad sector

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Tables 2.6(a), (b) and (c) show sectoral GDP, employment and investment growth rates. The highest GDP growth is in manufacturing (averaging about 14 per cent in the post Russian crisis years), and averages about 7.5 per cent for market services. Growth is mainly negative in agriculture and has been very low in the government sector post 1999, due mainly to the constitutional requirement to balance the state budget.

Employment growth in all sectors is more erratic, and even when positive, is well below the growth of GDP. However, there are indications of strong productivity growth in manufacturing, and somewhat weaker productivity growth in market services, and this is confirmed by the econometric calibration of the joint CES-constrained factor demand systems in the HE4 model. In those calibrations, the derived rate of Hicks-neutral technical progress in manufacturing was 9.3 per cent per year, and was 5.1 per cent per year in market services.

project). However, the advent of SPD 2007-2013, as well as the catch-up of SPD 2004-2006 public investment expenditures will change this picture radically.
Further insight into the performance of the four broad sectors can be obtained from Table 2.7 (productivity growth) and Table 2.8 (investment/GDP ratios. The high productivity growth in manufacturing is apparent, as is its somewhat erratic nature.\(^7\) One of the drivers of sectoral productivity is investment, and the investment/GDP ratios are shown in Table 2.8. The

\(^7\) The estimates of Hicks-neutral technical progress in manufacturing (9.3 per cent per year) and market services (5.1 per cent per year) are probably better gauges of the underlying long-term growth in factor productivity.
investment ratio is highest in agriculture. In the case of the government sector, we express the ratio in terms of total economy-wide GDP rather than sectoral GDP. The public sector/aggregate GDP ratio stays steady at about 4 per cent.

Table 2.7: Broad sectoral productivity growth rates

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Table 2.8: Broad sectoral investment/GDP ratios

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Finally, we examine sectoral wage inflation (Table 2.9) and movements in real unit labour costs (Table 2.10). The erratic nature of wage inflation is apparent, and may be caused by definitional problems and re-classifications. But there is clearly a general tendency for wage inflation to outstrip price inflation, due to the strong underlying growth of productivity. In the HERMIN-HE4 model, the wage bargaining equation for manufacturing suggests that almost 95 per cent of productivity is passed on to workers, leaving very little to fuel future investment growth. It is also noted that real unit labour costs appear to be rising more in market services (the “sheltered” sector) than in manufacturing (the “exposed” sector). In the HERMIN-HE4 model, the stylised so-called Scandinavian model of inter-sectoral wage-price transmission was used, and appears to be consistent with the stylised facts. Wages are determined in the manufacturing sector, and the rate of increase tends to be passed over to

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8 For the 2000-2004 period one notes the presence of a loan and consumption/real estate boom, and its inflationary consequences. Wage inflation is only a serious threat to growth when productivity growth is low, and real unit labour costs rise.
However, output prices in manufacturing are externally constrained, but are less constrained in market services, where the rate of growth of productivity is lower than in manufacturing. This generates the so-called Balassa-Samuelson effect that tends to push up overall inflation.

Table 2.9: Wage inflation by broad sector

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<td>7.1</td>
<td>13.6</td>
<td>22.6</td>
<td>8.2</td>
</tr>
</tbody>
</table>

Table 2.10: Real unit labour costs by broad sector

<table>
<thead>
<tr>
<th>Date</th>
<th>ULCNADOT</th>
<th>ULCTDOT</th>
<th>ULCNDOT</th>
<th>ULCADOT</th>
<th>ULCGDOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>52.9</td>
<td>47.3</td>
<td>54.1</td>
<td>33.4</td>
<td>53.7</td>
</tr>
<tr>
<td>1995</td>
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<td>20.9</td>
<td>33.4</td>
<td>19.1</td>
<td>36.3</td>
</tr>
<tr>
<td>1996</td>
<td>15.6</td>
<td>13.6</td>
<td>16.4</td>
<td>20.6</td>
<td>15.1</td>
</tr>
<tr>
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<td>8.1</td>
<td>3.9</td>
<td>9.7</td>
<td>0.9</td>
<td>8.4</td>
</tr>
<tr>
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<td>7.3</td>
<td>0.6</td>
<td>10.5</td>
<td>-2.1</td>
<td>4.1</td>
</tr>
<tr>
<td>1999</td>
<td>9.4</td>
<td>3.5</td>
<td>8.4</td>
<td>-7.2</td>
<td>16.1</td>
</tr>
<tr>
<td>2000</td>
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<td>0.3</td>
<td>-1.8</td>
<td>-6.7</td>
<td>0.0</td>
</tr>
<tr>
<td>2001</td>
<td>2.7</td>
<td>4.5</td>
<td>1.7</td>
<td>6.7</td>
<td>5.3</td>
</tr>
<tr>
<td>2002</td>
<td>4.7</td>
<td>2.4</td>
<td>4.5</td>
<td>3.4</td>
<td>7.9</td>
</tr>
<tr>
<td>2003</td>
<td>4.0</td>
<td>1.3</td>
<td>2.6</td>
<td>1.3</td>
<td>12.7</td>
</tr>
<tr>
<td>2004</td>
<td>2.5</td>
<td>0.1</td>
<td>2.5</td>
<td>8.0</td>
<td>7.6</td>
</tr>
</tbody>
</table>

2.3.3 Manufacturing sub-sector growth

In our portfolio analysis in section 2.2 we used the full set of disaggregated subsectors of manufacturing. However, the small size of the Estonian manufacturing sector makes it less useful to examine time series properties of these data in such highly disaggregated form. So, we restrict ourselves to treating the six-sector categories used in the construction of the HERMIN-HEN model.

---

9 If more data were available, a formal test of causality could be carried out to establish whether or not manufacturing is, indeed, the driving sector. If wage pressures came from the “sheltered” sectors (public and market services), then unsustainable pressures could result.

10 The Balassa-Samuelson effect asserts that productivity growth in the exposed sector (in our case, manufacturing) is higher than that in the sheltered sector (in our case, market services). But since wage inflation is expected to be relatively homogeneous across all sectors, and the exposed sector is likely to be the most influential in wage bargaining, wage inflation from manufacturing will spill over to market services, driving up non-traded prices and feeding on into consumer prices (Balassa (1964); Samuelson (1964)).

11 The difficulty with using the fully disaggregated manufacturing sub-sector data (as shown in Table 2.2) is that activities in one or a few large firms in the sector are likely to distort the overall behaviour of the sub-sector in a
Based on the limited disaggregated data that were available informally from the CSO, it was only possible to examine the structure of the manufacturing sector in terms of 15 subsectors (at the NACE two-digit level):

Table 2.11: Available manufacturing sub-sector data

<table>
<thead>
<tr>
<th>Manufacturing sub-sector</th>
<th>Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food, beverages and tobacco</td>
<td>MFBT</td>
</tr>
<tr>
<td>Textiles</td>
<td>MTEX</td>
</tr>
<tr>
<td>Clothing</td>
<td>MCLO</td>
</tr>
<tr>
<td>Leather and leather products</td>
<td>MLLP</td>
</tr>
<tr>
<td>Wood and wood products</td>
<td>MWWP</td>
</tr>
<tr>
<td>Pulp, paper and paper products</td>
<td>MPPP</td>
</tr>
<tr>
<td>Printing and publishing</td>
<td>MPUB</td>
</tr>
<tr>
<td>Chemicals and chemical products</td>
<td>MCHM</td>
</tr>
<tr>
<td>Rubber and plastic products</td>
<td>MRPP</td>
</tr>
<tr>
<td>Other non-metallic products</td>
<td>MONM</td>
</tr>
<tr>
<td>Basic metals and fabricated metal products</td>
<td>MMET</td>
</tr>
<tr>
<td>Machinery and equipment</td>
<td>MMEQ</td>
</tr>
<tr>
<td>Electrical and optical equipment</td>
<td>MEOE</td>
</tr>
<tr>
<td>Transport equipment</td>
<td>MTRE</td>
</tr>
<tr>
<td>Products not elsewhere classified (n.e.c.)</td>
<td>MNEC</td>
</tr>
</tbody>
</table>

On the basis of detailed examination of the structure and characteristics of these sub-sectors, it was decided to construct the new Estonian HERMIN-HEN model using the following aggregated subsectors of manufacturing (including mining and quarrying, TMQ):

Table 2.12: Manufacturing sub-sectors of HERMIN-HEN model

<table>
<thead>
<tr>
<th>HEN sub-sector</th>
<th>Description</th>
<th>Made up of:</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMQ</td>
<td>Mining and quarrying</td>
<td>TMQ</td>
</tr>
<tr>
<td>TFD</td>
<td>Food, beverages and tobacco</td>
<td>MFBT</td>
</tr>
<tr>
<td>TCG</td>
<td>Traditional sector</td>
<td>MTEX, MCLO, MLLP, MNEC</td>
</tr>
<tr>
<td>TKG</td>
<td>Capital intensive sector</td>
<td>MCHM, MRPP, MONM, MMET</td>
</tr>
<tr>
<td>TAT</td>
<td>Advanced technology sector</td>
<td>MMEQ, MEOE, MTRE, MPUB</td>
</tr>
<tr>
<td>TWD</td>
<td>Wood, wood products, paper, pulp</td>
<td>MWWP, MPPP</td>
</tr>
</tbody>
</table>

It was further possible to disaggregate the sector that was called “market services” (N) in the original aggregate Estonian HERMIN-HE4 model, into seven sub-sectors:

way that is impossible to explain without going down to the level of individual firms (as we do in Chapter 4). Even at the six-sector level of manufacturing used in HERMIN-HEN, there is an element of such distorting fluctuations (see report on Assignment 1 of this project).
Table 2.13: Available manufacturing sub-sector data

<table>
<thead>
<tr>
<th>Service sub-sectors</th>
<th>Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public utilities (electricity, gas, water)</td>
<td>PU</td>
</tr>
<tr>
<td>Building and construction</td>
<td>BC</td>
</tr>
<tr>
<td>Wholesale and retail trade</td>
<td>MWRT</td>
</tr>
<tr>
<td>Hotels and restaurants</td>
<td>MHRE</td>
</tr>
<tr>
<td>Transport, storage and communications</td>
<td>MTSC</td>
</tr>
<tr>
<td>Real estate, renting, business services</td>
<td>MRRB</td>
</tr>
<tr>
<td>Financial intermediation</td>
<td>MFIM</td>
</tr>
</tbody>
</table>

In the new Estonian HERMIN-HEN model, the aggregate market service sector (N) was disaggregated as follows:

Table 2.14: Market service sub-sectors orf HERMIN-HEN model

<table>
<thead>
<tr>
<th>HEN sub-sector</th>
<th>Description</th>
<th>Made up of:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PU</td>
<td>Public utilities</td>
<td>PU</td>
</tr>
<tr>
<td>BC</td>
<td>Building and construction</td>
<td>BC</td>
</tr>
<tr>
<td>M</td>
<td>Other market services</td>
<td>MWRT, MHRE, MTSC, MRRB, MFIM</td>
</tr>
</tbody>
</table>

Obviously the availability of efficient and sophisticated market service sub-sectors will play a crucial role in the promotion of manufacturing growth and development. But we do not pursue this particular topic in any great depth in the present paper.\(^{12}\)

In Tables 2.16(a)-(f), we present concise summaries of the main features of the sub-sector data for manufacturing, as modelled in the HERMIN-HEN model. The notation is explained in table 2.15 below.

\(^{12}\) See Chapter 4, sections 4.5 and 4.6 for examples of knowledge-intensive services sectors that are intimately linked with the performance ability of manufacturing sectors (e.g., the Forenel cluster in Forestry). The stark distinction between manufacturing and service activities that is embodied in such classification systems as NACE are now becoming a barrier to better understanding of performance in manufacturing and associated activities. This is yet another strong rationale for moving down to the level of the individual firm, as we do in Chapter 4.
Table 2.15: Manufacturing sub-sectoral notation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTDOT</td>
<td>Aggregate manufacturing GDP growth</td>
</tr>
<tr>
<td>O**DOT</td>
<td>Sub-sectoral manufacturing GDP growth</td>
</tr>
<tr>
<td>LT**DOT</td>
<td>Sub-sectoral manufacturing employment growth</td>
</tr>
<tr>
<td>IT**DOT</td>
<td>Sub-sectoral manufacturing investment growth</td>
</tr>
<tr>
<td>LPRT**DOT</td>
<td>Sub-sectoral manufacturing productivity growth</td>
</tr>
<tr>
<td>WT**DOT</td>
<td>Sub-sectoral manufacturing average annual earnings growth</td>
</tr>
<tr>
<td>ULCT**DOT</td>
<td>Sub-sectoral manufacturing unit labour cost growth</td>
</tr>
<tr>
<td>LSHRT**</td>
<td>Sub-sectoral manufacturing wage share of GDP</td>
</tr>
</tbody>
</table>

where

WD Wood, wood products, paper, pulp
AT Advanced technology sector
MQ Mining and quarrying
CG Traditional sector
KG Capital intensive sector
FD Food, beverages and tobacco

Although it is very difficult to carry out any robust econometric work with such a short data sample (i.e., eight years over 1997 to 2004), nevertheless one can extract some information. In the HERMIN-HEN model we disaggregated aggregate manufacturing into the above six sub-sectors. Imposing a CES production function, and calibrating using simple statistical curve-fitting techniques, yielded the following ranking of the Hicks-neutral technical progress parameter:

Table 2.16: Manufacturing sub-sectors of HERMIN-HEN model

<table>
<thead>
<tr>
<th>HERMIN-HEN model sub-sector</th>
<th>Description of sub-sector</th>
<th>Hicks-neutral technical progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>TWD</td>
<td>Wood, wood products, paper, pulp</td>
<td>14.7% per year</td>
</tr>
<tr>
<td>TAT</td>
<td>Advanced technology sector</td>
<td>13.7% per year</td>
</tr>
<tr>
<td>TMQ</td>
<td>Mining and quarrying</td>
<td>9.2% per year</td>
</tr>
<tr>
<td>TCG</td>
<td>Traditional sector</td>
<td>8.1% per year</td>
</tr>
<tr>
<td>TKG</td>
<td>Capital intensive sector</td>
<td>6.5% per year</td>
</tr>
<tr>
<td>TFD</td>
<td>Food, beverages and tobacco</td>
<td>2.6% per year</td>
</tr>
</tbody>
</table>

The subsequent six sub-sectoral tables provide at least some explanations for the above ranking. For example, the high rate of technical progress in the WD and AT sub-sectors tends to be the result of previous large investments, and this is indeed seen to be the case (Tables 2.16(a) and (b)).

The HERMIN-HEN model calibration also explored the processes of sub-sectoral wage determination, although in the final version of the model, a centralised wage bargaining equation for aggregate manufacturing was actually used. The separate disaggregated wage equations suggested that a high proportion of productivity was passed through to wages. This

13 See report on Assignment 1 of this project for full details of the econometric work carried out for HERMIN-HEN and HERMIN-HE4.
ranged from 100 per cent (in the case of the Consumer/Traditional goods, CG), to 80 per cent (in the Wood Processing, Advanced Technology and the Food Processing sectors (WD, AT and FD), to 66 per cent (in the Capital Goods sector, KG), and to a low of 50 per cent in Mining & Quarrying. As mentioned previously, this is a worrying feature of the functioning of the Estonian labour market. In a rapidly developing modernising economy, driven by investment, we would expect to find a much lower share of productivity being passed on in higher wages. We will return to this point in our concluding Chapter 5.

Table 2.16(a): WD: Wood, wood products, paper, pulp: 1997-2004

<table>
<thead>
<tr>
<th>Date</th>
<th>OTDOT</th>
<th>OTWDDOT</th>
<th>LTWDDOT</th>
<th>ITWDDOT</th>
<th>LPRTWDDOT</th>
<th>WTWDDOT</th>
<th>ULCTWDDT</th>
<th>LSHRTWD</th>
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</thead>
<tbody>
<tr>
<td>1998</td>
<td>5.1</td>
<td>11.6</td>
<td>1.6</td>
<td>44.8</td>
<td>9.8</td>
<td>9.6</td>
<td>0.7</td>
<td>40.7</td>
</tr>
<tr>
<td>1999</td>
<td>-2.3</td>
<td>13.4</td>
<td>-8.7</td>
<td>-21.9</td>
<td>24.2</td>
<td>17.0</td>
<td>-5.4</td>
<td>40.4</td>
</tr>
<tr>
<td>2000</td>
<td>16.6</td>
<td>32.7</td>
<td>9.6</td>
<td>0.2</td>
<td>21.1</td>
<td>16.7</td>
<td>-3.7</td>
<td>38.6</td>
</tr>
<tr>
<td>2001</td>
<td>10.6</td>
<td>12.6</td>
<td>2.4</td>
<td>28.4</td>
<td>10.0</td>
<td>15.3</td>
<td>5.4</td>
<td>40.4</td>
</tr>
<tr>
<td>2002</td>
<td>13.9</td>
<td>19.0</td>
<td>3.5</td>
<td>-60.8</td>
<td>15.0</td>
<td>17.1</td>
<td>1.2</td>
<td>39.7</td>
</tr>
<tr>
<td>2003</td>
<td>10.5</td>
<td>12.1</td>
<td>0.7</td>
<td>145.4</td>
<td>11.3</td>
<td>19.4</td>
<td>7.4</td>
<td>41.4</td>
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<td>11.2</td>
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<td>-2.5</td>
<td>-5.1</td>
<td>39.0</td>
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</table>

Table 2.16(b): AT: Advanced technology sector: 1997-2004

<table>
<thead>
<tr>
<th>Date</th>
<th>OTDOT</th>
<th>OTATDOT</th>
<th>LTATDOT</th>
<th>ITATDOT</th>
<th>LPRTATDOT</th>
<th>WTATDOT</th>
<th>ULCTATDT</th>
<th>LSHRTAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
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<td>13.6</td>
<td>7.2</td>
<td>44.8</td>
<td>5.9</td>
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<td>53.4</td>
</tr>
<tr>
<td>1999</td>
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<td>4.4</td>
<td>0.0</td>
<td>-21.9</td>
<td>4.4</td>
<td>4.4</td>
<td>0.5</td>
<td>56.8</td>
</tr>
<tr>
<td>2000</td>
<td>16.6</td>
<td>30.4</td>
<td>19.2</td>
<td>-9.1</td>
<td>-19.4</td>
<td>13.1</td>
<td>16.0</td>
<td>48.4</td>
</tr>
<tr>
<td>2001</td>
<td>10.6</td>
<td>2.8</td>
<td>-9.1</td>
<td>-19.4</td>
<td>13.1</td>
<td>16.0</td>
<td>5.7</td>
<td>48.4</td>
</tr>
<tr>
<td>2002</td>
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<td>1.0</td>
<td>41.4</td>
<td>46.3</td>
<td>2.8</td>
<td>50.9</td>
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<td>14.2</td>
<td>6.5</td>
<td>47.6</td>
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<td>8.9</td>
<td>0.1</td>
<td>49.7</td>
</tr>
<tr>
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<td>22.4</td>
<td>20.4</td>
<td>35.5</td>
<td>1.7</td>
<td>-0.8</td>
<td>-1.9</td>
<td>47.0</td>
</tr>
</tbody>
</table>

Table 2.16(c): MQ: Mining and quarrying: 1997-2004

<table>
<thead>
<tr>
<th>Date</th>
<th>OTDOT</th>
<th>OTMQDOT</th>
<th>LTMQDOT</th>
<th>ITMQDOT</th>
<th>LPRTMQDOT</th>
<th>WTMQDOT</th>
<th>ULCTMQDT</th>
<th>LSHRTMQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>5.1</td>
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<td>-1.6</td>
<td>60.3</td>
</tr>
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<td>15.6</td>
<td>-6.9</td>
<td>60.1</td>
</tr>
<tr>
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<td>1.7</td>
<td>-19.4</td>
<td>27.2</td>
<td>26.2</td>
<td>22.7</td>
<td>-2.8</td>
<td>57.6</td>
</tr>
<tr>
<td>2002</td>
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<td>15.8</td>
<td>-1.7</td>
<td>38.6</td>
<td>17.8</td>
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</tr>
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<td>2003</td>
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<td>10.3</td>
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<td>10.3</td>
<td>13.8</td>
<td>3.1</td>
<td>51.8</td>
</tr>
<tr>
<td>2004</td>
<td>10.7</td>
<td>-7.5</td>
<td>40.4</td>
<td>7.7</td>
<td>-34.1</td>
<td>-28.3</td>
<td>6.0</td>
<td>53.0</td>
</tr>
</tbody>
</table>

14 See report on Assignment 1 of this project for full details of the econometric work carried out for HERMIN-HEN and HERMIN-HE4.
15 In Table 2.16(a)-(f), the two-letter notation shown in each table title indicates the sub-sector (e.g., WD for wood, etc). The leading letters indicate the variable (OT for GDP; LT for employment; IT for investment; LPRT for productivity; WT for wages; ULCT for unit labour costs; LSHRT for the wage share of added-value. The trailing letters (DOT or DT) indicate an annual rate of change.
Table 2.16(d): CG: Traditional sector (consumer goods): 1997-2004

<table>
<thead>
<tr>
<th>Date</th>
<th>OTDOT</th>
<th>OTCGDOT</th>
<th>LTCGDOT</th>
<th>ITCGDOT</th>
<th>LPRTCGBDOT</th>
<th>WTCGDOT</th>
<th>ULCTCGDOT</th>
<th>LSHTCG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>5.1</td>
<td>-1.2</td>
<td>-10.2</td>
<td>44.8</td>
<td>10.0</td>
<td>21.9</td>
<td>10.9</td>
<td>57.2</td>
</tr>
<tr>
<td>1999</td>
<td>-2.3</td>
<td>3.0</td>
<td>-9.6</td>
<td>-21.9</td>
<td>14.0</td>
<td>12.2</td>
<td>0.6</td>
<td>58.2</td>
</tr>
<tr>
<td>2000</td>
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<td>5.3</td>
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<td>4.2</td>
<td>9.2</td>
<td>4.4</td>
<td>55.4</td>
</tr>
<tr>
<td>2001</td>
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<td>31.2</td>
<td>7.1</td>
<td>16.0</td>
<td>7.4</td>
<td>57.0</td>
</tr>
<tr>
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<td>9.8</td>
<td>5.3</td>
<td>33.9</td>
<td>13.9</td>
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<td>58.3</td>
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<tr>
<td>2003</td>
<td>10.5</td>
<td>5.7</td>
<td>32.9</td>
<td>-11.1</td>
<td>-0.6</td>
<td>3.0</td>
<td>59.2</td>
<td></td>
</tr>
<tr>
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Table 2.16(e): KG: Capital intensive sector (capital goods): 1997-2004

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Table 2.16(f): FD: Food, beverages and tobacco: 1997-2004

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2.4 Conclusions

The purpose of this chapter was to set the scene for an analysis based at the level of individual firms and their capabilities. As a preamble to this firm-level analysis, what the aggregate and disaggregated NACE time series data show is that Estonia is still in a period of transition. However, this transition is very different from the period that followed immediately after 1992.

The first phase of the transition of the former command economies of Central and Eastern Europe (CEE) involved considerable disorganisation and a very basic overhauling of industrial and institutional capacity (Blanchard, 1997). Mechanisms operating during this phase entailed substantial inter-sectoral reallocation of labour between the public and private sectors as well as between manufacturing and marketed services. The impact of restructuring generated the well-known U-shaped pattern for GDP and total employment in all CEE countries once the transition process was initiated. Estonia was a typical case of this
transition process. In the case of Estonia, the implementation of the reforms was clear and decisive, and the recovery was reasonably rapid.

However, the processes that characterised the initial years of CEE transition cannot be taken as the pattern of behaviour for the future. The next stage of transition for a new EU member state like Estonia is more likely to resemble the paths followed in recent decades by the so-called cohesion countries of the EU periphery: Ireland, Portugal, Spain and Greece. Structural adjustment in these countries lagged behind that of the more developed core EU states. The driving forces behind cohesion included progressive trade integration, foreign direct investment flows, technological catch-up and externally aided programmes of infrastructural and human-capital development (ESRI, 1997). It is probable that similar processes and adjustment mechanisms will operate in Estonia during the second phase of its transition, following on from the initial restructuring and institution-building stage.

Macromodels, like the Estonian HERMIN-HE4 and HERMIN-HEN, will be useful in the study of the next phase of transition. But they will not be able to provide a lead in the study of these processes, in the sense of being able to foresee future trends at the macro-sectoral level on the basis of analysis and projection of past trends. To understand the future possibilities for Estonia, we need to look elsewhere and explore the environment within which firms operate and the characteristics of individual firms currently operating in Estonia. The examination of the first theme – the firms’ environment – will be the subject of the next chapter, where we will make use of modern industrial strategy frameworks. The examination of the second theme – the characteristics of firms – will be the subject of the following chapter, where we make use of available data at the level of individual firms and clusters of firms.
[3] Business models and industrial growth

Elsewhere we have presented reviews of business model frameworks and elaborated the capabilities and innovation perspective (Best, 2001). Here we present two concepts from that perspective which clarify the pivotal role that business enterprise development plays in growth: the capability triad and clusters or, preferably, clusterization.

3.1 The capability triad

Technology is acknowledged as critical to high income and rapid growth. Where does technology management capability come from? The capability and innovation perspective focuses attention on three interactive domains that shape a region’s capability development processes: production capabilities, business model, and skill formation. Capabilities mediate between the resources of a region and their productivity. They constitute a Capability Triad. The Capability Triad provides a framework for analysing (or x-raying) an economy to identify its challenges and opportunities. In this respect it is a tool similar to Porter’s Diamond. The overlapping of the three domains as shown in Figure 3.1 visually expresses their interconnectedness. In what follows, each domain will be briefly introduced.

3.1.1 Production capabilities.

Production capabilities refer to the methods and practices by which inputs are processed into goods and services. They are anchored in universal principles and can, in the main, be observed and measured. A country’s level of productivity and per capita income is directly related to how far its production capabilities have advanced along the spectrum shown in Table 3.1.

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16 Interconnectedness complicates analysis and exposition. The method of analysis is to examine enterprise and regional capabilities from three conceptual viewpoints. We look consecutively from a viewpoint that highlights the production system, from a second viewpoint that focuses on business organization, and a third viewpoint that targets skill formation processes.
Table 3.1: Production Capabilities Spectrum

1. **Pre-flow, pre-interchangeability**: Craft production, by itself, offers no basis for flow. Each drawer is custom fit. The task is to develop product-engineering skills. Jamaica and Honduras.

2. **Interchangeability** (*PS 1*): product engineering without process engineering, hence low inventory turns and working capital productivity. Cyprus and Slovenia in the 1980’s.

3. **Single product flow** (*PS 2*): plants with economies of speed for a single product or range of products with dedicated lines. Workers are not multi-skilled and attend to a single machine. Training does not include continuous improvement, rapid changeover, or blueprint reading skills. Multi-national corporation (MNC) electronics production in Indonesia.

4. **Single product flow with continuous improvement** (*PS 3*): involves problem solving work *self-directed* work teams. Common training programs include Plan-Do-Check-Act diffused by the Japanese Union of Scientists and Engineers, the 7 problem-solving tools of TQM (total quality management) at shop floor level.

5. **Single product flow with process innovation** (*PS 3*): personnel include maintenance and process control technicians with skills to identify, fix and redesign machinery and production lines. Bottleneck analysis determines priorities. This may involve reconfiguring product design parameters at main office as required by DFM (design for manufacturability). Singapore in the mid-1980s, Malaysia MNCs in early 1990s.

6. **Multi-product flow** (*PS 3*): the Toyota system. *Kanban*, JIT (just in time), and SMED (single minute exchange of dies) are introduced in large plants. High throughput and flexibility are combined. Cellular production with self-directed work teams.

7. **Multi-product flow and product development** (*PS 4*): Japan and Taiwan both excel at concurrent engineering and design for manufacturability. Skills include reverse engineering, prototype development, and pilot runs.

8. **New product design and technology fusion** (*PS 4*): Japan’s Toshiba and Canon are leaders in linking development to operations at the plant level and linking research in generic technologies to product development. Core technologies are developed, often via fusion in generic technology labs. Technology management involves world-wide sourcing of the existing technology base in pursuit of novel applications.

9. **Systems integration and disruptive innovation** (*PS 5*): 3 M, HP and Motorola use cross-disciplinary teams to identify new technology drivers for product development. Disruptive or breakthrough innovations are pursued but within an organizational context of process integration and HPWSs (high performance work systems). Hardware and software integration drives product concept development.

10. **Open systems and design modularization** (*PS 5*): standard inter-face rules and diffusion of design capability support focus and network strategies. Fosters technology deepening R&D and techno-diversification.

Industrial development involves transitioning from a sector composition heavily weighted in the south and east poles as shown in Figure 3.2 in the direction of the west and north poles. Each step of the way involves the development of more advanced production capabilities and
their diffusion across more business enterprises which, in turn, enables industrial differentiation, itself integral to the growth process.\textsuperscript{17}

\textbf{Figure 3.2 Evolution of Industrial Structure}

Production capabilities are a major source of enterprise productivity, but they are not sufficient to generate revenues in the marketplace. Revenues depend upon business enterprises with systems in place to match market opportunities with production activities. This gives direction to production capabilities. Here, too, we can speak of generic or universal capabilities such as new product development and technology management. These capabilities have both production and business organization dimensions.

The critical role of the change agent in industrial transitions can not be ignored. For this we turn to the concept of the Entrepreneurial Firm, the growth driver in the capabilities and innovation perspective.

\textbf{3.1.2 Business model.}

However, whereas production capabilities are universal and can be replicated and widely diffused in virtually all contexts, business organization focuses attention on ‘core competence’, a second class of capabilities that cannot be readily observed, measured or replicated. In fact, the goal of every business enterprise is to establish a core competence or distinctive capability to give its offerings a uniqueness in the marketplace that cannot by copied or imitated.

This is the domain of the Entrepreneurial Firm. As a business model, the Entrepreneurial Firm is constituted by a core competence/market opportunity dynamic, an endogenous process,

\textsuperscript{17} In The Economy of Cities, Jane Jacobs (1969: 129) draws the distinction between growth as quantitative expansion of existing products and industrial sectors and as a qualitative process of differentiation and transformation.
built into the ongoing operations of the firm. Firms pursue market opportunities by developing a unique competence, often of a technological form, but the process of developing such competences creates new market opportunities in the form of redesigned products to better meet customer needs. The interactive process is endless.

New ‘market’ opportunities feed back to motivate changes in core competence setting in motion a new core competence and market opportunity dynamic. The commodity producer (defined as a firm without product development capability) is ill-equipped to meet product-led competitors, sometimes called the New Competition. Firms which lack unique competences also lack the capacity to anticipate emerging market opportunities and thereby differentiate their product in the market place. They are price-takers trapped by externally imposed market forces leaving the enterprise with little market shaping influence.

The fully developed Entrepreneurial Firm can be distinguished in three domains. First, the entrepreneurial firm pursues product-led competitive strategies and depends upon high performance work systems. Second, the entrepreneurial firm integrates design and manufacturing which is required for compression of new product development cycle times. Third, the entrepreneurial firm focuses on core competence and partners for complementary competences. It is thereby pursues a policy of open-systems networking characteristic of cluster dynamic processes and global production networks. Open-systems networking fosters greater enterprise specialization combined with inter-enterprise coordination of complementary business activities. Inter-enterprise coordination can take the form of supply-chain partnering, off-shore sourcing, standard-setting, and new product development alliances.

Processes of capability development go beyond the boundaries of entrepreneurial firms to that of clusters of enterprises. Crucially, in ‘open-system’ networks, entrepreneurial firms focus on core capabilities and network for complimentary capabilities. This involves horizontal or multi-enterprise technical coordination as distinct from vertical integration. A new dynamic between internal organisation and inter-firm competition is established. In pursuit of its goals, the entrepreneurial firm propagates new productive opportunities, which are pursued internally or pushed outside, producing opportunities for new enterprises, spin-offs or existing enterprises.

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18 The core competence/market dynamic is an abbreviation version of Penrose’s productive service/market opportunity dynamic (Penrose 1995). The idea of the entrepreneurial firm as an extension of the entrepreneurial function from an individual attribute to a collective or organizational capability is developed in Best (1990).
19 Richard Lipsey (1993) offered a broad definition of technology that resonates with the capabilities and innovation perspective. ‘Technology … must be broadly understood as our way of doing things. It includes:
- the products we make and consume
- the processes we employ to make products
- the organisations we use to co-ordinate our economic activity; and
- the institutions that provide the background structure to economic activity.’ For Lipsey, the term innovation is the ‘process by which these things are brought into being…and we may speak of product innovation, process innovation, organisational innovation, and institutional innovation’. He adds that innovations are constantly changing our technologies.
20 Individual firms may be entrepreneurial for a long or short period. From a regional policy perspective it is not important that individual firms survive but that the technology/market dynamic be ongoing if across firms. In this the entrepreneurial firm functions like runners in a relay race, handing the baton on after having done their job in advancing the region’s technological capabilities and redefined the market.
21 “A plant that has adopted a cluster of practices that provides workers with the incentives, skills, and, above all, the opportunity to participate in decisions and improve the plant’s performance has an HPWS” (high performance work system). See Appelbaum, Bailey, Berg, and Kalleberg, (2000).
22 In regional clusterization processes, open-systems networking fosters decentralization and diffusion of design and enhances regional innovation. These processes, in turn, reinforce and replenish entrepreneurial firms.
enterprises with the requisite capabilities (a process of ‘techno-diversification’). The rebounding pressures of product-led competition in the market on the internal organization of the firm reinforce the drive to develop unique products and production capabilities.

Internationally and historically, the Entrepreneurial Firm has taken many different variants. As noted, a common feature is the integration of design and production. The *kaisha* or Japanese variant of the entrepreneurial firm builds continuous improvement and incremental innovation into the operating units and coordinates specialist suppliers in closed networks. The Italian industrial district variant is based on the networked groups of specialist enterprises each of which focuses on a core competence and partners for complementary competences. Over time, the networked group of companies will redefine traditional sector and cluster boundaries. For example, furniture clusters have been transformed into interior design and furnishing clusters. A new mutually reinforcing dynamic between specialization within the firm and inter-firm cooperation/competition is established.

Escaping razor-thin margins associated with commodity-markets and making the transition to product-led competition depends upon the development of entrepreneurial firms. But the form than an Entrepreneurial Firm will or should take can not be determined theoretically or *a priori*. It will depend upon historical circumstances, geographical location, technological conditions, and other factors. Furthermore, the same conditions may support a range of incipient entrepreneurial firms. For these reasons we speak of diverse business models.

To summarize, the goal of the Entrepreneurial Firm is to build capabilities or institute processes to differentiate the firm’s product in the market place and establish a market niche and ongoing relationship with customers. Success requires product redesign and new product development capabilities. To the extent that firms are successful, the mode of competition shifts from price-led to product-led. The rebounding pressures of product-led competition in the market on internal organization of the firm reinforce the drive to develop new and unique products which, in turn, fosters the search for new technologies. Once a firm has institutionalized new product development processes it has the means to continuously develop new products and processes in response to market opportunities and new technologies.

3.1.3 *Skill formation.*

A workforce trained in natural science and engineering (NS&E) is indispensable to a modern economy. NS&E degrees include natural, agricultural, and computer sciences; mathematics; and engineering. Sustained growth depends upon moving up the production capabilities spectrum which in turn requires an increase in the technically educated graduates as a proportion of the college age population. Those countries that have developed new product development and technology management capabilities and made the transition to knowledge-intensive economies have increased the ratio by an order of magnitude. South Korea and Taiwan increased their ratios from just over 2 per 100 in 1975 to 11 per 100 in 2000–01. At the same time, several European countries have doubled and tripled their ratios, reaching figures between 8 and 11 per 100. The ratio for the EU is 7.6; Finland sets the standard at 13.2. Estonia lags far behind with a ratio of 1. 23

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23 For Estonia, of the 2272 graduates in the most recent year for which data was available, only 37 were in NS and 135 in engineering in a college-age population of 20,000. All data and ratios are from the National Science Board of the US National Science Foundation. http://www.nsf.gov/statistics/seind04/append/c2/at02-33.xls
The growth process in knowledge intensive industries is limited by the supply of engineering and scientific personnel required to staff rapidly growing firms. In fact, innovation and skill formation are opposite sides of the same technology development coin. Regional growth will be choked if the requisite numbers and types of graduate engineers are not produced by the education system. Three conditions must be met for success. The first involves characterization of the demand for specific technological skills. The second involves investment in technical education. The third involves skill formation in the workplace. A region that can institute skill formation processes in anticipation of technology transitions can build competitive advantage.

To summarize, the concept of capability triad captures the systemic character of change at enterprise and regional levels. The three domains of production system, business organization, and skill formation are not separable and additive components but interconnected sub-systems. Each domain captures a different dimension of capability. The business model domain of the capability triad captures the technological uniqueness of enterprise and regional development. This is the domain of the entrepreneurial firm and the core-competence/technology-capability and market opportunity dynamic that defines it. Every firm strives to develop a distinctive capability that cannot easily be imitated. But every firm also operates within a regionally based production system. The production system is constituted by production capabilities anchored in enduring principles of production and organization. More advanced production systems offer enabling conditions for entrepreneurial firms that, in turn, advance a region’s technological capabilities. The history of the evolution of production capabilities in the world’s most advanced region’s offers a roadmap to industrial development. Examples of government initiatives and mission-driven agencies that have spearheaded production capability transitions can be found in section 5.6 below.

A region that successfully negotiates a transition to more advanced production systems creates an organizational infrastructure for entrepreneurial firms to drive technological change and productivity growth. The problem is that making the transition involves complementary organizational change in all three domains. The interconnectedness of production, business, and skill has critically important implications for governmental policy making. When firms and regions become stuck in low productivity capability triads, the government may be the only institution that can coordinate organizational change in all three domains of the capability triad. Successful government industrial modernization programs focus on the mutual adjustment processes amongst the three domains. For example, human resource development (HRD) programs designed to save jobs by upgrading skills for enterprises with outmoded production capabilities can be counter-productive; in contrast targeted HRD programs that supply the skill requirements of technology-driven enterprises can fuel growth. The prize is to trigger self-organizing, interactive processes.

We explore business organization of the success stories in most major industrial sectors of the Estonian economy in search not simply of individual business success stories but of clusters of related enterprises. The importance of clusters, old and emerging, is important for two major reasons. Emerging clusters are at the heart of regional innovation systems and clusters, old and new, are indicators of often obscure regional technological capabilities. The critical role that clusterization plays in growth is less obvious and requires a brief explanation.

3.2 Specialization and Clusterization
Economic growth is a process of industrial differentiation including the emergence or creation of new sectors, the decline of some sectors and the advance of others. The vehicles of change are specialization and clusterization, two mutually reinforcing processes. Advances in productivity come from increasing specialization in which firms focus on core competences and partner for complementary competences. Specialization leads to economies of scale but, equally important, in improvements and innovations in products, processes, technology and organization. Groups of mutually specialized firms out-compete groups of non-specialized firms. But specialization does not happen spontaneously or automatically. An ongoing specialization process for any one firm depends upon a complementary multi-firm clusterization process involving firms interactively developing complementary specializations.

Clusterization is a process of self-organized specialization amongst inter-dependent companies. It is an open-system model of business and inter-firm coordination. Where it flourishes we can speak of a regional innovation system. Innovation of this type is an outcome of ‘systems integration’ in which a group of firms (and their specific competences) periodically are reconfigured to take full advantage of technological advances in sub-systems or constituent enterprises. In other words, clusterization is about fostering systems integration amongst related enterprises which means triggering a new round of specialization dynamics within constituent enterprises.

Every cluster is unique as each involves the shaping of regionally distinct patterns of specialization formed by unique mutual adjustment processes. These specialization and clusterization dynamics are not determined by teleological growth trajectories or technical laws but by firms designing new products and processes, experimenting with new technologies, and pursuing distinctive core competences. Success is often about being able to create new markets or responding to market opportunities with new products and capabilities. This triggers growth and further industrial differentiation.

A mature or developed regional cluster has self-sustaining properties based on a legacy from previous rounds of specialization and clusterization. The shared history of multiple companies working in the same sector and technology domains can result in the establishment of distinctive regional technological capabilities. The technological capabilities impart regional competitive advantage to present day companies.

Open-systems also mean that a technical change at one link in the network of enterprises will create new pressures and opportunities for specialists in each of the complementary capabilities. In this way design changes and technology advances are leveraged regionally. The decentralization and diffusion of design within a region foster a transition to product-led competition both within the region and between the region and other regions. Regions that make the transition to product-led competition can enjoy a competitive advantage over regions in which the dominant mode of competition is price.

Entrepreneurial firms foster a third capability development process which is leveraged by cluster dynamics. Driven by technology capability and market opportunity dynamic, entrepreneurial firms are forever advancing their own capabilities. In the process the region’s technological capability seabed is revitalised by the ongoing activities of its inhabitants. It is a virtuous circle. Regional technological capabilities spawn entrepreneurial firms, which upgrade regional technological capabilities, which spawn more entrepreneurial firms.
Thus, a region’s technological capabilities are an outcome of a cumulative history of technological advances embedded in entrepreneurial firms. But the historical process is also collective. Just as individual entrepreneurial firms develop unique technological capabilities, a virtual, collective entrepreneurial firm extends a region’s unique technological capabilities. The regional process of technology capability advance will likely involve a succession of firms, with new firms building on advances made by previous innovators. Regional specialization, in the form of industrial districts or clusters, is the outcome of the technology/market dynamic played out at the level of the collective entrepreneurial firm. By examining the dynamics of a region’s business model, we are at same time examining the region’s technological heritage. This is shaped cumulatively and collectively over time by the ongoing sequences of capability and market dynamics.

The specialization and clusterization dynamic presents an obvious challenge to the growth of companies in regions that do not enjoy a regional competitive advantage in the relevant technology domain. This is particularly true in the case of small countries that may lack the critical mass of companies to foster locally confined cluster dynamics including specialization and clusterization. Companies within small countries that do not have an established cluster do not have the option of partnering internally for the requisite competences and the market size is too small for vertical integration.

The option for such a company seeking to harvest the benefits of increased specialization is to establish links with foreign companies and regions which do have well established entrepreneurial firms and cluster dynamic processes. In fact, this can trigger the emergence of local clusterization and capability development processes. The Indian IT (information technology) cluster, the West Ireland medical devices cluster, and, as we shall see, an emerging Estonian ICT (information and communication technology) cluster have all followed this route.

The goal is to advance a region’s capabilities, to establish local dynamic capabilities defined as the means to develop new products and processes in response to market opportunities and technological changes. Interestingly, Estonia has fostered an emerging cluster in ICT by creatively linking with nearby clusters in ways that foster local technology assimilation and capability development.24

The first emerging cluster in a region is important as it begins a process of local, inter-firm specialization and clusterization which, in turn, fosters regional capability development and characterizes the demand or needs side for manpower development programs. Second, it can foster sector transitions if elements within the cluster trigger specialization and capability development in other, previously dis-connected sectors.

Third, it serves as a model to illustrate the combined dynamics of specialization and clusterization within a specific context that can shape the actions of management, the policies of government and, eventually, extra-firm institutions that foster growth and development. Fourth, it foster the renewal of old or stagnant clusters. We will illustrate the potential of the ICT cluster in Estonia to provide critical services to foster transformation of resource intensive sectors such as forestry products.

The challenge is to develop business models that recreate the core competence and market opportunity dynamic of industrial firms but do so within the context and unique conditions of a specific country or region. New business models emerge in a process of experimentation as management teams in various firms respond to market opportunities with redesigned or new organizational forms. The success stories are those business models that institutionalize the process of matching a region’s resources and emerging distinctive capabilities with market opportunities. In the process the region’s resources or services of resources and the firm’s capabilities are upgraded with each new product development cycle.

In fact, experimentation with and the discovery of such ‘entrepreneurial firm’ business models is the critical role of management teams. At the same time they are carrying out business activities they are performing two acts of discovery. The first is the development and refinement of business models that serve as entrepreneurial firms within the local conditions. The second is the discovery of a region’s latent or potential sources of competitive advantage often in the form of a heritage in deep craft skills and unique technological capabilities. Success in the marketplace is a guide discover and characterize both business models and regional competitive advantage.

Entrepreneurial firms and the management teams that direct them have a third role or responsibility which also impacts on growth: they participate with other constituencies in shaping a broad range of regulatory, extra-firm institutions that form the regulatory environment in which business enterprises operate. These include education, training, research and financial institutions and business development agencies. Some of these institutions can become powerful levers for technology assimilation. Two that stand out are the IDA Ireland (Industrial Development Agency) and Tekes (the research and development fund) of Finland.

3.3 Five Business Development Challenges in Estonia

In the next section we survey the developmental and organizational progress of business enterprises in Estonia. We will focus primarily on companies that have grown in the post-independence environment. We hope the survey offer insights to better understand the sources of success in the face of the specific challenges facing business development in Estonia. These insights can feed into managerial decisions and government policies to foster both the diffusion of successful business models to other sectors and to make the transition to higher performance standards of all business enterprises.

All of the firms surveyed have either been reorganized or emerged in post-independence Estonia. They all faced, and continue to face, a series of challenges in their efforts to build the organizational capabilities to compete in the new competitive environment. The success stories have found a way to address or somehow counter each.

The first challenge is a small domestic market. This is particularly acute in the age of globalization and product standardization. It means that companies with products for which economies of scale are important must compete both at home and abroad with companies that have achieved economies of scale within large home markets.

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26 The macroeconomic, legal, financial, fiscal and regulatory environments have been the same for all Estonian firms and most agree they have been mainly favorable to business and business development.
**The second challenge is a capabilities gap:** Pre-independence Estonian production units did not have world class manufacturing, product development or technology management capabilities and usually were several technology generations behind technology-leading companies. The lack of new product development and technology management capabilities is critical because without such capabilities, innovation and growth potential are limited. The lack of technology management capabilities is particularly critical because access to, and assimilation of, the world’s technological resources is the time-tested route to higher productivity and rapid growth.27

**The third challenge is the small size of an experienced managerial/entrepreneurial class.** This is because firms have operated in a market environment only since the early 1990s. Doing the Soviet Union period inter-firm relations were coordinated by Moscow ministries. Why is this so important? It is the role and responsibility of managerial leadership to develop strategies and business models appropriate to the circumstances in which they operate. Business enterprises not only make products and sell services, in the process they develop and advance a company, region and country’s capabilities including management know-how.

**The fourth challenge is the lack of a critical mass of local companies to form a dynamic cluster** and thereby offer opportunities for specialization and for inter-firm partnering for purposes of product development or technology alliances. Fortunately, Estonia is well-positioned to develop business models that leverage innovative clusters abroad to foster local capability development.

The fifth challenge is that science and technology policy is not a significant and widely accepted part of the Estonian economic modernization project. A national research system along with education are critical elements in a technology-based economic development program to widen the industrial structure, raise the level of technology within enterprises, and foster the transition to knowledge-intensive sectors. As in most countries there are technology and innovation governmental agencies, but R&D is not widely considered an important instrument of industrial renewal; the central position of universities and of industry/university partnering in technology policy have not been institutionalised; and the tools of science and technology policy have not been calibrated to fit the specific needs of Estonian industrial “catch up” to European Union levels. Fortunately, Finland’s long experience in science and technology policy offer a nearby source of valuable lessons (Lemola, 2003).28

In the next chapter we conduct an introductory audit of business organization within Estonia. We seek to learn from the virtual laboratory of business model experiments what has been working in Estonia in the post-(re)independence period of nearly 20 years since the Gorbachov reforms of 1987 legalizing private enterprise and less than 15 years since the official end of socialism in the former Soviet Union on 2 January, 1992.

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27 The starting point when Estonia gained independence was not propitious in terms of business organization. Chris Freeman (1997; 33) has enumerated the features on the ‘national innovation system’ of the USSR as including the following: high gross expenditure on R&D/Gross National Product; extremely high proportion of military/space R&D (>70% of R&D); low proportion of total R&D at enterprise level and company financed (<10%); separation of R&D, production and import of technology and weak institutional linkages; weak or non-existent linkages between marketing, production and procurement; some incentives to innovate made increasingly strong in 1960s and 1970s but offset by disincentives affecting both management and work-force; and relatively weak exposure to international competition except in the arms race.

28 There is a technology and innovation division with Enterprise Estonia which deals with support to for firms for R&D and product development besides other schemes (www.eas.ee).
Having set out an appropriate framework of analysis, we come, then, to an exploration of the business models that are emerging in Estonia in search of success stories given the historical conditions and global environment. As we shall see, a number of business models have emerged over the past 15 years. In fact, Estonia has been a virtual laboratory of business models with numerous experiments being carried out. The questions we pose are the following. Are new ‘Estonian’ business models being crafted that are advancing capabilities and hold promise in the drive to catch-up? If the answer is yes, what can we learn from success stories to date about the characteristics of business models which, if diffused, could both drive the development and transformation of Estonian industry to a more complex industrial profile and higher productivity levels and expand productive employment opportunities?

Our investigation is structured in terms of the following seven characteristics of firms:

i. Mass production outsourcing;
ii. Technology specialization outsourcing;
iii. Flexible specialization;
iv. Multi-business networks;
v. Leveraging natural resources;
vi. Knowledge-intensive clusters;
vii. Non-tradeables.

Although there will be some degree of overlap between these seven classes, with some firms possessing more than one characteristic, nevertheless these represent a series of characteristics that are usually distinctive and serve to capture dominant or primary features of firms and clusters of firms, without denying that there are also important secondary features.

4.1 Mass production outsourcing

According to one comparison, total hourly compensation for manufacturing workers was between 12 and 16 times higher in the Sweden, Finland, and Norway than in Estonia in 2002. Another, company-based study limited to manufacturing estimates German labor costs per worker of approximately 7 times those of Estonia but German labor productivity of approximately 6 times the Estonian level (Konings 2004; see also Tiits (2006)). In an age of increasing out-sourcing by companies in high wage regions it would seem that Estonia would be well-positioned at least for the Scandinavian countries with which Estonia has historic cultural and commercial ties. Out-sourcing in Estonia takes two forms: inward foreign direct investment and sub-contracting. In both cases, production in Estonia is linked to global markets indirectly by a market leader usually headquartered in one of Scandinavian countries.

Not surprisingly, a number of Scandinavian companies in mass production industries have established operating units in Estonia. These operating units are physically located in Estonia but organizationally integrated into multinational companies headquartered elsewhere. These investments leverage management capabilities and marketing channels of the parent

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company; little additional managerial input is required in Estonia. This is one way to by-pass the four challenges (small local market, limited management experience, capabilities gaps, and disconnected innovation system) that confront local companies.

There are many examples in electronics.\textsuperscript{30} \textbf{Elcoteq Tallinn AS}, a subsidiary of Finland-headquartered Elcoteq Network Corporation and ranked number 41 in the Top 100 list,\textsuperscript{31} is the biggest example, by far. In fact, its size dwarfs all others. What can we learn from it?

Elcoteq is the largest electronics manufacturing services (aka contract manufacturing) company in Europe. Its customer list is the Who’s Who of Nordic telecommunication leaders including Nokia and Ericsson.\textsuperscript{32} A significant part of Elcoteq’s medium and high volume production is located in Estonia; Elcoteq also has plants in northwest Russia, Mexico and China (it is exiting from production facilities in Hungary).

Estonian employment by Elcoteq reached 3600 at the beginning of 2000 and was approximately 2300 in 2004. But Elcoteq Tallinn’s sales rebounded to EUR 101 million in 2005, a doubling over 2003 (profits, however, were only EUR 4.3 million and roughly the same margin as in 2003).\textsuperscript{33} Elcoteq accounted for 83\% of total ICT (information and communication technology) exports in 2001 and 15\% of total Estonian exports in 2002 (Tarmo Kalvet, 2004: 11-12).\textsuperscript{34}

\textbf{Does the experience of Elcoteq suggest that the strategy of foreign direct investment (FDI) by multi-national corporations to compete on the basis of mass production combined with low cost labor is viable in the Estonian context?} The short answer is that this is not likely in the long run given the small size of the labor force in a country with 1.3 million people. Wages would likely be pushed up rapidly. But a closer look at Elcoteq suggests there are conditions under which it might be viable.

Elcoteq combines low wages with “lean manufacturing” operations in Estonian plants to achieve world class performance standards in cost, quality, and delivery time. Its competitive advantage relative to Elcoteq’s plants in China is proximity to headquarters and customers. Nearness of manufacturing plant to head office and design staff is a virtue in new product development time compression and nearness to customer shortens delivery time and fosters more direct communication between customer and producer. Thus it appears that low wages combined with “lean manufacturing” operations and nearness to headquarters and customers can be a basis for business success at least given current wage differentials with the Nordic countries.

Nevertheless, Elcoteq is an exception at least in size. Other examples of FDI in electronics and telecommunication sub-contracting employ many less. For example, Ericsson and Nokia suppliers with Estonian plants including Nolato in polymers, Merab, Traction, Nefab and PMJ are all small, focused operations (Högselius 2002: 17).

\textsuperscript{30} For examples see Högselius (2002), Nissinen (2002) and Tiits \textit{et. al}. (2003).
\textsuperscript{31} Äripäev, the Estonian newspaper, has developed a methodology for ranking the top companies in Estonia. It is now owned by the Bonnier Group, the leading media corporation in Scandinavia which also publishes the Baltic Business News a daily english language news service that covers the 3 Baltic Republics.
\textsuperscript{32} Other customers include ADC, Allgon, ABB, Danfoss, Kone, Vaisala, Viterra, Andrew Corporation.
\textsuperscript{33} Data are from \textit{Estonian Economy}, Vol. 9, No. 3 July-August 2005: 6-7.
\textsuperscript{34} Kalvet (2004: 11) notes that the average salary for blue collar workers (2291 employees) in Elcoteq Tallinn was 258 EUR (2001) and for white collar workers (344 employees) was 757 EUR compared to the average salary in manufacturing in Estonia of 330 EUR (2001).
The other biggest mass production, or at least high volume, manufacturers are in the non-woven, domestic textile industry, such as Wendre AS and Toom Tekstiil, but even here the employment levels of approximately 600 are low by Elcoteq standards. Here we find a different variant of the mass production business model.

Estonia has a number of ‘mass production’ textile companies. Unlike in electronics, these companies were formed before independence and have a strong Estonian management role. They offer a different strategy and organization model for establishing mass production capabilities in Estonia. Here, too, one company stands out.

The largest, Wendre AS, exports 95 percent of what it produces. The company’s origins can be traced flax processing in 1930s. In 1965, flax processing was replaced with the non-woven fabric products and, in 1990, the production of quilts and pillows based on the polyester fiber. In 1993 it was privatized. In 1998, Peter Hunt acquired a 26% stake and in 2002 became sole owner of Wendre. Today Wendre is part of the Trading House Scandinavia AB group with headquarters in Sweden.

Wendre entered into its first contract with IKEA, the Swedish home furnishings retailer, in 1996. The IKEA relationship has mushroomed. Today, IKEA accounts for roughly half of Wendre’s sales and 70% of the total blankets and 40% of the pillows retailed in IKEA's stores are supplied by Wendre. In September 2005, Wendre opened a 6,000 square meter warehouse as an integral part of IKEA's logistics system, according the CEO Peter Hunt. The US$ 4 million investment will commit IKEA to acquire the annual 3mn pillows and 3mn blankets, generating the annual sales turnover of EKr 1.5-2bn (EUR100-125 million over the next three years for Wendre (Äripäev, 28 Feb 2005, p.3; Estonian Economy, p. 6).

The warehouse is part of a rapid delivery competitive strategy. According the Wendre’s website, the estimated transport time for finished products is from 1 day in Scandinavia to a maximum of 4 days in Spain; from the order to the product delivery in 5-10 days; and from the client's idea to the finished product sample in about 6 hours.

Wendre is global in technology acquisition as well. In 1999, Wendre acquired licenses from Advansa GmbH (DuPont GmbH), giving it the right to manufacturer blankets with DuPont fibres like Aerelle, Hollofil and Quallofil 7-hole hollow fibre. In cooperation with Eurofoam GmbH (Recticel Group) Wendre established Wenfoam AS, which cuts and treats foam and foam boards. Finally, over the 1998-2003 period, Wendre acquired Swedish light-industry companies Bergs Polyden AB, Björn Sellen AB, Bema Bedline AB and Bema Quilting AB.

IKEA offers Wendre direct access to IKEAs vast distribution and retail system. IKEA in turn demands the highest performance standards in the home furnishing industry in cost, quality and delivery time. Much can be learned by participating in IKEAs supplier development program and the unrivaled engineering expertise in the application of world class manufacturing practices to the home furnishing industry. But IKEA controls the cost structure and enforces razor thin margins. Wendre AS was ranked number 3 in the Top 100 for 2003 before slipping to 62 in 2004. Nevertheless, Wendre’s successful relationship with IKEA does prove that world class high volume production principles and manufacturing practices can be achieved in Estonia even though the products that Wendre supplies are not complex and technologically demanding.
Toom Textile AS is a second high volume producer in non-woven household textiles. Like Wendre, Toom Textile AS specializes in bedding products utilizing non-woven technology that include pillows, quilts and blankets, and mattresses and employs approximately 600. Toom Textile was ranked 52 in 2004 and received the Best Estonian Exporter of 1998.

The non-woven, domestic textile companies offer a second condition under which mass production may be a viable business model in Estonia namely, leveraging a long-standing and distinctive technological capability by partnering with global market leaders. **Estonia’s competitive advantage in mass production of non-woven textiles is indicated by an application in the car industry.** **Mistra Autotex** is a rapidly growing Estonian owned company that supplies non-woven textiles primarily to leading mass production auto companies including Saab, Volvo, and Ford. IKEA is also a customer. In recent years employment has doubled from 80 to 160 and sales from 3 million to 12 million euros.

**Norma AS**, with over EUR 50 million turnover in 2001, is a second car industry supplier but it is in a related technology (non-woven textile). Norma originally supplied seat belts to the Russian car industry. In 1999, fifty-one percent of its shares were purchased in 1999 by a Autoliv, Inc. of Sweden the world pacesetter in auto safety equipment systems. Autoliv pioneered seat belt technology in 1956. With the acquisition of Norma, Autoliv has outsourced it seat belt product line. **It would appear in this case that the competitive advantage of Norma AS is a technological capability and skill set combined with low labor costs that may not be easily replicated in other low cost regions.** Sales dropped to EUR 33 million in 2004 (*Estonian Economy*, July-August, 2005: 7).

Given the low wages, and low margins in sub-contracting, some have questioned the mass producers contribution to the Estonian economy. But from a production capability, developmental point of view, Elcoteq, Wendre, and the others are making a contribution to Estonia’s growth potential; these companies not only employ but train and educate thousands of Estonians in lean manufacturing practices. These general skills, embodied in workers and managers, represent a move up the production capabilities spectrum and given the large numbers can diffuse to diverse applications sectors. Equally importantly, they are a stepping stone to the development of more advance production capabilities in the same and other sectors.

To elaborate briefly, a **virtue of all these cases is the introduction and development of high throughput, lean manufacturing capabilities within Estonian production units whether foreign or locally owned and managed.** They teach advanced low inventory, zero-defect manufacturing methods to workers and managers both within their companies and, potentially, to local suppliers. Economic growth and development depends, to an important extent, in the diffusion of these production capabilities to a much larger proportion of the economy. Furthermore, these are important steps in the progression to world class manufacturing (WCM) practices, including continuous improvement, multiple products on the same line, new product development and technology management capabilities, all of which are inputs into the establishment of a knowledge-intensive production system and innovation-led competitiveness.

However, as important as “lean manufacturing” is to increased productivity and competitiveness, it is only one, if major, step to world class manufacturing practices. It is represented by production capability level 3 in Table 3.1. Lean manufacturing and WCM have one important characteristic in common: high throughput efficiency, low inventory,
minimum indirect labor practices. It is an application of the principle of flow to a single product. It is an accomplishment of process engineering. It is achieved by equalizing cycle times for the production of all immediate inputs so that assembly lines can produce with batch sizes of one. This is true mass production.

WCM, however, is the application of the principle of flow to multiple products.\textsuperscript{35} It means the production capability to produce multiple products on the same assembly line without sacrificing throughput efficiency.\textsuperscript{36} It requires the introduction of a series of manufacturing practices including cellular manufacturing, quick changeovers or SMED (single minute exchange of dies), SDWT (self-directed work teams), and TQM (total quality management). It is represented by level 6 in Table 3.1.

**While plant-level investigation may prove otherwise, it is unlikely that any of the Estonian manufacturing plants established for purposes of sub-contracting to global mass producers and retailers have developed multi-product flow production capabilities.** It is even unlikely that they have achieved single-product flow with continuous improvement as represented by level 4 in Table 3.1. But this is not meant to underestimate the advances in production capabilities that exist in many sub-contracting manufacturing operations in Estonia. Mass production in the Soviet system was about mass batch production, not about the application of the principle of flow. The transition is as difficult as it is necessary. In fact, the transition to level 3 on the production capabilities spectrum is likely to be more difficult than the next transitions. Level 3 involves establishing the principle of flow to a single product. The next step involves educating the workforce in the problem-solving tools of the quality movement which is the basis for continuous improvement. These advances are prerequisites to extending the principle of flow to multiple products and then to new product development.

### 4.2 Technology specialization outsourcing

While the global consumer markets of electronics, cars, apparel, and household furnishings are familiar, globalization has also led to the creation of global niche markets often dominated by technologically specialized enterprises. Here the competitive advantage is not low cost production dictated by scale economies and demanding the strict implementation of WCM but a distinctive technological capability and the market is often a business or industrial market rather than households. In this case, the strategy of the global company is to establish and maintain global leadership in niche markets.

Here again we find Estonian units both owned by and which outsource to foreign headquartered companies. Most are headquartered in the Scandinavian countries but also a number are headquartered in other countries including the US, UK, and Germany and Singapore. The parent or market setting companies are rarely Fortune 500 in size (perhaps none are) but they have long histories of developing distinctive technological capabilities at the global level. The Estonian companies partner in order to tap into the global market, to advance, acquire and assimilate specialized technologies, and to develop managerial experience and know-how.

\textsuperscript{35} For examples see Best (2001, chapter 2).

\textsuperscript{36} Throughput efficiency can be measured in inventory turns or the amount of inventory required to sustain a certain level of output. Toyota set the standard for many years with an inventory turn ratio of nearly 300. Many mass batch production plants are not able to achieve double digit levels.
International Steel, an example of foreign direct investment, has invested over US $200 million in its Estonian galvanization plant Galvex Estonia AS. The plant supplies high spec, flat rolled, galvanized steel according to world class quality and delivery time performance standards. The steel is imported from Russia and Ukraine as well as from Japan and Korea and sold to steel, construction and automotive industries around the world. The capacity is estimated to reach 1,500,000 tons per year. It employs 170 in a lean manufacturing facility organized along state-of-the-art lines introduced by Nucor, the US mini-mill that revolutionized steel making. International Steel was attracted by the closeness to both EU and Russian markets, low taxes, the deepest, ice-free port in the Baltics, and an eager if untrained workforce.

JOT Eesti OÜ, a second example, was established in 1997 by JOT Automation OY, a Finnish parent company that designs, manufactures, sells and services production automation equipment for the electronics, telecom, car electronics and electronics contract manufacturing industries. JOT Eesti employed nearly 200 in 2001 with an output of 37 million EUR which is entirely exported. JOT Eesti’s average salary was 862 EUR in 2001 and it spent 12% of turnover on R&D (Kalvet, 2004: 11).

JOT Eesti OÜ won the Developer of Technology 2000 award by Estonian Technology Agency for the high technological level of products, the market potential, the speed of elaborating new products, the attractiveness of the target market and good position in competition. JOT Eesti also won the TOP Investor 2000 in Estonia award, also by the Estonian Investment Agency for the substantial foreign investment (47.7 million EEK) made in the year 2000, for the growth in export and turnover and for the large proportion of research and developing activities in the turnover. JOT Eesti took part in the Estonian National Quality Award Contest 2002, and in November 2002 received a finalist prize.

The JOT Group joined the Elektrobit Group in 2002. Elektrobit is a major global supplier of product development and engineering services, products and production solutions. Currently, JOT Eesti delivers high-level industrial robots to Nokia, Ericsson, Siemens, Motorola and Elcoteq. JOT Eesti’s objective is to be a leading supplier of ‘productization’ solutions and a leading technology partner behind the best brands in selected industry areas. The Group’s business idea is to improve the competitiveness of the customer’s product and production by assuming total or partial responsibility for product development, product design, and the design of production and testing solutions and their implementation.


JOT Eesti seeks to move up the production capabilities spectrum to operationalize new product development and technology management. The following is from the company’s website. Automation Solutions’ long experience in electronics production automation, our vision of how electronics production is evolving and our well-organized R&D activities are combined in the wide range of production automation equipment and solutions we’re offering to our customers for material handling, processing and assembly automation. Along with the equipment and solutions, we offer an in-depth understanding of product lifecycle and Design for Automation (DFA) issues that have a great effect on the profitability of mass production. The built-in flexibility is one of the design goals at Automation Solutions. It means that a piece of equipment can manage end products with a wide range of parameters without any changes to the cell or robot. The reusability is another goal when the cells and production solutions are designed. Modular structure of the single cell ensures efficient production modifications for new products. These guidelines lead to reliability, affordability, short delivery times and the product being a secure investment. Simple maintenance is the other design goal for the equipments. This is achieved by the platform standardization, together with easy access to components requiring maintenance and the use of standard, easily available components. The current frequency of new product releases demands fast time to market and time to volume. Short time to market can be achieved with careful project management,
More often, the global technology specialist will acquire an Estonian plant with a technologically-related heritage. Rautaruukki Oy of Finland acquired Rannila Profiil AS, a metal processing company which produces large metal structures, basically for roofs and enjoyed a turnover of 36 million euros in 2001. It has since been renamed Ruukki Construction AS. The parent has demonstrated that specialized steel making can be profitable in the Baltic region if it pursues a focused strategy of technological leadership, the “Nucor” low overhead organizational model, and a skill formation program. Critically important to Rautaruukki’s technology leadership strategy has been innovations in thin slab and ultra-thin hot strip slabs, plate technology, and organic coatings (Jonathan Aylen 2003). Equally important has been the company’s skill development and education programs institutionalized in Ferrea, the Rautaruukki Industrial Institute in Raahe, northern Finland. Ferrea offers a steel manufacturing and upgrading curriculum with hands-on practice at Rautaruukki where many of the graduates find employment.

Global technology capability specialist networks can also be found in resource intensive industries. Stora Enso, the forest products giant profiled below, has been included in the Dow Jones Sustainability Indexes for seven consecutive years, the only forest products & paper company that has been included in the indexes every year since the index was first launched.  

Balti Spoon was established by the Möhring group of companies in Kuusalu, Estonia. Karl Heinz Möhring, the founder he started veneer business in Hamburg in 1947, then he built the first veneer mill in Lemgo, the heart of German furniture manufacturing before establishing companies in Germany, Canada, Liberia, Brazil, USA, Estonia and Russia. In 1998, Balti Spoon started with one production building producing sliced and rotary veneer and employing 50 people. In 2000, a second plant was built, and in 2001 a third plant was built, each specializing in a distinctive veneer product. Today Balti Spoon is perhaps the largest birch veneer mill anywhere, employing 650 people.

Another resource-intensive example is cement manufacturing based on high quality limestone in Kunda which started in 1870. Kunda Nordic Cement AS, ranked number 78 in the Top 100 Estonian companies now belongs to the Heidelberg Cement Group. The Heidelberg Cement Group, with activities in 50 countries and worldwide cement sales of approximately 65 million tons and 42,000 employees, one of the largest cement manufacturers in the world. Maxit Estonia AS, ranked 33rd in the Top 100 Estonian companies, is also part of Heidelberg Cement; in this case the Maxit group of 45 companies in 30 countries. Maxit Estonia makes premix and cement blocks and exports 40% to Lithuania and Latvia. The interesting thing about Kunda Cement and Maxit Estonia is that they are part of a global company that has taken a bulky, heavy and largely non-tradable commodity and made it tradable.

It is not only Nordic headquartered companies that operate units in Estonia. Amphenol, a US contract manufacturer with 13,900 employees worldwide, acquired the former Microlink Elektroonika for the purpose of producing coaxial cable products to cable television operators and broadband telecommunication companies in Europe and around the world.

concurrent engineering process and development re-usage. Short time to volume is based on utilizing standard solutions and world wide capacity implementation resources.

39 DJSI World includes over 300 companies from 24 countries assessing economic, environmental and social aspects of the 2 500 largest companies in the Dow Jones Global Index.

40 Orica, based in Australia, the world’s largest supplier of commercial explosives with operations in over 30 countries including Estonia is another example.
Amphenol sells its connector products through its own global sales force and independent manufacturers' representatives to thousands of OEMs (original equipment manufacturers) in approximately 60 countries throughout the world as well as through a global network of electronics distributors. Amphenol employs 40 engineers and administrative personnel and 130 production workers. The exceptionally high number of engineers, if correct, suggests that Amphenol is doing product development work in Estonia.

Local knowledge-intensive business service companies also partner with global niche companies. For example, Entec AS is a small environmental consulting company 40 percent owned Jaakko Pöyry Group, the Finnish engineering consulting giant with a staff of 3600 located in 30 countries. The partnership enables Entec AS to integrate “global expertise with local presence”. The Jaakko Pöyry Group, which specializes in the forest industry, energy, and infrastructure and environment, is also 80 percent owner of forest industry consultancy, JP-Terasto Eesti OÜ.

Global niche networks offer certain protection from the competitive advantage that the East and South Asian countries increasingly enjoy in high volume production. Global niche networks tend to be based on the development of distinctive technological capabilities built up over many product generations.

Technology specialization outsourcing is a business model that offers considerable potential in terms of advancing Estonia’s managerial performance. The potential for management learning and transfer and assimilation of technology is considerably greater than with global production networks.

4.3 Flexible specialization.

Foreign direct investment and outsourcing offer one avenue for latecomers to connect with global markets and thereby establish the scale and develop the capabilities required to succeed. But global markets are not the only route. Another business model is to develop a core competence that has applications in multiple, mainly local markets. ‘Flexible specialization’ demands flexibility in production in order to alter the composition of output to fit shifting market conditions.

Standard Furniture AS is an example of the flexible specialization business model. Standard specializes in “office” or non-household furniture most of which is marketed domestically. In 2004, Standard achieved a double digit growth and profit rate on sales of nearly EUR 10 million, 72 percent of which was exported.41

The term office refers to a range of office, hotel, school, government, and public rooms. Public rooms includes conference and lecture rooms. Standard has supplied offices/rooms for companies in all business sectors, libraries, museums, schools, and hotels. Standard has established flexibility in production by combining a staff of designer/product developers with skilled labor and investments in flexible, numerically control machines. The flexibility enables the company, for example, to respond to a downturn in the demand for, say, office furniture with pursuit of, for example, hotel furniture.

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41 In 2004, sales increased by 11.3% to 155.6 million kroons and new profit came to 20.9 million kroons and exports increased by 12.45 (Estonian Economy, Vol. 9, No. 3 July-August 2005: 6).
Standard is an example of a locally owned business enterprise that is establishing a distinctive capability and employing a business model that is ideally suited to the environment of a small local market in a global economy. The market is too small for global giants to enter particularly when the demand is for a customized product.

Flexible specialization is also appropriate in knowledge-intensive business services that seek to leverage specialist expertise developed in other countries. For example, Fabec Elektronica OÜ is a Swedish electronic manufacturing service company whose employment in Estonia have grown from 10 in 1993 to 170 in 2005. It offers product- and technology design and manufacturing service, and responsibility for product life-cycle to North-European automotive, communication, industrial and consumer electronic trading companies.

4.4 Multi-business networks

A virtue of the flexible specialization business model is that it fosters industrial districts or networked groups of small firms as an alternative to vertical integration. In fact, flexibly specialized and networked companies enjoy the mutually reinforcing benefits of increasing specialization and market size. If, for example, all veneer-using furniture companies also produce their own veneers then the market for a specialist veneer making company will be small and not viable. In contrast, if all the veneer-using companies outsource veneers, the size of the veneer market will be determined by the size of the entire furniture industry. Most importantly, a well-managed specialist veneer-making company can use the experience of supplying multiple customers to develop distinctive capabilities that are unmatched in vertically integrated companies.

Business success, once we account for learning, depends upon focusing on a core capability and partnering for complementary capabilities. This seems to be an increasingly common business model in Estonia among big and small companies and is emerging in different sectors, although the form of networks varies from case to case.

Harju Elekter, in the electrical equipment sector, has used the multi-unit business model as a vehicle for technology/product differentiation and growth. In fact, Harju Elekter is a hybrid of global technology specialist and local multi-business group. Ranked fifth in the Äripaeva Top 100 Estonian Companies in 2004, Harju Elekter started production of electrical equipment in 1968 and still employs 130 in its electrical equipment factory. In 1988 it sought foreign partners and in 1991 began production of cable harnesses which were subcontracted to PKC of Finland, a global niche player in cable harnesses for the trucking industry. AS AJT Harju Elekter became a wholly owned subsidiary of the PKC Group in 2002. Today, PKC Eesti employs 500 in its Estonian truck cable factory.

Two joint venture companies in Harju Elekter Group were founded with foreign companies. The biggest cable manufacturer (installation cables and low-voltage power cables) in the Baltic states AS Keila Kaabel (HE participation 34%) in partnership with Nokia Cables from Finland was established in 1992. A fireproof and safety doors manufacturer AS Saajos Balti (HE participation 33.3%) in partnership with Saajos Int. Ltd. from Finland and Inexa A/S from Denmark in 1995. A third joint venture, AS Glamox Harju Elekter (HE 49% – Glamox, Norway 51%), was founded in 1992 but sold to Glamox in 2000. The main products of Glamox are light fittings and electrical heaters.
In 2002, Harju Elekter purchased 100 per cent of the shares of Satmatic Oy (previously a subsidiary of Siemens). The core business of the company is manufacturing equipment for power distribution networks, industrial and automation systems for the energy and industrial sectors. In 2003, Harju Elekter purchased 51% of shares of the Lithuanian company UAB Rifas. The core business of the newest subsidiary is the manufacture and sale of electrical control and distribution units and the design and installation of industrial automation equipment.

For output and employment size, however, the most important examples are in three large and closely related sectors: shipbuilding and ship repair, construction, and prefab housing.

Two examples can be found in shipbuilding and ship repair. BLRT Grupp’s history began in 1912 with the establishment of a company to supply the Russian Navy with ships. After World War II the company focused on repairs of military vessels, followed, in the 70s and 80s, on repairs of fishing vessels. Following Estonia’s transition to a market economy, BLRT Grupp management made the decision to develop “new versatile product lines”.

In the process, BLRT grew out from a single-business company specializing in ship repairs to a range of business activities linked to shipbuilding and repairing and other activities that leverage their skill base and related expertise. By the turn of the century, BLRT offered ship repair services, shipbuilding, rolling stock repair, heavy steel construction, port services, and steel scrap trading services.

The company has invested heavily and grown rapidly into one of the largest non-financial MNCs of Central and East European origin. Output has increased from 1000 million EEKs in 2000 to 2500 million EEKs in 2004 with about 3500 employees (including the acquisition of the Lithuanian company AB Vakaru Laivu Gamykla). Remarkably, it has invested 20 percent of output over the 2000-2004 period (investments of 1750 million EEKs and output of 8500 million EEKs).

A highly decentralized business model was established which, by 2005, has proliferated into 61 subsidiaries albeit many are tiny. According to the company:

“The structure was created at the end of the 90s based on the idea to make a more efficient and customer-oriented company. In turn this aim was caused by the necessity to compete successfully with other companies in the Baltic and Scandinavian countries.”

It also grew by two acquisitions. It acquired the Tallinn Sea Factory and its unique slipway facility in 2000 and it purchased the main holding of shares of a Lithuanian ship repair company, Vakaru Laivu Remontas in Klaipeda. Today Vakaru Laivu Gamykla is a multi-profile, dynamically developing company, which consists of 19 subsidiaries. The VLG structure is similar to that of BLRT Grupp.

Today the basic kinds of activity of the BLRT Grupp are as follows:

i. Shipbuilding
ii. Ship repair and conversion
iii. Manufacture of metal constructions
iv. Machine building
v. Scrap metal processing
v. Port services and stevedoring
vi. Rolling stock repair
vii. Production and sale of industrial and medical gases
ix. Metal trading
x. Road transport service

To date, this large decentralized, industrial enterprise has been a success. The BLRT Group has moved up in the Top 100 companies from 36th in 2003 to 26th in 2004. The multi-unit business model builds on the company’s heritage in shipbuilding and repair but has created the size necessary to support a management team combined with specialized business units that can deal directly with customers. For large projects, many of the business units work together but each can also work independently. The group actively participates in Estonian, Latvian, Lithuanian and Russian markets.

In the last year the BLRT Group and the Wärtsilä Corporation of Sweden set up a joint venture to service ships in the Baltic area. Wärtsilä, founded in 1834 as a sawmill, is a global niche operator in power plants for ship and offshore installations. Power is its core business. In recent years, Wärtsilä has become a leading provider of offshore power plants, including the operation and lifetime care services in decentralized power generation. It has a worldwide network of 130 offices and workshops in 60 countries providing a service workforce of some 6000 people.

The joint venture is owned 51% by Wärtsilä and 49% by the BLRT Grupp. The new company name is OÜ Ciserv BLRT Baltica and it will provide a single source of marine service covering all aspects of ship repair including servicing of engines, gearboxes, propellers and other ship equipment. Ciserv BLRT Baltica will operate in Tallinn, Estonia. The joint venture will provide Ciserv customers with full shipyard repair facilities in the Baltic region.

Loksa Shipyard AS is part of a similar networked business model. In 1994 it became the property of Odense Steel Shipyards Ltd., a member of the A.P. Moller-Maersk group of Denmark, the world leader in shipping containers and the biggest Danish investor in Estonia. A.P. Moller Group has more than 60,000 employees in more than 100 countries around the world. Besides shipping and logistics, the A.P. Moller Group is engaged in the exploration and production of oil and gas, shipbuilding, aviation, industry, supermarkets, and IT services. Loksa Shipyard has since specialized in metal ship parts and hatches, primarily for Danish-made vessels. The company claims that productivity of the Shipyard increased by five times in the first four years after the change in ownership. There are six A.P. Moller Group entities in Estonia with close to 2000 employees. Maersk Eesti is local agent for Maersk Sealand. Maersk Air Maintenance Eesti AS and Maersk Air Support Services Eesti AS provide Boeing aircraft maintenance and air support services for both Estonian Air, and Maersk Air. Balti ES is a part of Maersk Container Industry. Svitzer Eesti represents Svitzer brand in Estonia. A.P. Moller Group is the biggest Danish investor in Estonia.

AS Tarkon (85% owned by Swedish Hallberg-Sekrom) and a turnover of EUR 10 million is an example of a fast-growing metal processing company deploying the focus and network business model. Founded in 1907, the company has 600 employees and a fascinating history. The position of Tarkon AS within the Hallberg-Sekron is as follows:
Tarkon, in turn, had informal partnerships with the following companies in Tartu:

The parent company has a diversified customer base:

Merko Ehitus AS, number four in the Top 100 Estonian companies, is a public company in construction. It had a group turnover of EEK 3,110 million or Euro 200 million in 2004, a gain of 15% and a 50% return on equity.\(^{42}\) It is listed in the Tallinn, Frankfurt, and Munich

\(^{42}\) These figures may reflect the on-going real estate boom, which has started showing first signs of cooling down in early 2006.
stock markets. The Group consists of 32 subsidiaries (10 are in construction and the rest in real estate) and eleven associated companies. It operates in the three Baltic states and, with partners, won a tender worth Euro 13 million for reconstructing a factory building in Vyborg Russia. Merk Ehitus has 274 employees in the parent company and 636 in the Group.\textsuperscript{43}

A similar business model can be found at Eesti Ehitus AS, the third largest Estonian construction company, with a turnover of Euro 63 million and ranked number 80 in the Top 100 Estonian companies (Äripäev).

This sector is not without substantial foreign representation. NCC, the Swedish global construction and property-developing giant with 22,000 employees and Group sales of SEK 45 billion in 2004, established an Estonian subsidiary in 1996. NCC Ehitus AS was ranked number three in the Top 100 Estonian companies in 2004.

NCC Ehitus AS employs 80 directly and had a turnover of EUR 24 million in 2004. The parent, NCC, develops residential and commercial property projects and builds offices, industrial facilities, housing, roads, civil-engineering structures and other types of infrastructure. A vertically integrated company, NCC is also active in construction materials including asphalt and aggregates and conducts paving, operation and maintenance operations in the roads sector.

Pre-fab house construction is a closely related sector in Estonia that is also large in employment and may offer even greater growth potential. Pre-fab house builders are coordinators, organizers, and mobilizers of a broad supplier industry including sawmills for profiled boards, doors and windows, furniture, etc. Together these companies have the potential to coordinate a considerable number of companies and, in the process, foster the cluster dynamic processes of specialization and integration.

The leading example is Kodumajatehase AS, a factory producing ready-made-houses, which has climbed from number 360 to number eleven in the top Estonian companies. Kodumaja exports 95\% of its prefab houses, mainly to Germany and Scandinavia. More recently Kodumaja has extended its modular house expertise to built-in-factory, transported, and assembled apartment complexes up to 5 stories. Others in the prefab housing sector in Tartu include Plameko Ehitus, Estiske Laftehus, and Rannu Bangeman (Tartu Region, Sector Overview).\textsuperscript{44} Other Estonian producers include OÜ Matek, a large producer of pre-fabricated wooden houses in Pärnu, AS Astel, specializes in garden houses in Räpina. AS Ritsu in Valga county, AS RPM in Elva, AS Palktare in Saku and AS Palmatin in Tallinn all produce prefab log-houses (Tartu Region: sector overview).

Pre-fab housing construction is also a means of adding value to natural resources found in Estonia. This, too, is a sector with considerable potential if the right business models are developed.

\textbf{4.5 Leveraging natural resources}

\textsuperscript{43} From the Annual Report it appears that employees in the parent company make Euro 19K and in the group of companies Euro 14.3K; and the 4 board members make Euro 77K.
\textsuperscript{44} See \url{www.tartu.ee}; full reference: \url{http://cms.artmedia.ee/arinou/failid/Wood%20layout%20PR%20-%20final.pdf}.
Estonia has large forest resources and is a gateway to much larger forest resources in Russia. Perhaps surprisingly, the wood processing industry has considerable potential to become a high-value-added cluster if it develops advanced technological capabilities befitting a coming age in which natural resource stewardship becomes integral to business success.

Estonia’s industrial structure should not be compared with the average OECD profile but with successful resource-based economies such as Finland, Sweden, Canada, US, and Australia. For example, Finland’s forest products have declined but were still 21% of manufacturing and 29% of manufacturing exports in 2000. (This does not include the world leading paper machine makers, Metso). This involves cluster development and the promotion of “resource industry linkages”; it also demands R&D involvement and long and sustained investment in education, innovation, and entrepreneurship. Three types of linkages can be distinguished: downstream (beneficiation), sidestream (capital goods and inputs), technology (lateral migration). Downstream examples: pulp, paper, packaging, prefab houses. Job creation is greatest at the beginning and end of the value chain and least in the middle, processing links.

The challenge is to develop and leverage resource technologies along the lines of the Nordic countries. A good example is the Finnish forest and related engineering and electronics (Forenel) cluster (Kuusisto 2005). The idea is that the cluster is a unique combination of elements from all three.

Forest industry products include paper, board, and pulp as well as wood. Sub-sectors can include forestry, wood construction, chemical industry, machinery and equipment, automation and information technology, logistics, energy, research and education, consulting and risk management services, printing, and packaging.

Direct forest industry—wood and wood products; pulp, paper and paper products—employs approximately 70,000 people in Finland, and accounts for 5% of Finland’s GDP. When the other actors are added up (forestry, engineering, chemical engineering, transportation, business services, printing) it is estimated that the cluster employs up to 170,000 people in Finland. Overall the share of Finnish forest products of the world’s exports in the printing and writing papers is around 25%, in forest tractors 25%, paper machinery 30%, and pulp machines 40%. Amazingly, 60% of total capacity of the Finnish paper industry is now located outside Finland. It is argued that the Finnish forest industry is more anchored to the knowledge base of the cluster than to Finnish ownership as such. Besides the companies involved, research institutes and universities located in Finland contribute to this knowledge base (Kuusisto 2005)

The forestry industry has evolved almost beyond recognition by a cumulative specialization and clusterization process. Over the recent years, a key feature has been the emergence of knowledge intensive service activities (KISA). KISA can be seen as catalysts of change and have a role in the renewal of industry. Within the forestry industries KISA is particularly important in R&D, technical design, ICT, logistics, maintenance, and consulting. A recent OECD commissioned report lists the following KISA linked to the Finnish forestry industry (Kuusisto 2005):

45 For an interesting discussion of resource-intensive industry linkages see Paul Jourdan (2004). Jourdan is an official of the Ministry of Mining Technology, South Africa. www.mintek.co.za.
46 Italy also has a dynamic cluster that has evolved, in this case, from furniture to interior design and furnishing.
R&D. R&D activities related to forestry, logging, fiber research, chemicals, process development and logistics. Services are provided by suppliers, universities, research institutes, engineering firms and consultants, seed financing public and private, national technology agency, expert networks, piloting with a potential customer.

Expert services. Techno-economic, environmental and forestry-related services supplied by engineering firms and forest industry consultants, equipment suppliers and their contractors, universities and research institutes.

ICT services. Process control and automation, business management systems and global infrastructure sourced from IT-equipment suppliers, software developers, software service firms, and telecommunications operators.

Marketing, logistics and customer interface related services. Solutions selling, integrated systems and marketing services supplied by research institutes, consultants, a wide variety of experts providing specific knowledge for projects requiring cross disciplinary knowledge, experts from customer firms.

New business venturing. Business incubation and new business venturing services provided by innovation units, inventors, SMEs, business development experts, legal experts (patenting), financing experts and researchers.

Service, maintenance and facility management.

Where do such specialist KIBS (knowledge-intensive business service) companies come from? One source is spin-offs from larger firms. Another is the establishment of service subsidiaries. Forteck a maintenance firm jointly owned by a forestry firm and an industrial full-service firm, is an example.

“Forteck provides full service contracts to industries such as pulp mills, paper mills, chemical plants and sawmills. These large industrial processes require sophisticated maintenance in order to guarantee smooth operation and high availability of the production lines. The strength of Forteck lies in our experience in the process industry.”

Forteck is a subsidiary of Stora Enso which owns 75% of the shares. The remaining ownership belongs to ABB, which has developed a high level of expertise in service and maintenance on a global scale. Forteck employs about 1000.

A survey of forestry products industry of Estonia reveals vast opportunity for technological development. Almost ¾ of Estonian wood processing companies are small companies with up to 20 employees, with limited investment, and minimal processing. But this industry is changing rapidly.

The fastest growth in Estonian exports in recent years has been wood products. Foreign investment has poured into the wood processing sector since Independence. Some examples of the range of fields are shown in Table 4.1.47

47 See KPMG (2002), for details on these investments, including amounts.
Table 4.1: Larger foreign investments in wood sector

<table>
<thead>
<tr>
<th>Company name</th>
<th>Field of business</th>
<th>Foreign investor (country)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estonian Cell</td>
<td>Pulp plant</td>
<td>Norway, Austria</td>
</tr>
<tr>
<td>Horizon Pulp and Paper AS</td>
<td>Pulp, paper and other paper products</td>
<td>Singapore, USA</td>
</tr>
<tr>
<td>Balti Spoon AS</td>
<td>Furniture industry materials</td>
<td>USA</td>
</tr>
<tr>
<td>Stora Enso AS</td>
<td>Wood processing</td>
<td>Finland</td>
</tr>
<tr>
<td>Valga Gomab Mööbel AS</td>
<td>Furniture</td>
<td>Sweden</td>
</tr>
<tr>
<td>Finnforest AS</td>
<td>Sawn wood</td>
<td>Finland</td>
</tr>
<tr>
<td>Fenestra AS</td>
<td>Windows and balcony doors</td>
<td>Finland</td>
</tr>
<tr>
<td>Natural AS</td>
<td>Sawn wood</td>
<td>Iceland</td>
</tr>
<tr>
<td>Flexa Eesti AS</td>
<td>Furniture, sawn wood</td>
<td>Denmark</td>
</tr>
<tr>
<td>Viktor Stationery</td>
<td>Stationery</td>
<td>UK</td>
</tr>
</tbody>
</table>


Foreign investment in the timber industry has been associated with increased local processing and increased specialization. In 1992 unprocessed wood made up about 50% of the timber export but only 28% by 2001 (kpmg 2002: 56). Table 4.1 illustrates the range of specialist activities.

The largest foreign presence is Stora Enso, the largest wood processing company in Europe and the third largest in the world. Stora Enso current structure was formed in 1999, when three companies merged – Finnish Enso Timber, Swedish Stora Timber and Austrian Holzindustrie Schweighofer. But its roots can be traced back to the thirteenth century.48

48 Historical highlights of Stora Enso Timber:
2003 Stora Enso Timber acquires 66% ownership of Sylvester’s sawmilling operations in the Baltic States
2002 Company decided to build two sawmills to Russia and acquire 66% of Sylvester, Estonia’s largest wood product company
2001 Stora Enso Timber becomes fully owned by Stora Enso and a core business area
2000 Holzverke Wimmer 49% shareholding in Germany
1999 Stora Enso Timber Oy Ltd is created
1998 Enso and Stora mergers
Enso Timber and Holzindustrie Schweighofer mergers
1872 Enso Gutzeit
Hans Gutzeit starts first sawmill in Kotka
1642 First mentioning of Schweighofer as owner of sawmill
1288 Stora Koppaberg starts with mining
Today, it is an integrated paper, packaging and forest products company producing publication and fine papers, packaging boards and wood products, areas in which the Group is a global market leader. Stora Enso sales totalled EUR 12.4 billion in 2004. The Group has some 45 000 employees in more than 40 countries in five continents. Stora Enso’s shares are listed in Helsinki, Stockholm and New York.

Stora Enso serves its mainly business-to-business customers through its own global sales and marketing network. Customers are large and small publishers, printing houses and merchants, as well as the packaging, joinery and construction industries worldwide. The main markets are Europe, North America and Asia.

Stora Enso owns or is majority owner in six Estonian sawmills, all of which have been acquired since privatization of the forests. These mills are modern, highly capitalized facilities which process Estonian and imported timber, mainly from Russia.

Stora Enso Timber focuses on mass-customised value-added products for growing industrial end-uses. They include laminated, stress-graded and finger-jointed products for standardised building purposes and the joinery industries. Basic and commercialised products are manufactured for timber merchants and importer-distributors.

Other major foreign investments include Baltic Spoon, the specialist Birch veneer company also profiled above. The Finnish global giant UPM-Kymmene group together with the companies Forestex and Sylvester have begun a 100 million EEK investment in the production of water resistant birch plywood in Otepää. Estiske Laftehus, a Norwegian specialist in pre-fab log houses, has its manufacturing operation in Estonia. Irish capital established a sawmill called Balcas Estonia. One of the main owners of Toftan is Swedish company Thomesto Sverige AB.

Many foreign investors in wood products see Estonia as a gateway to the vast Russian forest reserves. For example, Baltic Lumber and Moulding Group is a vertically integrated company owned by Amdour Inc., USA involved in the planting, growing, harvesting, drying, manufacturing, marketing, and international distributing of lumber and millwork products. Baltic Lumber and Moulding OÜ. Estonia (a.k.a. PKA TKE Grupp AS) is a millwork facility in Estonia that processes lumber shipped from wholly owned sawmill operations situated in Russia. The Estonian plant utilizes, in the words of the company’s website, “state-of-the-art lumber processing equipment from world-class manufacturers such as Weinig, Kallfass, Nardi, and Industrial…This allows production of a wide range of millwork products from softwoods and hardwoods in volumes approaching 80 forty-foot containers per month” (http://www.balticmoulding.com/aboutus.asp).

Many of the locally headquartered woodworking companies have a long heritage that have left a mark on the development of the industry. TVMK Ltd., with 400 employees, is one of the largest woodworking companies in Estonia. It was established in 1877. In 1889 the factory became one of the first plywood producers in the world. It has claims to the development of special technology that enabled the use of bent plywood in furniture manufacturing for the first time in history. In 2001 TVMK Ltd. received a Quality System Certificate.

49 Estonia Imavere Sawmill, Launkalne Sawmill, Näpi Sawmill, Paikuse Sawmill, Sauga Sawmill, and Viljandi Component Mill.
**Tarmeko AS** with over 700 employees is the largest enterprise in the Estonian woodworking industry. It managed a transition from the combine, fully-integrated, “mass” production organizational form that prevailed in the Estonian furniture industry during the Soviet period.\(^{50}\) Tarmeko produced five different sizes of one single product: chipboard desks for Soviet Union customers. With the introduction of the Estonian Currency Board in 1992, both the supply of inputs from Soviet sources and the distribution system collapsed. Almost overnight the demand for chipboard desks dropped from 500/day to a couple of dozen.

Remarkably, whereas 96% of its products were shipped to the Soviet Union in 1991, 88% were shipped to hard currency countries in 1993. To meet the demand, the number of products increased to 150 and long production runs were replaced by short runs. In 1994, six directors took control of the company through a management buyout (Von Hirschhausen and Hui 1995). Today, AS Tarmeko has three major factories:

i. solid pine furniture factory together with office furniture department  
ii. upholstered furniture factory  
iii. form pressed veneer factory (birch veneer components and easy furniture)

Tarmeko has invested in modern, flexible machinery. For example, its birch veneer form-pressed products are processed with a computerized machining center which can machine complicated three-dimensional products.\(^{51}\) Modern technology is not the same as technology management capability which cannot be purchased. Consequently, productivity is not high by international standards and the large size has been a deterrent to attracting private investment, foreign or domestic. At present, Tarmeko is caught between its Soviet combine heritage and a business model that can foster a dynamic between capability development and market opportunity.

Some successful wood processing companies are new entrants. **Rait Ltd.** Tartu, established in 1991, climbed to number 44 in the Top 100 Estonian Companies in 2003. It grew from a small sawmill through co-operation amongst a group of small companies including Viiratsi sawmill, Aegviidu sawmill, Reola planing mill all of which supply a flexibly equipped wood finishing plant.

While forest products is the largest natural resource industry in Estonia, it is not the only one. The construction materials, oil shale, chemical, and power industries all export.\(^{52}\)

There are about 30 enterprises in Estonia with more than 50 employees engaged in manufacturing construction materials. There is a wide range of construction materials produced in Estonia, mainly cement and reinforced concrete details, bricks, roofing sheets, wall claddings, wallpaper, paints, and varnishes. Total sales of the members of the Association of Construction Material Producers of Estonia in 2002 was EEK 2.9 billion (1 EUR= EEK 15.65) (www.investinestonia.com). The turnover is equal to roughly 10 percent that of the construction sector.

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\(^{50}\) It was not real mass production based on low inventory and high throughput efficiency but mass in the sense of large quantity of the same product. Unfortunately, these two concepts lead to very different productivity levels and the fundamental differences are not fully appreciated to this day.  
\(^{51}\) The P. Bacci CNC TWIN with 5 axels is state-of-the-art technology.  
\(^{52}\) Kunda Nordic Cement AS and Maxit Estonia AS in the cement industry are profiled in the specialist technology section.
About 30 percent of construction materials produced in Estonia are exported. Due to the heavy and bulkiness of most construction materials export are mainly to Latvia, Lithuania, Finland, and Russia. Main export products are cement, plywood, roofing slates, bricks, paints, and varnishes.

The largest construction materials company in Estonia is Ruukki Construction AS, former Rannila Profiil AS, which belongs to the Finnish Rautaruukki Group (profiled in technology specialization outsourcing section above). The Estonian subsidiary had a turnover of EEK 650 million in 2002. The parent has operations in 24 countries and employs 12,000 people. Rautaruukki Group, perhaps best known for specialty steel products also supplies components, systems and total solutions to the construction and mechanical engineering industries.

The second largest producer of construction materials in Estonia is Kunda Nordic Cement AS, ranked number 78 in the Top 100 Estonian companies now belongs to the Heidelberg Cement Group, profiled above in technology specialization section. Its turnover was EEK 455 million in 2002.

OU Krimelte, also in construction materials, was winner of Enterprise Estonia’s exporter of year award for 2004 and was ranked number 13 in the Top 100 Estonian companies for the same year. Krimelte, originally a retailer, produces various joint sealants. In 2002, 95% of its production was exported to the Russian, Turkish, Spanish, Latvian, Lithuanian, Ukrainian markets.

Modern industry depends on electric power. Most of Estonia’s small power generation capacity was destroyed as first the Soviet and second the German armies retreated from Estonian territory. The post-war period was one of heavy investment by the USSR in electricity generating capacity fueled by oil shale. It is the only oil shale fueled system in the world. The development of the industry began with huge investment in Eesti Energia (established in 1939) and the integrated plant Eesti Põlevkivi for the purpose of mining oil shale. In the 1950s high-voltage power lines connected Estonia internally, for the first time, and into the Soviet grid. In 1966, the Balti power plant achieved the world’s greatest capacity of 1624 MW and in 1973 the Eesti Power plant achieved a capacity of 1610 MW. They were and are uniquely powered by oil shale. Oil shale was the pivotal resource in a huge mining, chemical and power generation complex in the northeast of Estonia employing many thousands. Eesti Energia employment dropped from 12,870 in 1999/2000 to 9542 in 2004/5. But it must remain the largest single employer in Estonian industry by a considerable margin.

The first written record of oil shale in Estonia is recorded in 1725 when globetrotter J.A. Gultanstadt mentions in his journals that local shepherders burn certain rocks for fuel. Today, virtually 100 percent of Estonia’s electricity needs are met by oil shale and an increasing amount is exported to the other Baltic republics especially with the shutdown of a unit of Lithuania’s Ignalina nuclear reactor of 1300MW. Estonia exported a record breaking 1.39TWh to Latvia and set a new record in oil shale production. Excess generating capacity is used to refine oil shale from Russia. Furthermore, oil shale is Estonia’s major export to the

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53 Other exporters of construction materials include Wiekor in roofing slates, Saajos Balti, K.M.T. Fassaadimeistrid, Nordkalk, Fenestra, Viking Window and Wienerberger.

54 The data and details in this section are taken from Eesti Energia, Annual Report 2004/05 and the analysis is indebted to Per Högselius (2001).
US along with associated mineral fuels. Exports have grown with the rise in the price of heavy fuel oil, shale oil’s main competitor. Still, the industry has 50 percent excess capacity.

Another significant event is the construction agreement on an Estonian-Finnish undersea cable with 350MW capacity to be built by the Swedish-Swiss group ABB. The export potential from the big shale plants looks promising with accession to the EU and the eventual connections to a deregulated European electricity market. Estonia could play a pivotal linkage role given its unique connections to the electricity systems of Russia, Finland, Latvia and Lithuania and, eventually, a deregulated EU. The long term future of oil shale generated electricity, however, is not entirely certain. The 100 percent state owned Eesti Energia has been investing in new fluidized-bed technology to address serious ecological issues with oil shale power generation.

Estonia’s co-dependent chemical industry is principally based in the Northeast (near to the excavation sites of oil shale). Increased efficiency of production has caused a shrinking of the chemical sector workforce, with employment decreasing from 7040 in 1997 to 4653 in 2001. The main player in the oil shale sector is the Viru Keemia Grupp Ltd with over 1000 employees. VKG produces over 90% fuel oils and the rest chemical products. While nearly three-fourths of its output is exported, it also supplies resins used by the manufacturers of plywood, wood chip boards and furniture and locally made shale oil is used for making antiseptic material for wood.

There are a number of smaller chemical plants in the area, which mostly have equipment from the Soviet times. The main products are: ammonia, urea, synthetic resins, benzene, toluene, formalin, coagulant, paints and varnishes, washing powders and detergents. The chemical industry has been slow to invest in modern equipment and relies primarily on technologies from the Soviet period. There is a heavy environmental burden from the past including oil shale energy and chemical wastes. The EU is actively involved in addressing a number of these issues relating to environmental standards.

There appears to be little development in companies and technologies associated with non-shale oil materials. Recently the European Commission ruled to let Estonia give biodiesel full excise duty exemption. As a result the bus operator ATKO Grupp is planning two biodiesel fuel plants of 10,000 ton capacity each. The plants will be located in central Estonia in the rapeseed growing areas. ATKO is responding to the European Commission’s 2005 ruling to let Estonia give biodiesel full excise duty exemption (Estonian Economy, July-August, 2005: 6).

4.6 Knowledge-intensive clusters

Information and communication technologies (ICT) is an Estonian cluster dynamics success story that includes dynamic capability development, technology assimilation and innovation in emerging inter-related sectors. It gives Estonia an interesting presence in the top, knowledge-intensive sector pole of Figure 3.2.

55 The chemical industry has downstream linkages: The main producers of consumer chemical products are Orto Ltd, Flora Kommerts Ltd and Tartu Flora Ltd. The major manufacturers of paints and varnishes are Sadolin Eesti Ltd and Baltic Color Ltd. The main producer of plastics and plastic products is Estiko Plaster Ltd. One significant enterprise producing explosives is Orica Eesti Ltd.

56 This section draws heavily from Per Högseth (2002).
The extraordinarily rapid development of a new knowledge-intensive cluster is captured by Per Högselius (2002: 26):

> When Estonia in 1991 gained its full sovereignty from the Soviet system, the country was obviously in a difficult starting position for building a dynamic telecommunications sector based on modern technologies. Yet only a decade later, Estonia is becoming one of the leading countries in the world in terms of utilization of new telecommunications technologies such as mobile telephony and the internet…

Post-independence Estonia inherited a limited penetration telecommunications system that was designed to minimize communication with the West. The infra-structural technology was obsolete at a time when the neighboring Nordic countries were at the forefront of a pervasive technological revolution. Estonia was in need of organizational knowledge, technology, and capital to modernize its telecommunications system.

The Estonian government negotiated with Nordic neighbors to create Eesti Telefon, a three-country joint venture including Televerket (now Telia, Sweden), Tele (now Sonera, Finland), and Eesti Telekom (Estonia). The deal struck included a 10 year, $250 million investment program to cover the installation of 30,000 digital lines annually with the goal of reaching a public telephone penetration of 45% (Högselius 2002: 14). Eesti Telefon was awarded a monopoly license for fixed telephony to end in 2000.57

Eesti Telefon focused on fixed network operations and a sister company, Eesti Mobiiltelefon (now EMT) became a mobile network operator. Efforts were made, unsuccessfully, to interest a telecommunications equipment company to establish equipment making in Estonia. Perhaps fortunately, Estonia did not have a local telecommunication equipment making capability. In any case, Nordic equipment suppliers such as Ericsson and Nokia, as well as Siemens, had opened a large technology gap, too large to close in this fast moving industry. Consequently, Eesti Telefon incorporated into the technology supply networks of the Nordic operators. This meant Ericsson and Nokia and their suppliers, some of which are physically located in Estonia. Examples include Keila Kaabel, a joint-venture collaboration between Nokia’s cable division and the old Soviet Harju Elekter plant described above. Elcoteq, as well, is a Finnish telecommunications industry supplier particularly of parts to mobile phones.58 In fact, many of the Nordic foreign direct investments noted in the outsourcing section above including Nolato, Merab, Traction, Nefab and PMJ form a ‘local cluster’ of suppliers to the global networks of the Nordic multinationals. They do not interact directly with Estonian companies and are not integrated directly into the Estonian economy but into a larger Nordic ICT cluster (Högselius 2002: 17).

The advantage is that the new telecommunication infrastructure deploys the latest Western technologies including Ericsson digital switches, a fiber-optic trunk (transmission system), and heterogeneous local networks. In a few short years, the latest technologies were transferred to Estonia to create an infrastructure which dozens if not hundreds of small and

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57 Not surprisingly, it appears that none of the negotiators from either side foresaw the forthcoming ICT and internet revolution. Hence, while ET was granted a monopoly in land telephony, Internet services and mobile telephony markets remained completely unregulated.

58 By locating early in Estonia, Elcoteq provided Estonia with a high-tech address that attracted other companies (see Baltic News Service interview with Nolato’s Lars G. Persson (18 May 1999) cited in Högselius (2002: 17).
innovative ICT companies, in turn, have leveraged to collectively and mutually establish a fast growing and innovative ICT cluster.

Eesti Telefon and EMT proved adept at transferring knowledge and skills in telecommunication network operations and services. Televerket and Tele were willing participants; they bought into the deal in part because of the willingness of Estonia to experiment with new technologies and services not only in wireless network operations but for backbone infrastructure equipment supplied by its long time suppliers such as Ericsson and Nokia. For example, Ericsson installed its wireless RAS 1000 system in 1994, only its seventh installation of this system in the world. In parallel, a fibre optic cable network was established. In 2005, Estonia continues to play this role of a mid-size site for advanced telecommunication infrastructure testing and development. Alcatel and Elion (an Este Telekom subsidiary) signed a deal for a Fiber-to-the-user field trial to deliver the full range of services in TV, voice, and Internet, “triple-play” services (www.home.alcatel.com).

As a result of the infrastructure, transferred and assimilated knowledge, and leading up to the termination of Eesti Telefon’s fixed telephony monopoly in 2001, a rapid set of cluster dynamic processes emerged which fostered a rapid pace of innovation in ICT. Government policy was strategic in establishing the joint venture, in implementing an announced deregulation, and in permitting free entry in the mobile telephony and Internet markets. Eesti Telekom’s fixed communication monopoly was designed to end in January 2001 but it faced heavy competition in the other markets from the early days from Nordic mobile network companies such as Sweden’s Tele2 and Finland’s Radiolinja.

While, as noted, the large network operators of fixed (Eesti Telefon) and mobile (EMT, Radiolinja and Ritabell) telephony relied heavily on the Nordic telecommunication giants and their suppliers to build an infrastructure equipment, they turned to small, local software firms to develop product applications.

In the ICT sector, Estonia is estimated to have over 450 firms but most are very small with 1-5 employees (Krull 2003: 19). Many began life to supply the demand for IT services first for banks and government agencies and later for enterprises of all types. Others reposition directly or indirectly form computer assembly. In the words of Högselius (2002: 23):

“Most of the Estonian computer manufacturers—there were a handful of them in the mid-1990s—subsequently diversified into software and the growing field of data communications and internet services”.

Some have become large by creating a local market. The fastest growing and largest example is MicroLink a 500 employee, market leader in IT outsourcing with a turnover of EUR 70 million in 1999.59 Founded in 1991 by two IT student dropouts, the original business was assembling PCs from computer parts made in Taiwan. Dubbed the Dell Computer of Estonia, MicroLink signed contracts with Intel and Microsoft to build up a PC assembly, wholesale and retail distribution business including a resellers’ and maintenance network across the Baltic countries. Along the way it has also divested non-core activities.60 The buildup of a

59 Pursuing opportunities as a diversified IT service provider, MicroLink undertook a growth strategy of merger and acquisition in the three Baltic republics. Following the acquisition of the second largest Estonian IT company Astrodata in 1998, MicroLink acquired fifteen IT-companies in Estonia, Latvia and Lithuania.

60 In order to focus management’s attention on core businesses MicroLink sold its 16% stake in Concorde XAL financial accounting software provider AS Columbus IT Partner Eesti and 66.7% interest in cable assembly
large business customer base with IT needs created growth opportunities for the provision of a range of IT services including software development, system integration, data communication, networking, enterprise resource planning, and customer support (Levine 2004).

Some have leveraged global open systems to penetrate the global IT market. A leading example is Aqris Software, a small Estonian IT company, which introduced RefactorIT in 2002. Refactor works like a kind of spreadsheet for programs written in Java code, automatically remodeling an entire application to reflect changes in parts of its code. The benefit is speed, saving thousands of man-hours required to reprogram manually (Levine 2004). Aqris has taken full advantage of global open-systems. According to Aqris, developers at Nokia, UBS, Royal Bank of Scotland, DaimlerChrysler, Ford, Siemens, Fujitsu, Pfizer, and other companies around the world are improving their code on a daily basis with RefactorIT, the company’s proprietary software tool. Refactoring is a process by which software code, which is continuously evolving, is reorganized and rationalized. Refactoring tools make code easier to understand, reveal bugs, help optimize performance, and improve quality. Manually refactoring code is laborious and error-prone; RefactorIT is an open-system automatic refactoring system. Unlike proprietary tools, RefactorIT plus into the leading Java IDEs and allows developers to continue to use the software development tools, editors, debuggers, and code generators from any company they like.

Some have formed partnerships to create a market. In the words of Högselius (2002: 24):

In summer 2000…the mobile operator EMT proudly introduced a new service—making it possible for people to pay for parking via mobile telephone—that it had developed in collaboration with the Estonian software company Voicecom. In the following year, EMT bought 26% of Voicecom in order to deepen the collaboration. In October 2000 another collaborative project was initiated, this time in the field of positioning and personalization of mobile phones. EMT’s partners were the Estonian software company Regio and the Finnish Done. R&D activities of the joint venture were to be located in Tartu.

Two of the biggest concentrations of software development in Estonia are in IT departments of banks. In fact, the two major banks in Estonia have been described as the informal leaders in the software industry. The software divisions of Hansabank (number 17 of Top 100) and Estonian Union Bank (number 36 of Top 100) have more personnel than the biggest Estonian software companies. Approximately 250 of Hansabank’s 2245 employees are IT specialists and Uhispank employs 139 IT specialists (Kalvet 2004:7). Half of Uhispank’s 600,000 customers bank online. In fact, bank checks have never been an important form of payment in Estonia, as it was less costly to introduce electronic bank cards, ATMs and Internet banking from the beginning. The prevalence of Internet banking has allowed the major universal banks to optimise their network of branch offices investing in ICT systems instead of incurring the brick and mortar and operating costs of the an extensive branch system. The

division MicroLink Electronics in January and May 2000, respectively; in January 2004 Delfi portals were sold to Findexa group from Norway; in May 2004, exiting being a shareholder of telecommunications equipment manufacturer SAF Tehnika.

Alan Martinson, the ex-chairman, has suggested that the business carried out by MicroLink of attracting investments and purchasing other companies could be defined as an “IT investment bank” activity. With this experience, Martinson has launched Martinson Trigon Venture Capital. Martinson interview in Levine (2004).

“ ” (International Herald Tribune, 15.10.2004).
high diffusion rate of mobile phone users led the banks to experiment with the technology developed by EMT for paying for parking by mobile phone, to the transfer of money amongst bank customers with their mobile phones. This service is potentially valuable to small businesses, for example plumbers or electricians, to collect fees directly from their customers (International Herald Tribune, 15.10.2004).

Not surprisingly, some of the telecommunication network operators have sought to diversify into IT. Eesti Telekom, the one-quarter state owned and Estonian parent of both Eesti Telefon and EMT, moved directly into IT in 2005 with the acquisition of MicroLink. Eesti Telekom could afford it. When the Estonian government privatized a large share of its stake in Eesti Telekom in 1999, the company became the largest Estonian enterprise, representing almost half of the total stock exchange (Högselius 2002: 18).

Today, the Estonian ICT cluster has independent software technology development capability. Examples, besides Aqris and EMT include the peer-to-peer networks Kazaa and Skype. Kazaa lets PC users around the world join forces to share one another’s recorded music, free. Skype offers free telephone calls over the Internet. Both are applications of peer-to-peer engines built by Bluemoon, a small Estonian software company headed by Jaan Tallinn. Tallinn met Kazaa founders Niklas Zennstrom, a Swedish entrepreneur, and Janus Friis when he was writing software for paying for parking spaces by mobile telephone. Many of the leading entrepreneurs including Kazaa and Bluemoon founders once did developmental work for Sweden’s Tele2.

Skype Technologies, purchased by EBay for $2.6 billion in 2005, has put Estonia on the global high tech map. While registered in Luxembourg, Skype Technologies global developmental headquarters are in Estonia. The sale price is approximately equal to one-quarter of Estonia’s GDP.

Finally, thanks to the combined underdevelopment of conventional telecommunications and the fortuitous lack of regulation of mobile telephony and Internet markets, Estonia has sophisticated and experienced customers in the new technologies. It remains attractive to leading foreign telecommunication equipment suppliers and network operators. The number of users of mobile services increased to 98.9 percent of the Estonian population by 2005, according to the Communications Board. The take-up rate of Internet services in Estonia is unrivaled. Estonian cable network operators’ broadband Internet revenues made up nearly 50 percent of their revenues in 2004 up from 3 percent in 2000.

4.7 Non-tradeables

The construction market in the Baltic States has grown steadily at double digit rates from EEK 40 billion (EUR 2.7 billion) in 2000 to EEK 52 billion in 2002 to EEK 71 billion in 2004. Estonian construction companies carried out construction works in Estonia and abroad of EEK 28.6 billion in 2004. In Estonia, construction works of EEK 27.7 billion were carried

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63 It goal has been to provide full IT services to the Top-1000 companies and public sector institutions in the Baltics. These services include system integration and infrastructure solutions, software development, ERP and business solutions, data communication and networking, and end-user PC services and support. With over 500 employees, the company is large by Estonian standards, but small compared to Nordic IT.


65 The statistics in this paragraph are from Estonian Economy, July-August 2005, page 6.
out, an increase of nearly 20 percent over the previous year. These figures reveal the huge size of the sector and its predominantly, if changing, non-tradable character.

The sector is internationalized with the presence of global leaders such as NCC Ehitus AS a subsidiary of NCC of Sweden. NCC Ehitus AS and Merko Ehitus AS both have construction projects in Russia and Merko Ehitus AS is involved in numerous projects in throughout the Baltic Republics. Both are profiled in the multi-business unit section above.

It seems that the leaders are well run businesses. Strikingly, 10 of the top 40 companies in the Top 100 are in construction and an additional 3 are in construction materials. The business model cuts across several categories. Construction companies do project management which requires formal and informal partners and long term and short term partnering. Therefore, they are inevitably multi-business and flexibly specialized. What is new is the global character of the industry. Increasingly there is competition across borders led by companies such as NCC with 22,000 employees worldwide. The share of Merko Group’s turnover of exports of goods and services was 20 percent in 2004 (Merko Group Annual Report).

Not surprisingly NCC Ehitus and Merko Ehitus use acquisitions to continuously reshape their company boundaries, develop their capabilities, and focus their core competence relative to the global competition. In 2001, NCC acquired a building company Inrestauraator OÜ. Inrestauraator OÜ had long-term experience in the field of restoration and reconstruction of buildings and had restored nearly 80 objects in the old cities of Tallinn and Tartu. In 2003, Merko disposed of its subsidiary OU Matek which produced prefabricated houses and UAB Merko Statyba in 2004.

Merko and NCC AS are not major employers relative to their turnover. The number of full-time personnel in the parent company of AS Merko Ehitus was 274 and in the Group it was 636 in 2004 (the average salary increased by between 20 and 30 percent for both). Group turnover was EEK 3.1 billion in 2004. The turnover of NCC Ehitus AS in 2003 was EEK 360 million and 80 were employed.

Estonia has a confectionary industry that goes back to the early 1800s. Stude’s sweets composed of marzipan figures and handmade chocolates were popular in the court of the Russian tzars, it is said. Still popular today, marzipan figures are produced by Kalev AS public company listed on the Tallinn stock exchange. Kalev had sales of EEK 843 million in the year to June 2005, an increase of EEK 218 over the previous year and employs 500.

Another large food processing company is Leibur AS which has made ‘whole’ bread since it was founded in 1762. Sales of the 243 year old company grew from EEK 2 million in 1990 to EEK 264 million in 2004. The number of employees decreased over the same period from 921 to 350 which must represent one of the largest increases in labor productivity on record anywhere.

These companies have leveraged a distinctive and popular low-tech product to grow large with the application of modern technology. The same can be said of Saku Õlletehase AS, a brewery with roots in the beginning of the nineteenth century which held 50 percent of the Estonian beer market in 1999. Saku Brewery has funded big investments by becoming part of

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66 The leading construction material companies are profiled in the raw material intensive category. The interesting thing about several of them including Kunda Cement and Maxit Estonia is that they are part of global company that has taken a bulky, heavy and largely non-tradable commodity and made it tradable.
Baltic Beverage Holding AB (BBH) which is itself a 50:50 joint venture between Carlsberg A/S of Denmark and Scottish & Newcastle Plc. BBH, which holds 75% of Saku, has 15,000 employees while pursuing a strategy of being global but acting local. Most of its 15,000 employees are locally employed by one of 18 breweries, 10 of which are in Russia, 4 in the Baltic countries, 3 in Ukraine, and 1 in Kazakhstan.

Tallinna Piimatoostuse AS is a similar example but in dairy. Its predecessor was a steam dairy formed in 1893. In the first year of independence, the dairy acquired new and modern equipment—a bottling line, cooling equipment and a steam engine which increased its daily raw milk purchases to 20,000 kg. Its exports are primarily butter. In 2004 it was ranked 42 in the Top 100.

We have already noted the role that leading banks have played in the development of the ICT cluster in Estonia. The banks have contributed to increased productivity and the growth of business generally by innovations in finance particularly in the area of factoring. **Estonia has the highest rate of factoring of the EU 8.** Factoring as a percent of GDP increased from around 2% in the late 1990s to nearly 15% in 2002 (Bakker, Klapper and Udell 2004: 24). Factoring is a form of asset-based finance where the credit extended is based on the value of the borrower’s accounts receivable—the payments owed by the borrower’s customers. The receivables are purchased by the factor or lending agency, not used as collateral for a loan. Factoring also typically involves more than just financing and often includes two other services: credit and collections. The bundling of services can be particularly valuable to SMEs that lack the resources and expertise to manage their credit and collection activities. Factoring is also particularly well-suited to financing receivables from large or foreign companies more creditworthy than the borrower.
[5] Summary and policy conclusions

5.1 Introduction

An outsider could be forgiven for wondering if there are 2 Estonian economies. The optimistic reading is enthusiastic about the emergence of a new economy captured by the following (Levine 2004):

“…the Soviets unwittingly helped foster one of the more remarkable post-Soviet success stories. There are only 1.4 million Estonians in a country a little bigger than Holland…With virtually no outmoded infrastructure to weigh them down, the resourceful Estonians have constructed a kind of e-republic that has already outpaced many of its new, much richer European neighbors. Internet and mobile phone usage per capita, for instance is higher in Estonia than France. Over half of all Estonians now pay for their street parking spaces automatically, using their mobile phones. The same system flopped when Estonian Mobile Telephone’s technology was marketed in Oslo, which is not exactly backward technologically. And Swedish companies often test ideas first in Estonia, since Estonians are known to have a heartier appetite for change than even the forward-thinking Swedes.”

The optimists can point to rapid growth following ‘shock therapy’. From January 2, 1992, the date when price controls were abandoned, industrial production in Estonia dropped over 40 percent by 1994-5 (Von Hirschhausen and Hui 1995: 8). But between 1994 and 2000, the productivity of manufacturing in Estonia increased on average by 8.2% per year (Tiits, et. al. 2003: 28; see also Chapter 2 above, Tables 2.6 and 2.7). GDP has continued to grow at over 5% annually over the 2000-2005 period.

The pessimists have a different reading. Unemployment has continued to grow throughout the 1990s to nearly 15% in 2000 and nearly 25% for 15-24 year olds (Tiits, et. al. 2003: 51; see also Table 2.3 above). Over the 1990 to 2000 decade the economy eliminated 70% of jobs in agriculture, 40% in mining and manufacturing and 33% in construction. Jobs were created in retailing and finance but overall private sector employment dropped by nearly 30% (Jauhiainen 2002: 5).

The drastic loss of jobs, if offset by the creation of jobs in higher productivity activities might be considered an unfortunate cost of transition from the old to the new economy. But the pessimists see not only loss of employment, but loss of competitiveness. Worse, the competitiveness condition borders on the “hopeless” described as follows:

“Despite the enviable records of economic growth in Estonia the competitiveness of the industrial sector has significantly decreased over the 1990s. The specialization of the Estonian industry on labour and resource intensive fields indicates an imminent threat of a lock-in to a low income level…Estonia’s situation is poor and should the current specialization continue—hopeless” (Tiits, et. al. 2003: 6).

The report commissioned by the Research and Development Council67 on the competitiveness of the Estonian economy with the finding that in Estonia the share of added value created by the middle- and high technology industries is decreasing. They find that the major source of

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67 The Report was chaired ex officio by Siim Kallas, then Prime Minister of Estonia and now Vice President of the European Commission. Before coming PM, Kallas had been President of the Bank of Estonia (central bank) and Minister of Finance
productivity growth over the last decade has been technology transfer invoked by foreign investment (Tiits, et. al. 2003: 31). But it has come at a cost. Foreign investments have been directed at resource-intensive and low-skilled employment” and the Estonian economy has become in time less knowledge- and skill-intensive. In fact, the authors argue, virtually all of the industrial sectors are tending to specialize in lower, less knowledge-intensive activities which are often linked to external value-chains with virtually no cluster effects within Estonia. They worry that if present trends continue, the technological structure and specialization patterns of the economy will become less complex with less capacity to adjust to intensifying competition. If this were to happen, instead of benefiting from European integration in terms of increasing specialization and technology assimilation, Estonia could suffer gradual economic peripheralization and even worsening of the productivity gap.

Estonia, the authors continue, has not benefited from the high quality foreign investment as has Ireland (2003: 48).

Who is right? Can both be right? Are there two Estonian economies? Why is it important?

It is important for one reason. Policymakers are guided by an understanding of the links between policy and economic performance. However, these links are not simple or straightforward. They are often presuppositions based upon a conceptual framework which is itself often taken for granted and not subject to critical scrutiny. This can be dangerous particularly if the framework, however implicit, does not capture the fundamental forces at play in an economy.

We would suggest that the lack of a framework to understand and interpret the fundamental challenges facing the continued development of the Estonian economy will likely foster disjointed and counter productive policies. Given the apparent success, at least in economic growth, and the glowing reports from some some well-placed observers, one approach is to hope for the best, ‘leave it to the market’, and rely upon luck. We propose an alternative, proactive set of policies to foster competitiveness and a conceptual framework to make them consistent. In some ways our approach is the hard way. Let us explain briefly.

Before examining the policy agenda behind the capability triad, it is useful to place it within a wider encompassing policy background. First, we need to understand the role of public policy, with complete openness and frankness about the severe limits within which public policy as well as private initiatives operate in small peripheral economies like that of Estonia. Second, we need to acknowledge the many problems that arise from the legacy of traditional industries in Estonia, but in a way that encourages rather than hinders the creation of a regional growth dynamic driven by new as well as transformed sectors. Only then is it fruitful to turn to a critical evaluation of the likelihood of whether the policy proposals outlined in this report, which arose out of analysis based on the capability triad, will produce a step change in Estonia’s industrial performance as well as wider spill-over social and developmental benefits.

Luck plays a large part in industrial strategy. The expected external conditions needed to support success do not always conveniently arrive, and their absence may frustrate otherwise admirable policy initiatives. Nor is the true significance of the internal elements of a strategy

68 Johannes Stephan (2003) estimated a fivefold gap in productivity levels between EU-15 and Estonia at market exchange rates but only double using purchasing power parity exchange rates.
always fully understood even by its own designers. But luck and chance, however random, can be handled best within well thought out and coherent frameworks that take full account of the nature of the external environment (opportunities and threats) as well as realistic views of domestic capabilities (strengths and weaknesses).

Why do we need such frameworks? There is an old Irish (Gaelic) proverb that says: "An té nach bhfuil láidir, ní foláir dó bheith glic", or, "If you are not strong, you had better be smart". In the quest to break free from narrow, dependent and reactive policy mind-sets, frameworks such as Porter's diamond or the capability triad do not provide all the answers. But they certainly help small economies to be smart when time is pressing and when financial and human resources are limited. They are absolutely essential if one wishes to bring focus and synergy to the disparate policies that make up broad industrial strategy in a transition economy like Estonia.

Conceptual frameworks and policy design, implementation and renewal usually evolve in parallel with each other. Frameworks are rather like maps that tell you where you are, where you need to go, and the direction that you must take in order to get there. Policy design and implementation deal with the messy business of gathering resources, making pragmatic choices, overcoming obstacles, and bringing the team along with you to your ultimate goal. To confuse these separate but interrelated elements of strategy, or to emphasise one at the expense of the other, will almost certainly lead to failure. Having a wonderful map, but of a route that would take you over impassable terrain, is useless. Wandering aimlessly in the wilderness bereft of any maps is equally futile.

The capability triad contains a synergistic combination of insights drawn from the economic theory of the firm and the historical evolution of business structures and practices. The triad is based on the interaction of three distinct but interrelated elements: a business model, production capabilities and skill formation. The business model element of the triad describes how entrepreneurial firms can grow, based on the creation of new firms through technology diversification, inter-firm networks within open systems, and regional specialization based on technological capabilities. The production capabilities element of the triad integrates ideas from operations management and strategy into a logical system of production models that drives home the lesson that competitive strategy and productive systems are bound together. The skill formation element of the triad provides a vital input to innovation and serves to facilitate the synergistic interaction and reinforcement of all three elements. Finally, an important implication is that any overall programs in the area of industrial strategy require the close integration over time and space of the change programs that need to take place within each of the elements of the triad.

Perhaps the most daunting aspect of the capability triad is that it treats the scope for public policy as being almost completely and seamlessly blended into the detailed mechanics of change processes that occur within private firms. In this framework, as well as in Porter's diamond, public policy and private entrepreneurial actions do not operate in isolation from each other, but become mutually reinforcing. Only in one element of the capability triad - skill formation - is there some scope for a separable and transparent role for public policy, namely, to ensure that the right mix of education and skills is produced to accommodate the changing demands of the economy as it develops. Even here, the synergy between public and private activity is crucial. For example, an ESRI study (Denny et al, 2000) showed that for different types of training intervention, those closely linked to the
market were most effective in combating unemployment while in contrast, training of a more general nature did not, on its own, appear to have an enduring beneficial effect.

Studies that represent the near “hopeless” interpretation tend to rely upon aggregated industrial statistics\(^6\) and conceptual frameworks that do not control for entrepreneurial firms or characterize business models while the optimistic view relies on a combination of snapshots of successful companies found in the business press and macroeconomic data on growth and productivity that obscure rising imbalances such as the huge current account deficit. We would suggest that not surprisingly, both views capture a part of the Estonian economic life but risk seriously mischaracterizing the critical processes that are driving the Estonian economy and the critical challenges and strategic opportunities.

Our critique of both the optimistic and pessimistic scenarios is that neither is anchored in a conceptual framework in which business enterprises and organizational capabilities are central variables. The categories of conventional economic analysis are too aggregative on the one hand and are based on sector taxonomies that obscure business and industrial dynamics and capabilities. For example the same category manufactured wood can include clusters as dynamic as forestry products of Finland, interior design and furnishing of Italy, as wells as log cutting activities in Russia. Companies and whole sectors can exhibit hugely different productivities across regions even within countries. This is indeed the case with Estonia.

The capability triad takes us behind the faceless, anonymous companies found in official statistics to explore the development, or lack of development, of organizational capabilities in the business enterprises and operating units of foreign enterprises that operate in Estonia. We look for the development of production capabilities including new product development and technology management to gauge the gaps that must be addressed to advance productivity. We use a SWOT (strengths, weaknesses, opportunities, threats) analysis framework to organize our findings which in turn are based on the survey of successful business enterprises in Estonia. While these enterprises represent a small proportion of the 4500 registered companies, they represent many of the most dynamic companies and therefore a virtual laboratory to better understand the deep challenges and strategic opportunities.

5.2 Strengths

*Business experiments*: Estonia has many business model experiments underway. In fact, this is an important role of a country or region’s entrepreneurial/managerial class. It seems that economic rapid and sustained growth success stories are based on discovering business models that fit the historical and competitive contexts.

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\(^6\) A drawback of the productivity gap literature is that most of the production related data are still two-digit ISICs and NACE codes. The same applies to R&D data. A second drawback is the out-moded industrial classification systems which were designed before new product development and technology management capabilities altered competition from price-led to product-led and in circumstances in which the dynamics of specialization and clusterization are limited. Competitive success depends upon developing distinctive capabilities and products which often can not be fit within traditional classification codes. A third drawback is the enterprise anonymity requirement upon which all government company data is recorded. Thus innovative firms in traditional sectors may signal the development of new sources of competitive advantage but their successful performance numbers will be lost in the averaging process of data presentation. These drawbacks are not meant to imply such studies and numbers are not useful only that they need to be complemented with company level analysis.
Competitive niche companies: By distinguishing between two types of outsourcing, which we called mass production and technology specialization, we were able to identify a range of global technology niche companies, mainly Nordic, that have formed partnerships with Estonian companies or established Estonian operating units in various sectors. An important feature of these companies is that they represent a form of competitiveness for which Estonia can sustain a competitive advantage relative to lower wage Asian ‘mass production’ competitors. Examples include Raatuuarki, Moller in shipbuilding, NCC in construction, Wartsila, …

Distinctive technological capabilities: While the mass production model alone would not give Estonia a competitive advantage, we found patterns in the success stories. For example, Estonia seems to have developed a distinctive technological capability in non-woven, household textiles in partnership with Nordic brand name companies. Wendre, Tooms, and Norma in safety belts are all in highly specialized markets and act, in the case of Wendre, as a logistics unit for IKEA. In the case of Elcoteq, nearness to customer and product development and design department in headquarters seems to offer Estonia a competitive advantage.

Technology upgrading: In the case of resource intensive industries, we again find an important Nordic global play, Stora Enso, which has invested in technology upgrading. The actual raw materials do not come from Estonia, instead the competitive advantage is based on Estonia’s long established networks with forest resource intensive regions to the East. But as we suggest with the example of Forenel, modern resource-intensive clusters can be highly dynamic and integrate a number of sectors. Here we find examples of Estonian plants that are benefiting from integration with R&D and KISA intensive inputs from Finland.

The case of forestry products offers an important lesson: Estonia’s industrial profile should not be compared with the standard OECD profile, but with resource-intensive regions. These can become highly knowledge-intensive as in the case of US agriculture. They can also be part of clusters that penetrate a range of sectors. The example in Estonia could be construction, construction materials, pre-fab housing as well as furniture.

Emergence of an ICT cluster: The emergence of an Estonian ICT cluster is a success story that offers valuable lessons about the potential for clusterization in Estonia, particularly ways to benefit from the nearby Nordic model. It illustrates four themes: first, the difference between technology transfer and technology assimilation in that Estonia has generated new applications and even new technologies; second, the multi-sector reconfiguring processes associated with cluster development, in this case IT, computer assembly, and banks; third, the leveraged impact of the pre-independence investment in advanced technical skills; and fourth, the strategic role that government can play in aligning the three dimensions of the capability triad.

5.3 Weaknesses

Excessive reliance on foreign ownership: It is estimated that companies wholly or partly owned by foreigners account for about 50 percent of Estonia’s GDP and over 50 percent of the country’s exports.70 If a substantial portion of these companies were fostering the development of organizational capabilities, this would not necessarily be a weakness.

70 It should be noted that the reliance of Irish manufacturing on foreign ownership is even greater than in Estonia. But the circumstances are very different (see Bradley, 2001).
However, a large proportion of foreign owned subsidiaries play a sub-contractor role with limited networking, design, product development and technology management capability development.

Furthermore, indicators of ‘revealed competitive advantage’ are not encouraging. The Estonian economy suffers from a large trade imbalance originally funded by inward foreign investment but increasingly by portfolio investment and an increase in foreign indebtedness. The basic problem is lack of exports. Exports have grown, but primarily in resource-intensive categories. For example, the top 25 exports to US have grown from $22 million in 2000 to $363 million in 2004. The biggest growth areas are in 27 mineral fuels (VKG shale oil); 72 iron and steel (Galvex); 44 wood; 29 organic chemicals. The biggest exports to the European Union include cement; wood; and textiles. Elcoteq accounted for 83% of ICT exports in 2001, which suggests that even this dynamic sector is not yet exporting in large amounts (Kalvet 2004: 11-12). Exports are an indicator of ‘revealed competitive advantage’ which suggests that Estonia has not made substantial progress in transitioning to a more organizationally complex capability profile.

This interpretation is reinforced by a consideration of the industrial composition of foreign direct investment in Estonia. Only 13.2 percent is in manufacturing. Invest in Estonia, the Government’s investment agency, has a list of 60 companies with major shareholdings in 2004. The largest are in Telecommunications (1 big one) and Banking with 3 of the 6 biggest. Eleven are in finance, insurance and real estate (FIRE), ten are in retail, wholesale, and hotels, seven are in food including tobacco, six are in construction or construction materials including cement, the fourth largest. Eleven are in fuels (3), four in wood processing, one in paper, one in chemicals, one in explosives, and one in energy. Three are in textile products.

The total stock of foreign direct investment was EUR 10.42 billion in January 2006 a figure greater than GDP. This amounted to EUR 5164 per capita in a country with a per capita income of EUR 6779. This is not a weakness itself, but the lack of local capability development must be addressed. It is partly linked to the lack of locally headquartered firms.

Few entrepreneurial firms: Estonia has a small number of quite successful business enterprises that are growing and can be described as entrepreneurial firms. They have product development capabilities and they are learning firms. It is hard to estimate the size of this group of companies but it represents a small proportion of all firms. Locally managed, growing firms with entrepreneurial firm characteristics are relatively few outside of Tallinn and Tartu.

Inheritance of mono-functional settlements: Estonia has an inheritance of mono-functional settlements of small towns and villages (500 to 10,000 inhabitants) with only one economic sector or one single enterprise. In Estonia, 34 were created during the Soviet period (Jauhiainen 2002: 11). These single function and often single enterprise industrial settlements were distributed by industrial policy but without recognition of the critical interplay between periphery and nearby towns or cities, even if small, in industrial change and development. Not

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71 One could argue that the debt escalation could be partially explained by the cyclicity of the economy, yet there are also similarities with the developments in Nordic countries before financial crisis in early 1990s and East Asia at the end of the decade.

surprisingly, these industrial settlements have not enjoyed dynamics of specialization and clusterization associated with industrial districts in Western Europe. These mono-functional settlements specialize in simple products such as dairy, textile fish, textile, wood, cement, glass (see Table 9 in Jauhiainen). None specialize in multi-process or multi-component products.

Mono-functional settlements are reinforced by strong forces of technological inertia. An important example is energy and Estonia’s 100% dependence on shale oil and its associated mining and chemical industrial complex. Here, as in ICT, the Nordic countries offer leadership in the transition to a post-carbon future.

Low ratio of science and engineering graduates: New product development depends upon instituting processes by which new technologies are integrated into products and processes. This, in turn, requires technology integration teams made up of individuals from a range of technical backgrounds. Ironically, Estonia was bequeathed with a considerable talent pool in computer science, cybernetics, artificial intelligence and information technology. Estonian software expertise was developed at the Institute of Cybernetics (www.ioc.ee) as part of the Soviet space program (Levine 2004). Unfortunately, these investments required to maintain a high level of technical education has been severely run down in Estonia with potentially serious consequences for business development, innovation and growth.

In fact, graduates from doctoral courses in the technical fields have virtually collapsed and put Estonia near the bottom of the league table and ill-prepared to move up the production capabilities spectrum to higher value-added activities and sectors. The expansion of engineering and science graduates in the fast growing transitional economies in the last decades of the last century are shown in Table 5.1.

<table>
<thead>
<tr>
<th>Table 5.1: Engineering and science graduates 1975 and 1995</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year</strong></td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>Ireland</td>
</tr>
<tr>
<td>Singapore</td>
</tr>
<tr>
<td>South Korea</td>
</tr>
<tr>
<td>Taiwan</td>
</tr>
</tbody>
</table>

* First university degrees awarded in natural science (NS), engineering (E) in 1975 and 1995.

| Table 5.2 shows the number of graduates from doctoral fields of study over the 1994-2001 period in Estonia. These totals are consistent with the numbers presented in the international comparisons by the US National Science Foundation. For Estonia, of the 2272 graduates in the most recent year for which data was available, only 37 were in NS and 135 in engineering in a college-age population of 20,000, for a ratio of approximately 1. The ratio for the EU is 7.6; Finland sets the standard at 13.2.73

73 All data and ratios are from the National Science Board of the US National Science Foundation. http://www.nsf.gov/statistics/seind04/append/c2/at02-33.xls
Table 5.2: Graduates from doctoral courses by field of study

<table>
<thead>
<tr>
<th>Field of study</th>
<th>Total 1994-2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Science</td>
<td>64</td>
</tr>
<tr>
<td>Mathematics and statistics</td>
<td>8</td>
</tr>
<tr>
<td>Computer studies</td>
<td>11</td>
</tr>
<tr>
<td>Engineering and engineering trades</td>
<td>34</td>
</tr>
<tr>
<td>Manufacturing and processing</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>118</strong></td>
</tr>
</tbody>
</table>

Source: Tiits, et. al. 2003, Table 20.

The problem is that Estonia has been going the wrong way in this critical statistic. South Korea and Taiwan increased their ratios from just over 2 per 100 in 1975 to 11 per 100 in 2000–01. At the same time, several European countries have doubled and tripled their ratios, reaching figures between 8 and 11 per 100.

The problem has been recognized by the government which puts the required number of new high level IT specialists alone at more than 500 annually. The newly created IT College is an effort to address the challenge (www.itcollege.ee). But even if and when it does get scaled up it is designed to address only a small part of the technical education skill gap and does nothing to alleviate the severe lack of PhD level qualifications that are the lifeblood of high tech research capability and industries (Kalvet, Pihl, and Tiits 2006).

5.4 Opportunities

Estonia’s location advantage can not be underestimated. Any technology follower would be lucky indeed to be located next door to the highly successful Nordic economies. The opportunities are many and varied.

*Emulate the Nordic model of economic management:* The Nordic economies set the world standard for competitiveness, renewal of traditional industries, and innovation infrastructures. For example:

The World Economic Forum ranks Finland most competitive economy, and Sweden, Denmark, Norway and Iceland were 3rd, 5th, 6th and 10th, respectively. According to Augusto Lopez-Claros, director of the global competitiveness program at the World Economic Forum:

“The Nordic countries are characterized by excellent macroeconomic management over all—they are all running budget surpluses—they have extremely low levels of corruption, with their firms operating in a legal environment in which there is widespread respect for contracts and the rule of law, and their private sectors are on the forefront of technological innovation,”

The Nordic model has been highly successful in reinventing traditional industries and fostering a knowledge intensive economy and it is right next door to Estonia. Success stories can be seen first hand and be an excellent educational vehicle. In addition, Nordic companies are world leaders in R&D spending and they have each built up innovation infrastructures.
This has created a huge pool of technological and educational capabilities that can be tapped by Estonian enterprises and institutions and, combined with local resources, a basis of new product development and technology management.

It must be stressed, however, that the Nordic model is a prime example of the benefits from the integration of all three elements of the capability triad. To date, it is an opportunity and not a strength in the case of Estonia mainly because of the underinvestment in advanced technical education.74

**Foster technology assimilation.** Business success depends upon the development of distinctive, hard to imitate capabilities. Particularly for technology followers, the development of distinctive technological capabilities does not depend on massive investments in fundamental research. But it does depend upon the development of technology management capabilities. Companies do not need to reinvent the wheel, but to “dynamically assimilate” technologies developed elsewhere (Bell 1997). The idea is that competitive success comes not from the passive adoption of foreign technologies but the capability to tap the world’s pool of technology for the purpose of new product development.

**Leverage Nordic clusters internally:** Dynamic Nordic clusters create opportunities to foster clusterization processes within Estonia. The idea of cluster dynamics can be seen as an modern application and elaboration of Gunnar Myrdal’s concept of cumulative causation. Myrdal conceptualized cumulative causation in terms of linking internal and external processes. He stated that “…the main scientific task is…to analyse the causal inter-relations within the system itself as it moves under the influence of outside pushes and pulls and the momentum of its own internal processes” (Myrdal 1957: 18). His emphasis on mutual adjustment linking external forces and internal processes is the core idea. But so, too, is the emphasis on careful empirical analysis of the specific “pushes and pulls” and “internal processes”.

**Leverage resource advantage:** Estonia’s industrial structure should not be compared with the average OECD profile but with successful resource-based economies such as Finland, Sweden, Canada, US, and Australia. Finland’s forest products have declined but were still 21% of manufacturing and 29% of manufacturing exports in 2000.75 This involves cluster development and the promotion of “resource industry linkages”; it also demands R&D involvement and long and sustained investment in education, innovation, and entrepreneurship. Three types of linkages can be distinguished: downstream (beneficiation), sidestream (capital goods and inputs), technology (lateral migration). Downstream examples: pulp, paper, packaging, prefab houses. Job creation is greatest at the beginning and end of the value chain and least in the middle, processing links.

**Foster gateway advantage:** Estonia has a second, major locational advantage that might be compared with Singapore or Hong Kong. Estonia has an opportunity to play a role as a

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74 The Nordic countries also feature social protection legislation, which does not undermine their competitiveness. So why do people not mention Denmark or Finland in discussions of development success stories? “It’s that old myth that social protection requires more business regulations and hurts business,” said Caralee McLeish, an author of the World Bank’s *Doing Business in 2005*, “In fact, we found that social protection is good for business, it takes the burden off of businesses for health care costs and ensures a well-trained and educated work force.”

75 This does not include one of the world leading paper machine makers, Metso (Jourdan 2004).
regional headquarters for supplying components and products from ex-USSR countries with whom it has long standing networks and commercial ties to global outsourcers.

Singapore acts as a regional headquarters or gateway for global companies pursue commercial opportunities in nearby south Malaysia and Indonesia just as Hong Kong played a similar role linking the interior of China to western companies. But whereas Singapore and Hong Kong focused initially on labor-intensive products and services, Estonia would focus on resource-intensive materials, components, and products. Over-time, Estonia’s competitive advantage could move from delivery of low cost resource-intensive products, to low-cost, engineering intensive, resource intensive products to ‘packaging and integration’ capabilities. ‘Packaging and integration’ captures the idea that Estonian firms would not be mere coordinators of regional activities but ‘instigators and initiators’ of economic activity, match demand and supply on local, regional, and global levels (Enright, Scott, and Dodwell 1997). This complex of activities transcends the metaphor of value chain with that of value network. The later captures the idea of real-time coordination and design integration across activities, of clusters rather than supply chains.

Modernize manufacturing: There were under 4,500 industrial enterprises in 2000, and about 4100 in manufacturing. Approximately 30 enterprises account for 30% of industrial output and approximately 180 for over 60% of industrial output (Jauhiainen 2002: 13). Therefore, a business development program that doubled, for example, the productivity of these enterprises would have a large impact on growth and per capita income. Here, again, the small size of Estonia can be turned to an advantage: an effective manufacturing modernization program is of manageable proportions.

In addition, the geographical location combined with low wages offers a window of opportunity to establish flexible mass production plants in Estonia. Elcotec, in electronics, and Wendre, in textiles are both outsourcing examples of mass production plants that compete on the basis of low cost combined with nearness to customer and to Nordic company headquarters where product development capabilities are centralized. As wages go up, it will be necessary for these plants to develop world class manufacturing performance in multi-product flow and quick ramp-up or rapid introduction (not design) of new products (levels 4,5, and 6).

Partner with global technology leaders to develop small market opportunities: The strategy of local technology leadership is potentially open to Estonian companies that partner with global market leaders in niche markets. The production scale of the global leader may not be appropriate for small and medium sized markets or small sized products or small orders. Here a smaller scale production unit can be efficient. An example of such a symbiotic relationship between a large and small company in the US is captured by the following quote: “For years, a company called Nextel Partners has helped its ally, Nextel, provide wireless digital communications services in midsize and small markets” (New York Times, 9-4-05). Regio (www.regio.ee), a cartography and mobile positioning company, which has a global sales agreement with Ericsson is an Estonia example.

5.5 Threats/challenges: policy implications

Estonia deserves credit for doing many things right. In a period of little more than a decade Estonia has gone from having an antiquated, low penetration telephone system to a kind of e-republic (Krull 2003).
While it is clear that a number of private individuals were the product champions driving information society advances before they received political support, government did respond. In fact it was the academic network EENet (www.eenet.ee), inspired by their Nordic counterparts, who introduce the Internet to the universities in 1994. Nevertheless, the support from the Open Estonia Foundation, a philanthropic fund set up by George Soros, and from the government played a pivotal role in the emergence of the Estonian information society. It created the legal environment and joined the effort to computerise the universities and schools and connect them to the internet76, computerized public administration, and developed major e-services for the public sector. Government IT programs have been a major stimulus to IT business development.

Government regulatory policy was conducive to ICT cluster dynamics. Not least important, the government granted a fixed term concession agreement to a joint venture involving the Swedish and Finland telecommunication monopolies, Televerket and Tele, and Eesti Telekom to build an innovative telecommunications infrastructure. Perhaps more important, the government fostered free market competition in the mobile telephony and Internet sectors.

Besides the physical creation of a new domestic infrastructure system, the modernization program fostered a dramatic gain in technological and administrative knowledge within Estonian telecommunication companies. A key feature of the approach by the government was to focus on establishing local capabilities in network operations and not in equipment production (Högselius 2002).

Successful as Estonia has been in managing a transition from stagnant industrial structure to a fast growing western-oriented economy and from an antiquated to a world-class telecommunications system in only a decade, it would be wrong to rest on its laurels. The wage and productivity levels are low, and the balance of payments deficit and high unemployment are resistant to improvement. Not surprisingly, a number of barriers to the next phase of growth are emerging. These, too, will require transitions.

The fundamental challenge today is to negotiate a transition from a growth period driven by foreign direct investment primarily by cheap inputs and resource intensive activities to the development and diffusion of more advanced production, product development, and technology management capabilities. The problem is not in the quantity of foreign direct investments attracted so far; it is that a strategy has not been designed to successively pull in higher value-added production activities from the home bases of the multinational corporations (MNCs). The temptation is to base a strategy on leapfrogging technologies and this is not helped by the huge success of doing exactly this in telecommunications. What is needed, instead, are policies that focus on a step by step advance in production capabilities across a broad range of companies and sectors.

MNCs, instead of being a barrier to technological advance, can be a facilitator. The strategy is not limited to a re-division of activities within MNCs but to transform Estonia’s competitive advantage and business model. The goal is to use MNCs as a means of focusing on building manufacturing and technology management capabilities that are matched with emerging market opportunities. The skill formation system is the crucial institution and, to date, it has not been brought into play. The strategy must be to synchronize skill formation with

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76 See Estonian Education and Research Network (www.eenet.ee) and Tiger Leap (www.tiigrihype.ee)
the progression of enterprises up the production capabilities spectrum. With the development of design capabilities, locally based firms (and subsidiaries) take a big step to becoming entrepreneurial firms.

Singapore is one example that bears serious consideration in terms of the integration of its skill formation system with the development of its business system. The Republic of Ireland is another. Singapore’s electronics industry was strategically converted from a labor-intensive manufacturing operations platform for vertically integrated MNCs to a horizontally integrated manufacturing services cluster with ever increasing development of manufacturing-complimentary service activities such as engineering-intensive product redesign and process automation and complementary business services associated with regional coordination, procurement, development, and integration activities.

The responsiveness of the skill formation system is captured by Siow Yue Chia, director of the Institute of Southeast Asia Studies in Singapore (2000: 365-6):

…since the 1960s, the educational system has been continually restructured—with emphasis on technical and vocational education below tertiary level to provide a growing pool of skilled workers and technicians; and rapid expansion of engineering, business and computer education at tertiary level. Forty percent of the graduates from polytechnics and universities are trained in engineering and technical areas. The proportion of an age cohort enrolled in polytechnics and universities is targeted to reach 60% by the year 2000. Formal education is supplemented by training in specialized industrial training institutes to produce qualified craftsmen and technicians. The establishment of the Skills Development Fund provides upgrading training for those already employed.

Technology management capabilities, alone, do not explain the uniqueness of Singapore’s electronics cluster and its high per capita income. But they have contributed to the extension of Singapore’s competitive advantage from manufacturing to the delivery of low-cost, high quality engineering services to “packaging and integration” capabilities. The latter underpin Singapore’s emergence as a regional headquarters for supplying manufacturing services.

Why the emphasis on Singapore. Partly because of its role as a regional coordinator. But more importantly to stress the critical role of education in economic growth in both the Nordic and Asian models.

In the words of Elizabeth Becker (2004):

“Asian countries at top of the list [global competitiveness rankings of the World Economic Forum] share some of the same attributes as the Nordic countries. They place few obstacles for business enterprises and offer strong protection of property rights. They also place a high premium on education.”

The concern is this: the very success of the Nordic model does make it a barrier to the local development of capabilities in Estonia if all three dimensions of the capability triad are not central to policy. A very important first step has been made over the past decade namely the development of partnerships with advanced business enterprises. This sets the stage. Now it is

77 The expression “packager and integrator” comes from Enright, Scott, and Dodwell (1997). It captures the idea that Hong Kong or, by extension, Singapore firms are not mere coordinators of regional activities but “instigators and initiators” of economic activity, match demand and supply on local, regional and global levels. Such firms (or networked groups of firms) embody a complex of activities that enable them to add value.
crucial to develop policies that align all three elements of the capability triad. This will include large investment in education. The magnitude of the challenge is captured in Figure 5.1 below.

5.6 The Way Ahead: ten proposals on development strategy

We conclude with a brief summary of ten proposals to guide industrial policy in Estonia. The proposals move from an emphasis on business model to capability development to skill formation, the three elements of the capability triad, and are illustrated in Figure 5.2.

5.6.1 Apply the principle of system integration

The Capability Triad, the key to transformational growth, requires the alignment of change programs in business organization, production capabilities, and skill formation. At present, the critical inter-relationships between, for example, capability development and skill formation are obscured. Fragmentation undermines the effectiveness of governmental agencies. Consequently, the inter-relationships fall outside the purview of each specialist department; yet it is precisely the processes of mutual adjustment that underlie the growth process. By aligning industrial policy initiatives according to the principle of system integration, the goals of capability development and skill formation, prerequisites to rapid growth the activities of the separate agencies can become mutually reinforcing.

5.6.2 Concentrate on entrepreneurial firms

Entrepreneurial firms can be characterised in terms of a technology-capability and market-opportunity dynamic that drives growth. The drive to advance their technological capabilities is simultaneously a market targeting, market refining, and ultimately market creating process. Because of their unique knowledge of product development possibilities, entrepreneurial firms can anticipate consumer demand. This anticipation reverberates back on product definition and capability development. This, in turn, triggers a new iteration of the technology/market dynamic.

78 W. Edwards Deming (1982), the ‘father’ of the quality movement whose ideas are often credited with inspiring the Japanese production system insisted managers focus on the management of interrelationships as well as statistical quality control and the plan-do-check-act paradigm of total quality management. The idea of system or process integration spread from the material conversion process in the factory to the business enterprise which became understood, not as a collection of profit centers but as an integrated set of inter-related processes such as material flow, order fulfillment, new product development. Not surprisingly, the same principle has applications in government policymaking.
Figure 5.1: Percentage of 24-year olds with natural science and engineering degrees (years vary between 1990 and 2001)

Entrepreneurial firms are the ‘first among equals’ in the national innovation system. They are the microcosm in which coordinated organizational change in each of the three domains of business organization, production capabilities, and skill formation takes place. Their development is the key goal for a growth oriented industrial policy. Entrepreneurial firms drive specialization and clusterization dynamics; they create pressures for new firm creation and they diffuse technology management capabilities.

New firm creation is particularly important. New entrepreneurial firms can come from various sources including diversifying companies, company spin-offs, research laboratories, supplier development programs, and subsidiaries of global production networks. The turnover of firms is part of a Schumpeterian process in which technological creativity is enhanced. An indicator of industrial policy success is the ratio of new firms to a given population of firms.

The entrepreneurial firm advances a region’s technological capabilities in pursuit of market opportunities. Many will fail, but in the process the region’s capabilities and skill base are advanced and new growth potential is created. Emerging firms benefiting from experiences
and skills gained in previous entrepreneurial efforts may well reap the rewards. The region gains in the process.

5.6.3 **Diffuse high performance work organisation**

Firms organised according to the old business model are stuck at low levels in the production capabilities spectrum (PCS) (see Table 3.1). Those that seek to advance up the PCS will be systematically inclined to develop a ‘high performance work system’ (HPWS). In fact, the extent to which a firm has made the transition to a HPWS is one measure of entrepreneurial capability. Teamwork in a HPWS includes the integration of design and manufacturing, a key stage in advancing a company’s new product development capability. While all firms pay lip service to customer needs, responsiveness to market opportunity depends upon rapid new product development capability.

The pervasive diffusion of the new model of work organisation was critical to the resurgence of the American economy in the 1990s. The proportion of employees in firms that made some use of self-managed work teams increased from 28% in 1987 to 68% in 1995 (Appelbaum et al. 2000).

Entrepreneurial firms can be fostered indirectly by advancing bottom-up managerial capabilities. Furthermore, gearing up these capabilities is, at the same time, fostering internal growth and creating a seedbed from which new firms emerge. For this reason, the HPWS and quality movements can be a catalyst for entrepreneurial firm formation both within existing enterprises and via new firm creation.

The production capabilities spectrum shown in Table 3.1 offers criteria for locating a region’s production plants in the global production order. The criteria are derived from a literature and quality awards that emerged in the 1980s and 1990s to benchmark world class manufacturing processes.

The production capabilities spectrum identifies the specific production challenges to advancing a region’s productivity at any point in time. These challenges can focus industrial policy initiatives. However, successful initiatives must address the challenges with organizational change methodologies that work at the enterprise level within the context of specific regions. A number of organizational change methodologies have been developed in recent years.

Iawo Kobayashi’s (1995) 20 keys methodology is an outstanding example. The 20 keys framework provides criteria for locating a plant compared with international competitors. The classification system identifies 5 levels of performance for each of 20 organizational characteristics of a firm. It is a system for self-assessment that can be conducted by the workforce following a brief training program. Thus the organizational change methodology is based on the principle that those required to make the new system work are involved in designing and developing the new practices. The five levels for each key offer criteria that can become operational goals to guide production improvement action plans and to evaluate workforce performance.

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79 M. Best, with colleagues, has introduced Kobayashi’s 20 keys program for self-assessment and production transition in groups of companies in a number of different countries with perhaps greatest effect in Slovenia. See Petrin (1995 and 2004). Professor Tea Petrin was Minister of Economy in Slovenia in the years leading up to EU accession.
5.6.4 Foster open networks

Entrepreneurial firms are the drivers of regional growth dynamics. This is because entrepreneurial firms are the initiators of a range of regional growth dynamics that distinguish high from low performance clusters. These include techno-diversification, horizontal integration (or value networks), and industrial speciation (or new industry creation). Just as high performance work systems foster the decentralisation of design, inter-firm networking capabilities foster the diffusion of design. Such open-system networks are an infrastructure to enhance regional innovation.

The Internet, which itself fuses information and communication technologies, has assisted the establishment of standard design protocols and thereby enhanced inter-firm networking. Consequently, barriers from the closed technology architectures and the bureaucratic inertia of vertically integrated business enterprises are lowered and specialized companies can integrate, dis-integrate, and re-integrate with other companies as technologies change. Thus the open system cluster fosters an increasing specialization dynamic amongst companies.

An industrial development strategy for Estonia must be based on entrepreneurial firms and open-systems networking; the two reinforce one another. Open-systems networks are, to date, the form of business and industrial organisation that supports regional competitive advantage based on rapid new product development in knowledge intensive sectors (PS 5 see Figure 3.2). Before the development of the focus and network business model, an industrial development strategy based on vertically-integrated enterprises and closed-system networks was a viable strategy.

The small size of Estonia dictates top priority to inter-regional networking as well. Fortunately, Estonian enterprises have unique potential to network, as a group, with the Nordic countries. The Nordic region has enjoyed regional growth dynamics that, in turn, has increased wages and land prices and generated various congestion costs. This has put pressures on Nordic companies to move labor intensive activities abroad and opportunities for Estonian-based companies to develop production capabilities without heavy investments in market development.

Industrial policy should focus on networking for another reason. Companies compete as members of networked groups of companies and the diffusion of new practices and principles across networked groups is critical to making the transition to more advanced technology management capabilities. An example is JIT (just-in-time) production because it depends

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80 Three modes of inter-firm coordination can be contrasted: price, closed networks, and open-systems networks. Each mode affects the internal organisation of the enterprise differently.

81 In fact, information technology is to the knowledge-driven economy what the machine tool industry was to the diffusion of the principle of interchangeability and unit-drive electricity was to the diffusion of the principle of flow, which ushered in the age of mass production. In each case, a new principle of production was associated with the development of a new business model capable of achieving a breakthrough in performance standards that redefined the basis of industrial leadership. Like the emergence of the machine tool industry and fractionated electric power, information technology has fostered an entirely new approach to product architecture, production organisation, and business model, which in turn has redefined industry boundaries.

82 Networking is also an attribute of the technology management capabilities associated with PS 4 and PS 5, requirements for competitiveness in complex production activities, associated with the west pole. Networking here is required to apply the principle of multi-product flow that, in turn, requires kanban type supply-chain management. Kanban based supply-chain management, as developed in Japan, depends on keiretsu, or closed-system networking.
upon an inter-firm coordination of inputs and outputs which, in turn, puts pressure on suppliers to synchronize cycle times. This, in turn, creates pressures to move to cellular manufacturing and high performance work systems.

Investing in networks has the added advantage that the industrial policy-making agency is not dependent upon the successful introduction and implementation of new principles or practices in any single firm. Furthermore, the public investment is weighted in favor of generic and transferable capabilities. Petrin (1995; 2004) offers examples of networking industrial policy initiatives in the case of Slovenia.

5.6.5 Develop and diffuse technology management capabilities

Discussions of technology management are missing in industrial strategy documents around the world. Nevertheless, technology management is a powerful tool at both enterprise and governmental levels for driving growth.

Over the past 200 years the world had built up a huge technology pool, a pool that is being added to all of the time. The recipes for this pool are largely public information. They are written in patent applications and journal articles and embedded in products.

Rapid growth involves developing technology management capabilities to tap the world’s pool of technology, a vast resource for regional growth. A tenet of the capabilities and innovation perspective is that social organisation must be in place in advance of or simultaneously with technology advances. Hence the stress on technology management.

The East Asian economies that have achieved high rates of growth have a critical mass of industrial enterprises with the capability to develop new products and processes based on refining, fusing, and advancing generic or already known technologies. Together, these are the attributes of a national system of production and technology management.

The policy implication is simple: technology management can be a powerful tool for achieving growth goals. Leaders in industrial development have developed new models of technology management and high growth followers have developed regional capabilities to manage technology. Technology management at the firm level is about developing the organisational capability to manage the technology/market dynamic; technology management at the regional level means fostering the virtuous circle of regional growth dynamics. Both involve policies concerning technology adoption, adaptation, assimilation, development, combination, diffusion, and diversification.

5.6.6 Integrate technology management and skill formation

Growth goals should be linked to inter-sectoral transitions toward activities and products demanding more production-complex and knowledge-intensive capabilities. Success can be measured by movement toward the west and east poles of Figure 3.2. This means developing

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83 Slow growth followers, on the other hand, lack the capabilities to tap the world’s pool of technologies. This is not surprising. Successful technology management itself requires the development of three distinct but interrelated capabilities: strategic, organisational, and production. Successful technology management, like the establishment of price for Alfred Marshall, depends upon both blades of a pair of scissors; supply must be matched by effective demand. While demand in price theory is mediated by income, demand in technology management is mediated by production capabilities.
and diffusing new product development and systems integration capabilities associated with PS 4 and PS 5 (Table 3.1).

Perhaps the most important network for transformational growth and for success in the technology management capabilities corresponding to both PS 4 and PS 5 activities and sectors is the inter-institution network which integrates the elements required for long-term manpower planning. Such a network involves moving from a fragmented organisational structure to an integrated enterprise, educational, and governmental skill-formation system.

In Estonia, the major barrier to growth for technology management capabilities corresponding to PS 5 sectors and activities is the integration of regional growth dynamics with skill formation processes. The latter means linking company technology visions, university curriculum developers, school teachers and resource planners (including teachers at school, college, university, and company levels) into a single process. The Republic of Ireland software manpower development programme is a model (Horn 1998).

5.6.7 Partner with firms bringing inward investment to advance capabilities

Inward investment should be assessed in terms of advances in the business model, production capabilities, and skill formation. The purpose of foreign direct investment is not to increase employment and internal investment but to foster regional growth dynamics and transformation growth.

5.6.8 Integrate mission-driven diffusion agencies with industrial policy goals

Governmental and non-governmental modernisation agencies can be ‘systems integrators’ for making a transition to higher skills, and powerful diffusers of new capabilities. A range of examples and models offer methodologies for success (see Best 1995).

Industrial policy measures should target generic capabilities; firms take care of unique capabilities. Generic capabilities are regional assets or ‘social capital’. The quality movement is a model. It is critical that the quality management approach be consistent with the development of the top-down/bottom-up (leadership/design) or technology/market dynamic of the entrepreneurial firm.

New product development is a second candidate for a specialised diffusion agency to drive across a wide range of firms. Firms without new product development capabilities are not organised to pull new generation technologies into production and thereby to pursue fast cycle-time competition. The goal for such agencies is to develop methodologies for systematically moving enterprises up the capabilities spectrum.

5.6.9 Link visible and invisible colleges

Skill formation involves every level of education and every company, or it should. Learning and knowledge creation occurs in both visible educational institutions and an ‘invisible college’ of ‘tacit’ knowledge generation and diffusion that takes place informally.

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84 In the late 1990s, nearly half of Irish Republic full-time manufacturing employment was in foreign-owned firms. These firms generated over 80% of manufacturing export revenues. Mary O’Sullivan (2000) reports that in 1996, net output per person engaged by US enterprises operating in Ireland was IR£177,000 compared to IR£34,600 for indigenous companies.
Production is about two outputs: goods or services, and information. A learning economy is one that develops means of capturing the information by-product and converting it into improved systems. The informal knowledge generated in the process of production is a potential resource. It is part of an invisible skill formation process. It applies to tacit, or non-codifiable, knowledge built up by enterprises conducting experiments, formal and informal, over long periods of time. Tacit knowledge is often a critical ingredient in unique capability development and a source of unique competitive advantage.

5.6.10 Administer the research, technology development, and innovation infrastructure

Knowledge-intensive industries depend upon support research in emerging technologies. In most cases, technological advance and development is a process of mutual adjustment between technology-driven firms, research-intensive universities, and government R&D funding. Sometimes the frontiers of technological research are pushed out by company-led agendas, at other times by university-led research agendas.

Industrial policy to support long-term growth in high-income regions involves government funding commitments in research and technology infrastructure. Industrial innovation depends upon a responsive skill formation system. Developing governance capabilities for integrating university research, technology development, and industrial innovation has received little attention but it is the heartland of industrial policy in knowledge-intensive industries.

Once again, nearby Finland offers a model that is being studied and imitated by countries around the world. Finland went from a low income to one of the world’s richest countries in less than 4 decades. Critical to its success has been the establishment of a science and technology infrastructure. Its transformation and the evolution of Finnish science and technology policy are outlined in Lemola (2003).

The challenge is only partly about making predictions about which technologies and industries will be the growth areas of the future. More importantly, it is about pushing the trajectories of generic technologies that will play a role in many future industries and foster a series of derivative future technologies. Biotechnology and ICT (information and communication technologies) are examples of technology domains that will have widespread industrial applications. Academic research in genome technology and photonics are investments in support technologies of the future, much like electronics was in earlier decades. All three, however, depend upon nano-technology production capabilities. Governments that invest in skill formation in these areas are not placing bets on the future, but investing in it.

85 US industrial policy support for the development and application of the principles of interchangeability and systems integration was critical to establishing American industrial leadership in the middle decades of the nineteenth century and the latter decades of the twentieth century. The specific technologies could not have been forecast, but the generic technology trajectory was predictable. The latter involved the transition from mechanical to electrical to electronic to photonic and biotechnology domains. Government funding of science education was informed by these trends.

86 The National Development Plan of the Government of Ireland has recently integrated the Technology Foresight Ireland, a technology foresight exercise conducted by the Irish Council for Science, Technology and Innovation, into it industrial policy programme. The current annual budget of IR£20 million will be expanded to IR£1.9 billion over the seven-year life of the National Development Plan.
The challenge for industrial policy is to develop governance capabilities for fostering applied technological development to reinforce and foster the continuity of unique, regionally-based technological capabilities. Careful attention to the specific regional growth dynamics that extend a region’s unique technological capabilities and leverage its technological heritage are critical to developing a region’s competitive advantage and fostering industrial growth.

The technology infrastructure and skill formation process starts with maths and science teaching in the early years of education. The lack of penetration of new technology in Estonia’s industry and declining enrolments in science and engineering courses at the tertiary levels can both be traced back to limited interest in science amongst young people and investment in preparing maths and science teachers. Industrial policy is, in part, about addressing bottlenecks in this process. Only government has the responsibility, the breadth of agencies, the time horizon, and the legitimacy to drive the institutional changes to synchronise industrial development and the skill formation process for knowledge-intensive industries.

A final and critical point. In many countries initiatives have been introduced which seek rapid exploitation of scientific results based on the assumption that they are plentifully and almost freely available in the universities and public research institutes. The problem in many Central and Eastern European countries seems to be that after 10-15 years of neglect of the importance of public R&D there is very little available for immediate commercialisation, and large-scale investment is needed to move the S&E related higher education and public research back to world class.
6.1 Introductory remarks

The main political rationale behind the expansion of EU development aid in the second half of the 1980s came from the fear that not all member states were likely to benefit equally from the Single Market. In particular, the less advanced economies of the Southern and Western periphery (mainly Greece, the Italian *Mezzogiorno*, the southern Spanish regions, Portugal, Ireland, and Northern Ireland) were felt to be particularly vulnerable unless they received development assistance (Cecchini 1988). Attention is now turning to the new EU member states, and during the period 2007-2013 a high proportion of the EU development assistance will be directed to these states.

What is special about EU development policies is their ambitious goals, i.e., the provision of financial assistance (in the context of a domestic public and private co-finance requirement) to implement policies whose explicit aim was to transform the underlying structure of the beneficiary economies and to prepare them for exposure to the competitive forces unleashed by the Single Market and EMU. Such policies move far beyond a conventional demand-side, cyclical stabilisation role of public expenditure, and are directed at the promotion of structural change, the acceleration of medium-term growth, and the eventual achievement of real convergence mainly through efficiency improvements in supply-side processes.

EU financial assistance is made available within explicit multi-annual public investment programmes. An important economic consequence for public investment planning is that a more strategic approach can be taken by recipient member state governments. It enables successive administrations to break with annual capital budgeting and put in place systematic development plans of longer duration (i.e., for five, six or seven years). Given the presence of external development aid, the task of co-financing the investment activities is also less difficult in terms of its consequences for domestic revenue raising or public sector borrowing.

Since accession to full membership of the EU in 1995, Finland has made two institutional changes to its science and technology policy. The first has been active involvement in EU research programs which has reinforced the trend to internationalisation of Finnish research (Luukkonen and Hälikkä, 2000). The second is captured by Lemola (2003: 65): “The biggest transformation has been growth of regional innovation policy in the late 1990s, which has been largely accomplished by EU’s regional policy and the instrument of this policy, the EU’s structural funds”.

6.2 The rationale of EU-style National Development Planning

Standard textbook economics asserts that all one has to do to promote real convergence between the regions of any state or between grouping of states is to put in place policies that facilitate the free movement of goods and the factors of production. If all markets are competitive, any initial international or interregional disparities are likely eventually to vanish

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87 We use the term “National Development Plan” to signify the document that must be drawn up by every recipient state and region prior to formalising the nature and extent of EU assistance. Terminology has changed over the years, and detailed regulations evolve, but the overall process has remained much the same. In the case of Estonia, and in the case of regions, the term Single Programming Document (SPD) is used. The current assistance programme in Estonia is SPD 2004-2006.
and there is no need for specific structural regional policies.

One of the more interesting consequences of recent advances in the study of spatial economic processes is that the conditions required for automatic convergence to take place are increasingly seen as not holding in practice. Policy has increasingly come to focus attention on the importance of such factors as the initial level of national or regional physical infrastructure, levels of human capital, or on the fact that countries or regions that start off at a structural disadvantage (perhaps with an unfavourable sectoral productive structure) may never converge in any reasonable time period. Research has even suggested that the removal of barriers to trade and factor movements may actually lead to a relative deterioration rather than an improvement of some regions (Samuelson, 2004; Fujita, Krugman and Venables, 1999).

Influenced by growth theory, and by a desire to implement policies that have long-term benefits, the EU-inspired National Development Plans have three main economic priority areas of investment:

a) Direct support for productive investment as well as other measures to improve the environment of enterprises;

b) Infrastructure expenditure to offset structural and geographical disadvantages;

c) Spending on human resources to augment human capital.

After the initial NDP design phase is complete, the impacts of such policies can be evaluated at the macroeconomic level, in terms of the “cohesion” (or real convergence) objective. In the case of the present Estonian SPD 2004-2006, the report on Assignment 3 of the present project provides details of the model-based methodology used as well as results for the mid-term evaluation of the SPD as implemented in the years 2004 and 2005.

But when individual programmes, sub-programmes and measures are being designed or evaluated, it is also important to have a microeconomic classification that draws attention to the rationale for public intervention. In the course of the mid-term evaluation of the Irish NDP 1994-99, Honohan (1997) suggested a classification that is specifically designed to aid in the evaluation of NDP measures. His taxonomy divides NDP interventions into four categories:

- Type I: Spending to provide services which are thought to have a public good characteristic that would inhibit their optimal provision in the private sector;

- Type II: Schemes chiefly designed to alter relative prices facing private firms and individuals in order to correct for some externality – a corrective subsidy.

- Type III: Targeted schemes designed to alter behaviour where private agents are thought to be inadequately informed, or where a specific externality exists;

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88 The key reason why formal macromodels like HERMIN are constructed is to use them to try to isolate the Structural Fund impacts from all the other factors that influence growth and development in Estonia (e.g., trade integration, industrial strategy, etc.).
- Type IV: Subsidies whose chief effect is *re-distributional* in character.

The combined use of macro and micro NDP evaluation techniques is described in Bradley, et al. 2005. **However, micro analysis of the Estonian SPD 2004-2006 has not yet been carried out.** Nor has there been any analysis of the links between the macro and micro aspects of the SPD and the needs and requirements of Estonian industrial strategy.\(^{89}\)

Thus, it is not yet possible to examine how the Operational Programmes contained in SPD 2004-2006 serve to address the public policy requirements of, say, the Capability Triad, which was discussed in Chapter 3.

### 6.3 NDP design and development needs

The development needs of an economy evolve over time. In the previous chapters we examined the first (post-1992) transition and the second (post 1995) situation in Estonia. In Chapter 4 we identified the types of successful firms upon which Estonian convergence might be built. In chapter 5 we set out the issues in industrial strategy which will need to be addressed by policy makers, but in the public and in the private sectors.

Since Estonia is relatively new to National Development Planning over extended periods of up to seven years, it is instructive to compare and contrast it with the case of Irish National Development Planning, since Ireland is about to complete its third and final EU-assisted NDP. The NDPS influenced the evolution of the Irish economy over the past 15 years. But equally, it could be held that the evolution of the economy also influenced the redesign of successive NDPS. The reverse causation – i.e., the influence of economic performance on the structure of the successive NDPS – can be seen from Table 6.1, which shows the percentage shares of each of the three main economic categories of public investment, for each of the three NDPS.

#### Table 6.1: Percentage shares of CSF EC funding: Main economic categories

<table>
<thead>
<tr>
<th>Economic Category</th>
<th>CSF 1989-93</th>
<th>CSF 1994-99</th>
<th>CSF 2000-06</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aid to productive sector</td>
<td>56.0</td>
<td>47.0</td>
<td>16.0</td>
</tr>
<tr>
<td>Human resources</td>
<td>25.0</td>
<td>32.0</td>
<td>36.0</td>
</tr>
<tr>
<td>Physical infrastructure</td>
<td>19.0</td>
<td>21.0</td>
<td>48.0</td>
</tr>
</tbody>
</table>

Source: Bradley, 2003

The first NDP (which was designed in 1988 and ran from 1989 to 1993) focused heavily on direct aid to the productive sectors, with a strong emphasis on human resources, and a substantial programme of investment in physical infrastructure. The direct aid element may be overstated in Table 6.1, since some of these measures included elements of training and education that are difficult to split out in that first NDP. The emphasis on “direct aid to the productive sector” in this first NDP was appropriate since it was designed at a time when the economy had not fully emerged from the deep recession of the 1980s. Direct aid programmes aimed at the productive sector (mainly manufacturing) appeared to offer the fastest and best immediate return in terms of implementing the Irish industrial strategy, while the other

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\(^{89}\) Industrial strategy can be explicit (as in the cases of Finland and Ireland) or implicit and diffuse (as appears to be the case in Estonia and the Czech Republic). Unlike the strategies of the former centrally planned economies, modern industrial strategies focus mainly on the role that the provision of public goods can play in boosting growth potential. Of course, the absence of any such strategy is in itself a strategy!
programmes built up and offered the promise of longer term returns. However, many aspects of the schemes implemented had been carried over from an earlier pre-NDP period, and were simply expanded. The Irish NDP policy designers had considerable experience on designing and implementing such schemes, in the context of an industrial strategy aimed at attracting inward foreign direct investment (see Bradley, 2001).

By the time of the second NDP (which was designed in 1992 and ran from 1993 to 1999), the increased emphasis on human resources (up from 25 to 32 per cent) reflected concerns about the continuing high level of unemployment and the enduring pattern of “jobless” growth as older firms were replaced by newer more productive ones. These schemes had “equity” aspects that complemented the main “efficiency” element that was central to the concept of an NDP.

The third NDP (designed in 1999 and running from 2000 to 2006) was conceived at a time when the success of the Irish economy had become a topic of international discussion (Krugman, 1997). By the late 1990s the Irish economy had moved to what was effectively full employment, and major infrastructural deficits had been exposed by the rapid growth in the volume of traffic on the congested road systems both in the major cities, and connecting these cities. In order to address these bottlenecks, there was a major shift to infrastructure investment (increased from a 20 per cent share during the first two NDPs to a share of 48 per cent in NDP 2000-2006). The share going to human resources also increased (to 36 per cent), with a focus on upgrading skills, and there was a reduction in direct aid to the now booming productive sectors.  

In the absence of detailed analysis, it is difficult to draw close parallels between the Irish case and the emerging Estonian policy needs. However, the analysis of chapters 3, 4 and 5 of this report suggest strongly that a focus on policies aimed at stimulating the manufacturing sector and associated business services would be likely to generate large dividends. Such policies would initially require a careful balance between human resource development and policies aimed at building on existing Estonian manufacturing successes. The initial mid-term impact analysis of SPD 2004-2006 is worrying in that it suggests that such schemes have not yet got off the ground, and that there is still a strong focus on the agricultural sector. Since the human resource needs have been emphasised in previous chapters, it is instructive to turn, once again, to the Irish experience in this area.

6.4 Human capital aspects of National Development Plans

A distinguishing feature of the Irish approach to National Development Planning has been the careful focus on the role of human capital in the process of enhancing the growth potential of the economy. Between a quarter and a third of the total resources of the Irish NDPs for 1989-1993 and 1994-1999 were devoted to this category of intervention, and this was considerably great than the proportion allocated in the Greek, Portuguese or Spanish NDPs.

It must be emphasised that the Irish government had operated a very active Human Resource (HR) programme since the early 1960s, and long before the first NDP started up in 1989. Ireland never experienced the industrial revolution of the mid and late 19th century, and the

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90 It should also be noted that the domestic co-financing ratio increased steadily between the first and the third NDP. The most recent NDP was mainly financed out of national resources.
only heavily industrialised part of the island of Ireland - centred on Belfast - was split away from the state in 1920, when the island was partitioned. In the absence of widespread industrialisation along British lines, the Irish state operated the apprenticeship (or skills training schemes) through a state agency, now called FáS. So, the HR area was always an organic element of Irish economic policy, from long before the NDP. The main benefit of the European assistance was that it permitted the expansion of existing schemes as well as the development of new ones. In the case of University-based education, the scientific and technical aspects were implemented through expansion of existing institutions as well as through the creation of a series of Regional Technology Colleges (RTC's) that were closely linked with the needs of industries in their particular catchment area.

The pressing need to address the high rate of Irish unemployment in the late 1980s (when it was at almost 20 per cent of the labour force) dominated thinking during the first NDP. In particular, the problem of long-term unemployment and youth unemployment meant that the individual measures were designed to address the social exclusion and poverty consequences of pervasive unemployment, rather than to focus on the role of improvements in human capital in promoting convergence.

By the time that the second NDP was being designed, for the period 1994-99, the labour market pressures had begun to ease slightly, the economy was growing strongly, and the Human Resources Operational Programme in NDP 1994-99 was a more complex blend of policies aimed at equity and efficiency goals. The Human Resources OP for 1994-1999 was the first fully integrated HR programme designed within the context of the NDP. It was the largest single OP in NDP 1994-1999, and absorbed about one third of total resources. It was a blend of measures designed to boost human capital (the “efficiency” or “competitiveness” goal), as well as to enhance the employment prospects of the unemployed (the “equity” goal). But these are not conflicting goals, since the “equity” interventions also increase human capital, but do so through measures that are focused on those sub-groups who are unable to perform effectively in the labour market.

It should be noted that the HR programmes for NDP 2000-2006 were expanded again, as a share of total expenditure, even though by that time the Irish labour market was registering full employment. Irish policy-makers clearly understood the vital need to increase the domestic education and skill base as the firms in computers and pharmaceuticals from the 1980 wave of FDI were moving rapidly towards maturity and could only be replaced by newer firms at earlier stages of the product life-cycle, requiring ever more sophisticated labour inputs. If Estonia wishes to emulate the Irish development process, or to participate in the Finnish one, a similar strong focus on human resources will be needed.

6.5 NDPs and economic development processes

At the risk of oversimplification of what are very complex issues, the recent industrial performance in Ireland shows that the intelligent combination of economic policy and business strategy has generated huge synergies in terms of rapid national growth and convergence. To achieve these synergies requires the clever use of public policy to exploit opportunities and remedy weaknesses shown up by policy frameworks such as Porter’s “diamond” of competitiveness and the capability triad. The timing for Ireland was opportune in that it could build a growth and convergence strategy around its EU Structural Fund programmes, and articulate them in a series of three National Development Plans.
As one examines ways in which Estonian policy makers can use EU assistance to design policies to accelerate their growth rate in order to catch up, the lesson one can draw from the Irish experience is that it benefited from the working out of a series of different types of beneficial externalities:

i. There was an initial clustering of similar industries. This process had been kick-started in Ireland early in the 1960s by incentives based mainly on very low rates of corporate taxation, and a range of other attractive incentives towards investment and training. Two such clusters grew strongly in the 1980s: pharmaceuticals and computer equipment. Although they were mainly foreign owned, they were supported by the rise of local suppliers of specialised inputs.

ii. These clusters generated a local labour market for skilled workers which further facilitated the expansion of the cluster. The early focus on human capital during the 1960s and 1970s was enhanced by the training and human resource policies of the Structural Funds. This provided a vital boost to ensuring an elastic supply of highly trained labour during the 1990s when there was a massively increased inflow of foreign investment;

iii. Spillovers of information and skills from the high technology clusters further encouraged growth in high technology areas and provided the basis for additional clustering effects, often in traditional areas that could benefit from new technologies in their supply chains (e.g., food processing, music and films, high fashion clothing, etc.). It became important to facilitate internal transport and communications, and the urgent need for improvements in physical infrastructure and in the productive environment supported by the Structural Funds became crucial.

iv. Finally, the efficiency externalities operated against the background of a consensual process of social partnership that had been put in place to ensure that there were as few losers as possible in the fiscal and wider economic restructuring that were required to drive a virtuous circle, with the result that growth was less likely to be choked off by industrial unrest.

Thus, openness to the full rigors of competition in the international marketplace was a necessary condition for Irish economic success, but was not sufficient. Nor did the availability of EU development assistance guarantee rapid convergence, as the comparison of Ireland with Greece and the Italian Mezzogiorno illustrates. The barriers to faster growth needed to be correctly identified, a broad growth-promoting policy environment had to be put in place, and the specific Structural Fund public investment policies had to be appropriate, efficient and effective. The intelligent use of the EU development assistance, within a stable fiscal and monetary environment and good industrial relations, ensured that maximum benefit could be made from a uniquely favourable international environment.

In the future, the most successful states will be those who learn to play a critical role in shaping markets by mediating connections between the local and global, and by influencing how local-specific assets are mobilized within the range of opportunities available in the global economy. The concept of a Development Network State has been defined as one that is embedded in a variety of levels and types of governance institutions and works as a liaison or broker in creating networks and empowering non-state actors (Ó Riain, 2005). The only way that this approach led to success in Ireland (after thirty years trying) was that it eventually
became embedded in a *Network Development State* where most, if not all, the other state and private sector actors worked to reinforce the development process. Arriving at the best way of promoting development is one of the very hardest things that government can do. The EU, in the case of Ireland and Estonia, can act as a partners in the process. But the strategies and initiatives have to be home-grown.
Conclusions: catch-up strategies and Estonia’s fate

Estonia has likely achieved most of the productivity gains from the massive decrease in employment and the growth gains from privatization and associated real estate and construction boom. Where can the productivity and growth gains come from to replace these one-off sources?

Estonia’s economic fate is confronted with two powerful counteracting forces: peripherization from premature integration into the EU and capability-developing integration with dynamic Scandinavian companies and clusters.

Integration into the EU pits inexperienced and standalone, mid- and high-tech companies against clusters or networked groups of specialist enterprises that benefit from long established regional advantages. Such advantages are a consequence of interactive processes of mutual specialization by which clusters are formed and by which regionally distinctive technology capabilities are cumulatively and collectively built up over many product generations. Thus, these competitors tap into a heritage of regionally specialized business and technology environments, often referred to as ‘external economies’ which can not be readily quantified. Consequently, we should not be surprised of evidence that rapid liberalization of markets associated with entry into the EU can be destructive to the most knowledge-intensive sectors of the accession economies (Stephan 2003; Tiits et al. 2006).

Against this threat, is a major opportunity for Estonia of which most technology catch up countries can only dream–neighbor to the Scandinavian economies, which regularly feature among the top performers in competitiveness rankings. The challenge is to develop a catch-up strategy that leverages this locational advantage. Can it, for example, be used to foster the transition of existing local companies into entrepreneurial firms as well as the creation of new ones?

The Scandinavian countries have in relative abundance what Estonia lacks: globally competitive industrial clusters. The opportunity for Estonia is that while these innovative clusters act as incubators for new firms, at the same time they tend to be located in urban areas which translates into high costs for expanding firms. Nearness to R&D centers, markets, skilled labor pools, and a range of specialist business service resources are all advantages of an urban environment in the early stages of company life-cycles (Jacobs 1969). But as companies scale up operations the congestion costs of the urban environment can dominate the location benefits from the company formation phase. Therefore, the nearness of Estonia to a number of highly innovative and congested Scandinavian urban areas offers a considerable opportunity for attracting fast growing, globally competitive companies.

The goal in targeting this cluster-spillover form of foreign direct investment is not the immediate creation of jobs but, in combination with local firms, creating a critical mass of companies to stimulate local cluster dynamic processes. For many industries, Estonia’s small size would suggest a more realistic goal of extending cluster boundaries into Estonian industrial space. This would reduce barriers to entry for new firms within Estonia as local

91 The timing of Estonia’s entry into the European Union was not determined by economic calculations alone. Furthermore, a small country, especially, must be part of a larger economic union and the timing of entry is dictated by the larger entity.
firms could focus on core capabilities and partner for complementary capabilities within the cross national cluster.

Successful catch-up strategies do not just happen, they are enacted or administered by technology-based economic development agencies under the authority of government enactment. For example, the Irish Industrial Development Authority (IDA). The IDA was established as part of a catch-up economic development strategy based on foreign direct investment (FDI). One element was to create an attractive environment for business and the second was to negotiate deals with foreign-headquartered high tech companies as part of a process of local capability development. The IDA pursued this strategy to great effect. It identified and attracted fast growing, electronics companies. DEC was attracted in 1971, Ericsson in 1974, followed shortly by Mostek, Fujitsu, Wang, Apple in 1980, Motorola, Intel, NEC and Philips. DEC was particularly strong at advancing complex product development capabilities and skills in Ireland (Drew and Foster 1994). Over time a number of fast growing ‘complementary’ sectors have emerged stimulated by the success of the foreign-headquartered electronics sector. Examples include Europe’s biggest software industry, a telecommunications infrastructure, manufacturing applications of IT, and IT applications in the services sectors.

The ‘Finnish model’ for catch-up, in contrast, does not rely on FDI. The Finnish Tekes (National Technology Agency) was established as a semi-autonomous public agency to plan and execute a strategy for global marketplace success based on national technology programs and indigenous technology capability development. The strategy is similar to that followed by Japan, South Korea and Taiwan (Mazzoleni and Nelson 2005) and many American state governments. State governors in the United States work closely with educational institutions and the private sector to build competitive advantage based on distinctive and high-level skills and technological capabilities. Semi-autonomous, government-sponsored agencies leverage public research funds by coordinating with educational institutions and industry to nurture science and technology infrastructures. The most effective university and public research programs have occurred in the application-oriented science and engineering fields guided by the technology needs of well defined user communities (Mazzoleni and Nelson 2005).

The FDI-led and the indigenous technology capability development catch-up strategies are not mutually exclusive. In fact, they share two key elements. First, both strategies have been implemented by semi-autonomous public agencies that have intentionally or inadvertently triggered cluster dynamic processes to generate sustained growth. The IDA, Tekes, and their American state government counterparts, are agencies for an industrial development vision in which cluster dynamics figure prominently. The idea is that while the initial location of a cluster may be serendipitous, clusters have powerful self-organizing, feedback dynamics that, once set in motion, can provide the region with competitive advantage in the associated technologies for long time periods. The technology agency’s role is to be a handmaiden for

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92 The rise of TBED (technology-based economic development) policies in state governments in America has been an alternative to the ‘race to the bottom’ dynamic in which state governments compete to attract companies with tax incentives. For publications of TBED by state governments in the United States see the National Governors Association website [www.nga](http://www.nga) and the Tech-Based Economic Development Resource Center of the US Department of Commerce’s Office of Technology Policy and State Science and Technology Institute (SSTI) [http://www.tbedresourcecenter.org/](http://www.tbedresourcecenter.org/). For references to TBED initiatives in Massachusetts see [www.massinsight.com](http://www.massinsight.com) and [www.masstech.org](http://www.masstech.org).
cluster emergence and, in the same process, to extend and deepen national technology capabilities.  

Second, both strategies require a major public sector commitment to tertiary and technical education in science and technology. Sustained growth depends upon product development and technology management capabilities in an ever wider range of companies which must be matched with the requisite human resources.

Looked at with the aid of the sector composition graph (see Figure 3.2) the challenge for Estonia to transition toward the knowledge-intensive, upper or ‘north’ quadrant is compounded by the early, possibly premature, integration into the EU and the collapse of the science and engineering educational infrastructure. However, the opportunity for Estonian policymakers is not simply in the knowledge-intensive upper quadrant. Given the high level of unemployment and the comparatively low level of production capabilities, the challenge is to increase production and upgrade business organization in all four quadrants. We have emphasized the opportunities for value-add up-grading of ‘east’ quadrant, raw-material intensive industries. Peripheral regions within Estonia can offer opportunities for labor-intensive operations of companies located abroad and within Tallinn in both the ‘west’ and ‘south’ quadrants.

All four quadrants offer ample opportunities for making step-changes in productivity by transitioning up the production capabilities spectrum as shown in Table 3.1. Government leadership in developing a production modernization agency with the authority, resources and skills to transform traditionally organized companies into learning companies could have a step-change impact on productivity. Such advances in production capabilities would establish the organizational foundation for the diffusion of new product development and technology management capabilities.

Entry into the EU has created the opportunity for Estonian policymakers to leverage EU regional investment aid to achieve its capability development goals.  

Here again the Republic of Ireland and Finland have shown the way. The composition of Irish structural funds shifted from over half going to direct aid to productive sectors (marketing, design skills, R&D) in the first period (1989—93) to only about 15% in the third period (2000-06). The share going to human resources increased steadily from a quarter to over a third over the same period and physical infrastructure followed growing from less than one-fifth to nearly a half. Astonishingly, Irish GDP per head as a percent of the EU-15 average went from 66% in 1986 to 122% in 2002 (Bradley 2004).

93 For US examples of cluster development initiatives see Cortright 2006 and Rosenfeld 2002.
94 State governments vie for federal funding from the federal government within the US in much the same way as nations vie for EU project and structural funds in Europe. For an example see ‘2005 Index of the Massachusetts Innovation Economy’, Massachusetts Technology Collaborative, index indicator 15 at http://www.masstech.org/institute/the_index/2005index.pdf.
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