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ADB recognizes ‘China’ as the People’s Republic of China; ‘Hong Kong’ as Hong Kong, China; and ‘Vietnam’ as Viet Nam.

Abbreviations

ADB	Asian Development Bank
AEC	ASEAN Economic Community
API	application programming interface
AREIO	Asian Regional Economic Integration Observatory
ASEAN	Association of Southeast Asian Nations
BDF	Baltic Development Forum
BSR	Baltic Sea Region
BUP	Baltic University Programme
CAREC	Central Asia Regional Economic Cooperation
CEF	Connecting Europe Facility
CPMM	Corridor Performance Measurement and Monitoring
ECEI	European Cluster Excellence Initiative
ECO	European Cluster Observatory
ESCA	European Secretariat for Cluster Analysis
ESPON	European Observation Network for Territorial Development and Cohesion
EU	European Union
EUSBSR	EU Strategy Baltic Sea Region
FDI	foreign direct investment
GIS	geographic information system
GMS	Greater Mekong Subregion
GTAP	Global Trade Analysis Project
GVCs	global value chains
KHIDZ	Kunming High-tech Industrial Development Zone
NSTDA	National Science and Technology Development Agency
OECD	Organisation for Economic Co-operation and Development
PA INNO	priority area innovation
R&D	research and development
RCI	regional cooperation and integration
SMEs	small and medium-sized enterprises
TEN-T	Trans-European Transport Network
TFP	total factor productivity

Note: For the purposes of this report, \$ refers to United States' dollars; € refers to European Euros; RMB refers to the People's Republic of China's yuan renminbi; \$1.00 = €0.88; \$1.00 = RMB 6.21; €1.00 = \$1.12; €1.00 = RMB 6.99; RMB 1.00 = €0.14; RMB 1.00 = \$0.16.

Introduction

The integration and interlinkage of national markets through regional cooperation and integration (RCI) can add a set of drivers to productivity growth. The first chapter of this book reviews the drivers, instruments and tools that link RCI to productivity. Multilateral institutions have identified key drivers of productivity for emerging economies. This study first characterizes types of productivity for the reader. The related literature identifies key drivers of Total Factor Productivity (TFP) relating both to macro- and microeconomics. On the real, microeconomy side – the sole focus of this book – trade openness, foreign direct investment flows, trade-related infrastructure, quality of (skilled) labor inputs and the efficient allocation of human resources, economic diversification through structural change policies, financial sector development, and the business-oriented institutional and regulatory framework explain most of TFP growth.

The linkage of markets through regional integration can add a set of drivers to TFP growth in terms of:

- trade agglomeration economies and the human capital intensity of regional production;
- regional economies of scale;
- structural transformation and the regional heterogeneity of production;
- increases in regional 'value-added' content in trade;
- opening of the economy to trade.

This study focuses primarily on these regional drivers of emerging economies' productivity.

A review of empirical literature finds that only a few key RCI policy instruments energize the regional integration drivers listed above. These instruments fall under the policy categories of:

- competition, skills and innovation incentives;
- agglomeration from cluster development;
- economic corridor development and connectivity;

- trade facilitation;
- foreign direct investment (FDI) and related technology transfer.

The *World Development Report* (World Bank, 2008) demonstrates clearly that the way to get both the benefits of agglomeration and scale of production, and the benefits from a convergence of welfare is RCI. This is confirmed by the Baltic Sea Region (BSR) experience, as analyzed in Chapter 2. In addition, an extensive collection of literature of recent years demonstrates that regions, as shown in the BSR, greatly benefit from active government policies, such as fiscal, cohesion, labor market and financial inclusion policies in terms of welfare convergence.

As part of its efforts to develop a second generation of RCI policies, the Asian Development Bank (ADB) draws insights from comparable efforts in other areas of the world. Chapter 2 outlines how BSR economies have leveraged RCI drivers of productivity. Following the Baltic Sea Region experience, greater regional integration strengthens tendencies to agglomerate economic activity in clusters. Small and medium-sized enterprises (SMEs) co-locate with larger, especially foreign-owned, technology companies. Targeted finance helps them integrate into regional and global innovation and production networks. Therefore, with the absorption of more skilled labor, employment-based welfare can spread through a region more integrated by way of an 'ecology-of-clusters'. Key financial market-driven policies designed to enhance SME productivity can support trade and supply-chain finance. More unconventionally, second generation regional integration finance tools can also be instituted. Clusters contribute significantly to innovation and further product heterogeneity in open economies. Successful clusters include economic networks or corridors, when these form competitive regional cluster ecologies. Broadly, the literature finds a positive and significant relationship between effective, independent competition policy and TFP growth. Trade integration, which leads to increased market size of a region, further increases competitive pressure, and this enhances regional productivity growth. Overall, as a result, BSR economies have broadly avoided a slowdown in productivity growth, even during the global financial crisis (except for one year, 2009).

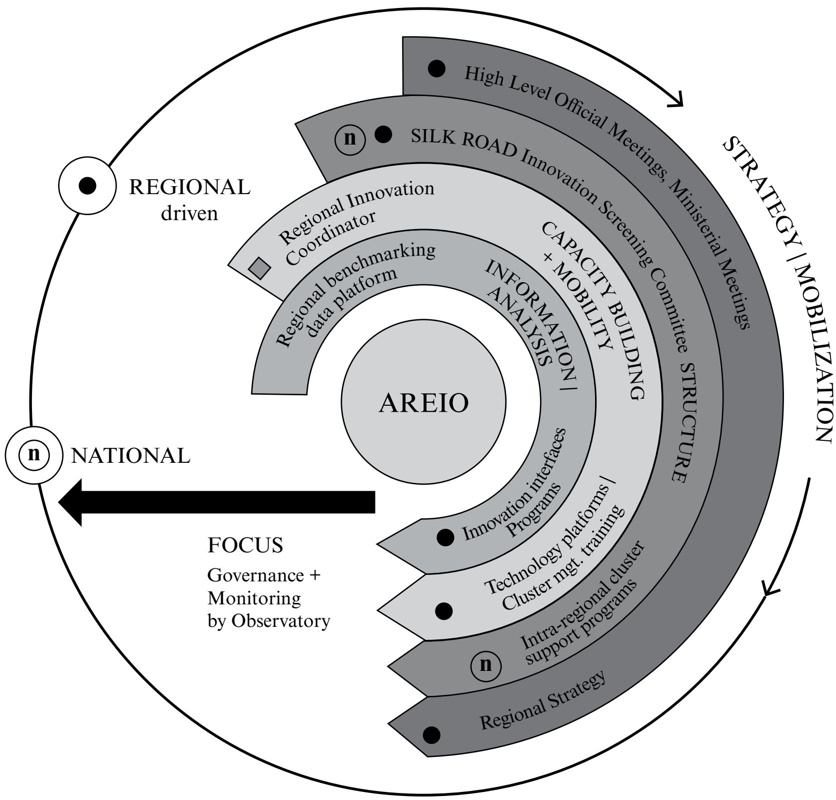
As the Baltic Sea Region shows, European (inclusionary) cohesion policies undertaken on national levels can be influenced by regional consensual coordination mechanisms. This is implemented effectively in the BSR through an innovation steering group. Horizontal policy coordination can work by setting common goals for regional technology platforms, innovation cluster networks, diagnostic- and indicator-based tools and infrastructure. It can help develop the free movement of researchers, knowledge and technology across a region.

The remainder of Chapter 2 details the interconnected layers of policy tools applied in the Baltic Sea Region and how they stack up and relate to each other to effect regional 'embeddedness', connectivity and proximity. It details the indicator and measurement system of the policy tools, and how they have come out in measuring Baltic Sea Region integration progress, for instance, in terms of innovation-driven productivity growth and increases in competitiveness. Then it focuses on one particular policy and knowledge tool, the cluster observatory, and how this tool has fared in terms of achieving policy objectives. Finally, the chapter draws lessons that may be strongly related to the Greater Mekong Subregion (GMS) and Association of Southeast Asian Nations (ASEAN) Economic Community (AEC) contexts in Asia. This sets the stage for building a road map for development of innovation cluster ecologies in Asia.

Chapter 3 examines opportunities for Asian regions to better exploit RCI drivers of productivity. Acknowledging the huge differences between the BSR and Asia, it spells out key lessons from the BSR experience, which are applicable in the context of Asian regions. First, BSR economies were quickly reviving their equivalent of the economic mystique of the Eurasian medieval silk roads, the trading union of the 'Hanse', in their revival of cooperative bottom-up and consensual regional development institutions. Secondly, these resurrected institutions successfully leveraged the regional drivers of productivity growth by exploiting the potential agglomeration and scale economies, and by catalyzing 'connections activities' between the economies' complementary firm structures, by developing high-value-added global value and logistics chains, triggering large regional productivity benefits from structural transformation. Thirdly, this was accomplished in an inclusive manner, by prioritizing regional institutional twinning for human capital accumulation, especially in economically lagging areas of the region. This can, for instance, involve partnering of sector-specific research labs.

Also in this chapter, GMS countries' trade structure is characterized by extra-regional interdependence in global value chains. This is apparent from detailed GMS regional value-added trade flow data. The numbers are corroborated by field visits and interviews. The main export zones and research and innovation clusters in Yunnan Province, the People's Republic of China (PRC), Thailand and Viet Nam depend on intermediate inputs from the industrialized East Asian economies and from the eastern coastal areas of PRC. This is also where the bulk of value-added products are exported from (plus the European Union and North America). The basic concept of 'trade in value-added' is that domestic value-added combines with foreign value-added to produce exports. The GMS can still be characterized as a region dependent on central-urban nodes located at the coast for the integration in global value chains (GVCs). This situation in the GMS indicates clear opportunities for consensual governance, policies and tools that build up a cooperative innovation cluster investment plan in the region. The study provides a roadmap for undertaking successful innovation and skill-based cluster ecology development in this region.

First, the GMS needs to establish a regional coordinator (secretariat) of cluster-network-based cooperation (see Figure I.1). Such a coordination arrangement can be housed in a critical innovation hub of the GMS. The coordinator will act as facilitator, creating and maintaining the public sector, the business community, and the non-profit education and research sector relationships (triple helix), and the international networks in the



Source: Author.

Figure I.1 Asian Regional Economic Integration Observatory, strategy and mobilization related products and fields. Under the coordinator structure, representatives from different countries, according to national priorities, could chair priority innovation steering groups. The kinds of instruments and tools that can be employed in the GMS context are platforms and tools for dialogue and networking between triple helix cluster stakeholders, including construction of actual and virtual meeting spaces, creating of knowledge-enhancing partnerships and twinning arrangements (such as under the proposed Asian Regional Economic Integration Observatory, AREIO), and building of comparable innovation cluster statistics and data anchored in geography (geographic information systems (GIS)-compatible).

As became clearer in field interactions in GMS and Central Asia Regional Economic Cooperation (CAREC) economies, there is need for policy and knowledge tools which can drive a region into a successful ecology of clusters linked with economic corridors via agglomeration economies, via an increase in value-added shares in and along regional and global value chains, and via structure transformation into high skill industries and services, which, taken together, will exploit burgeoning heterogeneity in production and trade across borders. Key national policy instruments such as labor market policies (migration, skill development), technology and innovation policies, cluster and corridor policies, and competition arrangements need strengthening, and at the same time they require regional coordination so that regional growth and welfare can be augmented. The Baltic Sea Region's bottom-up creation of a set of decision tools for cluster development and innovation collaboration – which catalyze business connection (embeddedness), create bridges among stakeholders (physical and figurative, referred to here as connectivity), and strengthen economic flows (proximity) measured in value-added along historic trading routes or modern 'silk roads' – can and should inspire commensurate action in Asian regions. The knowledge toolbox for this has yet to be built, including, foremost, an Asian Regional Economic Integration Observatory (AREIO).

Apart from presenting a succinct roadmap for developing Asian regional cluster ecologies in the last chapter, the ADB technical assistance for this book was primarily to tailor best-practice RCI knowledge platforms on productivity for emerging second-generation Asian RCI requirements. As part of this study, a pilot, web-based observatory is set up for GMS and CAREC cases, and details on design, data, indicators and visual interface are presented. There are now, worldwide, a number of existing and developing observatory platforms, produced by development agencies, the United Nations, governments, universities and companies.

Finally, in the last chapter the book recommends, in detail, the development of an Asian Regional Economic Integration Observatory (AREIO).

First, such an observatory provides a regional consensual focus for identifying regionally inclusive and beneficial activities with high economic pay-offs. Secondly, an AREIO focuses on activities that catalyze connections, by creating a knowledge platform for data management and analysis aligned with this objective. Thirdly, this book shows how to make such a knowledge platform particularly successful for (a) policy dialogue oriented toward the development of networks of strong regional innovation clusters (an 'innovation network ecology'); (b) regional cost–benefit assessment of policy actions and investments with a dedicated cross-border focus; and (c) identification and prioritization of how to meet common competitiveness challenges and related visualized sharing of knowledge among regional actors. In the case of building innovation cluster ecologies, which, by their very nature, require experimentation, it is even more important than in other cases of policy and investment to observe what works and what does not.

The observatory in the Baltic Sea Region has been developed over time through a series of European grants. The ongoing grant focuses on updating open data and mapping of innovation cluster networks, and related standard indicators. Data for a regional competitiveness and inclusive growth analytical frame is linked to indicators of resource fundamentals, drivers and outcomes. The Stockholm School of Economics is the content manager, to ensure sustainability and accessibility of cluster observatory. In Asia, significantly better open data, indicators and analysis platforms for regions need to be developed to allow triple helix stakeholders to develop objective and detailed understandings of regional integration assets and constraints, as well as distribution of benefits and costs. Multilevel governance arrangements (local, national, regional) need to be continuously informed about developments in the regional productivity and income distribution landscapes. This requires static and dynamic data analysis on a regionally standardized basis. Very importantly, Asian regions need to institute a site content manager who ensures quality of a trusted web-source for decision makers, and ultimately the AREIO's long-term sustainability. An outline of the European Cluster Observatory budget and management framework can serve as initial guidance.

1. The impact of regional cooperation and integration drivers on economic productivity and welfare, with particular attention to Southeast Asia

INTRODUCTION

Geography and related histories shape regional cooperation and integration (RCI), and factor markets (human resource composition and natural resources). In the early 1990s, regional economic integration efforts in Asia and Europe were boosted by geopolitical events in both continents with the disappearance of the Soviet empire. Also in the early 1990s, the Asian Development Bank (ADB) began supporting concrete regional cooperation projects, for instance, in the Greater Mekong Subregion (GMS) and in Central Asia (Central Asian Regional Economic Cooperation (CAREC)). Coincidentally for at least 25 years since about 1990, the field of economic geography has been developing analytic tools which help us better understand how an economic landscape evolves and is shaped (Desmet and Rossi-Hansberg, 2014; Boschma and Martin, 2010; World Bank, 2008; Krugmann, 1991; among many others). These analytic and knowledge tools illuminate how wealth is generated as an outcome of productivity growth. Within this framework, economic actors pursue targets, which can be obtained by using policy instruments aimed at influencing key identified drivers of desirable targets.

This first chapter reviews the drivers, instruments, and tools that link RCI to productivity. Multilateral institutions have identified key drivers of productivity for emerging economies. This study first characterizes types of productivity for the reader (see Figure 1.1, summarizing impact paths from RCI to productivity and competitiveness).

A review of the empirical literature (Brunner and Prasad, 2014) finds only a few key RCI policy instruments, which energize identified regional integration drivers of productivity growth. These instruments fall under

POLICY INSTRUMENT	TOOL BOX	DRIVER	WELFARE IMPACT
Labor market policy	Mobility	Agglomeration	Productivity + Distribution
Skill development policy	Capacity	VA Share in GVC	Competitiveness + Cohesion
FDI, technology policy	Capacity	VA Share in GVC Heterogeneity	Productivity + Cohesion
Corridor development policy	Mobility	Agglomeration	Productivity + Distribution
Cluster policy	Analysis	Human Capital Intensity	Competitiveness
Innovation policy	Research	Structure Transformation	Competitiveness
Competition policy	Structure	Openness with Scale Economies	Productivity + Cohesion

Notes: FDI = foreign direct investment; GVC = global value chain; RCI = regional cooperation and integration; VA = value-added.

Source: Author.

Figure 1.1 Impact paths: regional cooperation and integration to welfare

the policy categories of (a) competition, skills and innovation incentives; (b) agglomeration from cluster development; (c) economic corridor development and connectivity; (d) trade facilitation; and (e) foreign direct investment (FDI) and related technology transfer.

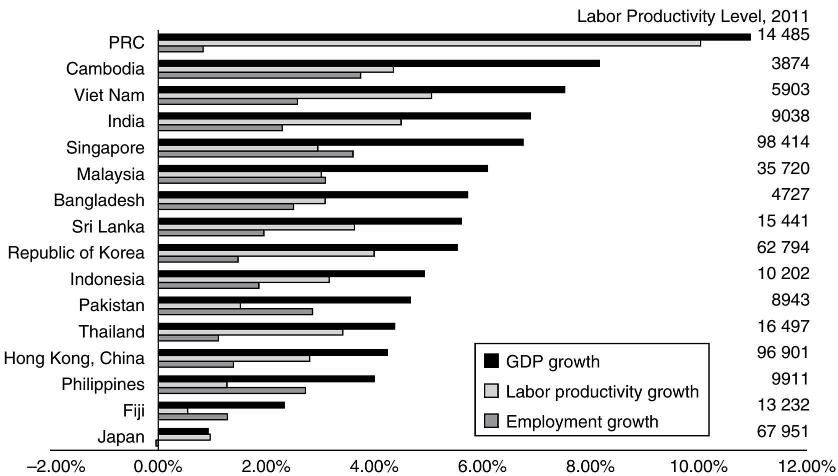
The integration and interlinkage of markets through regional integration can add a set of drivers to productivity growth in terms of (a) trade agglomeration economies and the human capital intensity of regional production; (b) regional economies of scale; (c) structural transformation and regional heterogeneity of the production; (d) increases in regional value-added content in trade; and (e) trade opening of the economy. This study focuses primarily on these regional drivers of emerging economies' productivity.

The *World Development Report* (World Bank, 2008) demonstrates clearly that the way to get the benefits of both agglomeration and scale of production, and the benefits from a convergence of welfare is RCI. This is confirmed by the Baltic Sea Region (BSR) experience, as analyzed in Chapter 2. In addition, an extensive body of literature from recent years demonstrates that regions as shown in the BSR greatly benefit from active government policies, such as fiscal, cohesion, labor market and financial inclusion policies in terms of welfare convergence.

1 THE CHALLENGE OF SLOWING PRODUCTIVITY GROWTH

Since 1965, East Asia has exhibited the world's highest productivity growth, followed by the European Union's first 15 countries (the EU-15), which are mostly wealthy, northern European countries, and then by the rest of Asia, mainly 'developing Asia' (Badunenko et al., 2013). However, those growth figures in East Asia, as well as in the rest of Asia, are down significantly following the 1997 Asian financial crisis, partly for reasons that have inhibited economies' full leverage of RCI drivers and instruments of productivity growth. Presently, there is a gradual and protracted slowdown in economic growth of developing Asia. A key feature of productivities in Asia is the large differential across economies and sectors (see Figures 1.2 to 1.6; ADB, 2014).

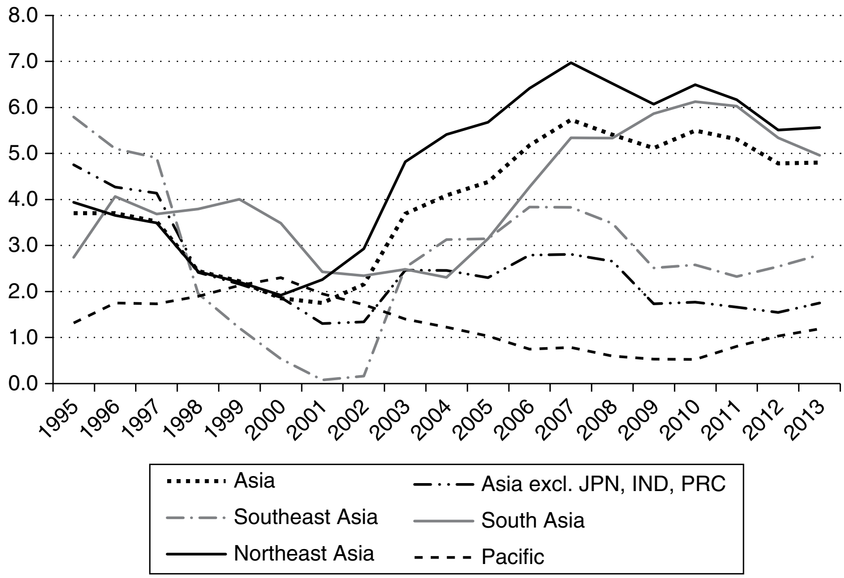
This is due, in part, to the inability of Asian developing economies to capture greater value from traded services and production. Generally, productivity and related economic growth are driven by the increasingly



Notes:
GDP = gross domestic product; PRC = People's Republic of China.
Period for Cambodia is 1993–2011.
GDP growth is calculated using local currency at constant prices. Labor productivity level is constant in 2005 purchasing power parity, US$.

Source: Conference Board Total Economy Database, January 2014 edition.

Figure 1.2 Gross domestic product, labor productivity, and employment growth, 1990–2011



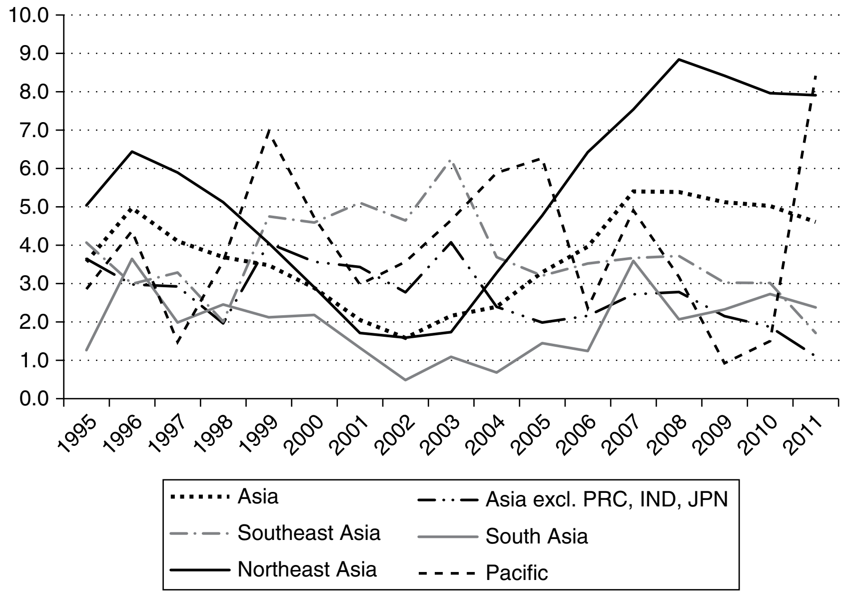
Notes:
PRC = People's Republic of China; IND = India; JPN = Japan.
Years refer to endpoints of 5-year averages computed using compounded annual growth rates.

Source: Conference Board Total Economy Database, January 2014 edition.

Figure 1.3 Labor productivity growth (%)

efficient use of factors of production (that is, labor, capital, skilled human resources), and by investment in technology, innovation and knowledge to move a production possibility frontier outward. Furthermore, with increased supply economies of scale, positive spillovers, for instance, from agglomeration of economic activities can further accelerate productivity and growth.

Regional economic structure is essential when it comes to capturing value-added along trade networks. Eastern European economies have done well in integrating with regional and global value chains, and they are increasing their share of value-added, whereas Central Asian economies have largely been unable to integrate (Shepotylo, 2013). This has to do with the accessibility of markets and the economic density of activity in a region. RCI, however, can help reduce disadvantage in geographic structure, in the reduction of the cumulative value of tariff and non-tariff barriers, and with the removal of regulatory weaknesses, and weaknesses in firm



Notes:
PRC = People's Republic of China; IND = India; JPN = Japan.
Years refer to endpoints of 5-year averages computed using compounded annual growth rates.

Source: Asian Productivity Organization database.

Figure 1.4 Agriculture: labor productivity growth (%)

structure and productivity heterogeneity, among others. Firm innovation, which is a major factor impacting competitiveness and growth, is distinctly conditioned on the geography in which it is embedded.

2 REGIONAL DRIVERS OF PRODUCTIVITY

2.1 Agglomeration of Resources and Spatial Division of Labor

Regional skilled labor migration can be a driver of productivity growth by spreading the use of technology from cutting edge innovation locations to other, newly emerging innovation clusters. In high-income economies, skill-biased job creation is rooted in research and development (R&D); in middle-income economies, skill bias is rooted in imitation-based

BOX 1.1 TYPES OF PRODUCTIVITY: A REVIEW

Labor Productivity, Output (in Value-added Terms) per Worker and Unit Labor Costs

One key factor in productivity growth is the change in the productivity of labor. The most desirable measure of labor productivity is the value added by one labor (person) per unit of time (for instance, an hour). Unit labor cost is the wage cost of labor in real terms per unit of value added.

Capital Productivity

Similarly, capital productivity is measured as the value added by unit of capital, per unit of time.

Total Factor Productivity (TFP)

Limitations of single-factor productivities are well known, as labor productivity, for instance, is affected by the excluded input factors of capital and technology. Hence, research often uses TFP as an appropriate productivity measure, as TFP is invariant to the intensity of use of all observable factor inputs to produce a unit of value added (labor, capital, technology used as a residual) – variations in output produced from a fixed set of inputs, etc., see Syverson, 2011, p. 330. Badunenko et al. (2013), using a large dataset of countries from 1965 to 2007, find that less-developed economies benefit mainly from capital accumulation-driven (labor) productivity, whereas relatively wealthy economies benefit much more from technology-driven productivity when world (labor) productivity (TFP) growth is decomposed into its components. Roland-Holst and Sugiyarto (2014) attribute TFP growth in Asia mainly to capital deepening. In practice, there are also measurement concerns with TFP. It is harder to measure than single factor productivities, as, for instance, it is difficult to measure capital stock. Recently in the literature, efforts have been made to adjust for quality measurement of real output (Benkovskis and Woerz, 2013). This has to be done on a detailed sector or even product level, and based on firm-level statistics. Firm-level statistics are used to analyze key factors that drive TFP, for instance, the business environment in which firms operate (as measured by an infrastructure indicator, financial development indicator, governance indicator, labor market flexibility indicator, labor quality indicator, and a competition indicator) has significant influence on their productivity (Anos-Casero and Udomsaph, 2009).

Productivity versus Competitiveness

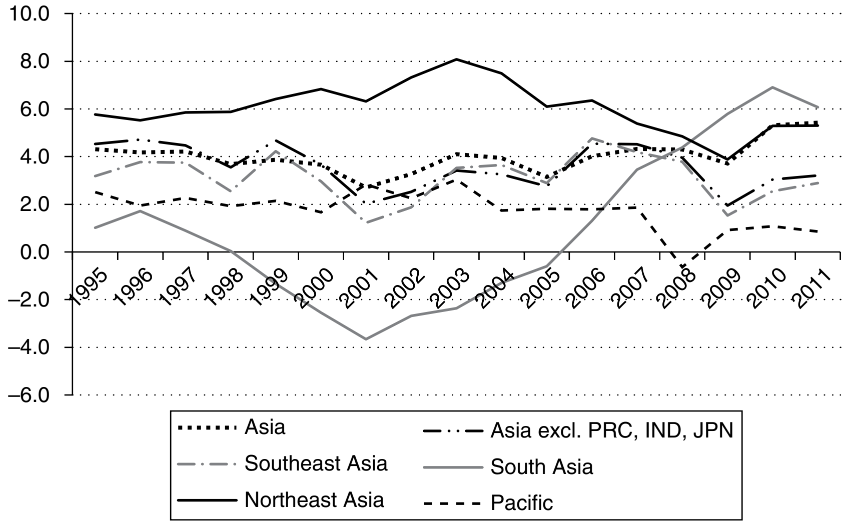
Competitiveness is *not* the same as productivity (for example, TFP). Modern definitions of competitiveness attempt to measure how productively the resources in a region are employed for trade. Competitiveness is a comprehensive framework, which attempts to capture all factors that drive the 'prosperity potential' (Ketels, 2013, p. 270) of a location, and with focus on factors amenable to policy action.

Value-added goods produced domestically and exported (vs. imported) are the key here to determine, for instance, the competitiveness of a country or of a region (Melitz and Redding, 2014). The drivers of competitiveness include the quality of institutions (such as the legal system), the quantity of government investments in infrastructure, the degree of competition, the quality of the workforce, the nature of macroeconomic policies (for example, the size of the public debt), the TFP, and so on. Timmer et al. (2013, p. 6) define the competitiveness of a country as 'the ability to perform activities that meet the test of international competition and generate increasing income and employment'. Based on world input–output tables, they then measure competitiveness based on value-added and jobs involved in global value chains. With appropriate indicators of competitiveness in place, an impact assessment system could focus on the effects of RCI efforts on competitiveness.

A new measure of *aggregate* competitiveness of a location is gross national income (or the closest possible measure that can be achieved locally, which might be gross value added) divided by population of employable age (Enright, 2013). This is a simple measure of how productively the most important resource – human capital – is employed for trade. The aggregate measure is indicative of a set of underlying fundamental causes that policy instruments address to achieve, for instance, higher growth. Delgado et al. (2012) organize these factors or drivers into three groups: (a) social infrastructure and political institutions; (b) monetary and fiscal policy; and (c) microeconomic competitiveness. It is important to note that none of the causal factors individually offer a set path to productivity and inclusive growth. New research on competitiveness aims to capture a breadth of factors that enable each region to harness those drivers that matter most given its particular circumstance at a given point in time (Ketels, 2013).

specialization, which can emanate from FDI and from trade and market integration (for example, global value chain) linkages. Policy tools can support this labor migration, as can be seen in the case of the software sector, and in the innovation cluster establishment in the Baltic countries. As skilled workers are scarce in the emerging market economies, the regionally enhanced transmission of ideas and adapted technologies makes this scarce labor resource more productive, and also enhances productivity in cutting edge innovation locations by allowing 'farming-out' and 'imitative innovation'. Regional integration of more productive economies with less productive ones increases the productive heterogeneity among regional firms, according to Melitz and Redding (2014) (see also Brunner and Prasad, 2015), and, as a result, drives up productivity growth.

To the extent that trade expands markets, we would expect to see a greater division of labor as increased specialization takes place. Concurrently, a number of activities previously taking place at the same location might become spatially separated (possibly in different countries or regions). Once spatial division of labor occurs, advantages from labor pooling (lower search costs for workers) and knowledge spillovers (knowledge-sharing



Notes:
PRC = People's Republic of China; IND = India; JPN = Japan.
Years refer to endpoints of 5-year averages computed using compounded annual growth rates.

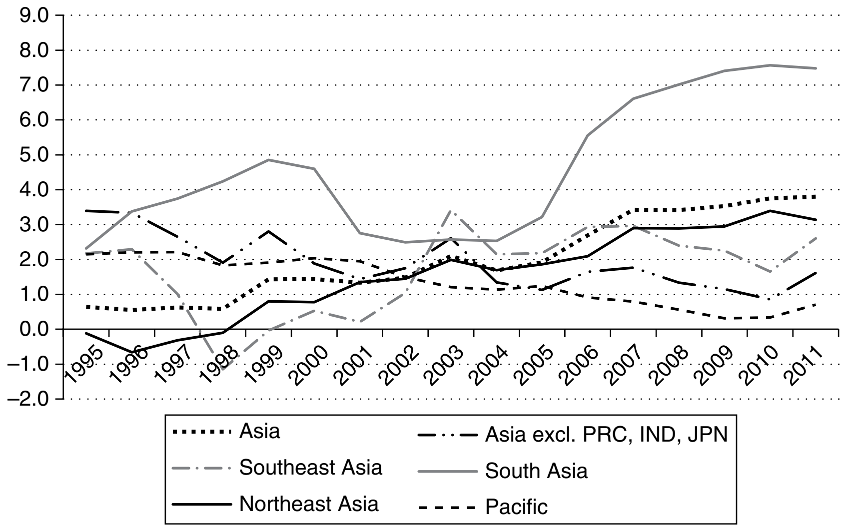
Source: Asian Productivity Organization database.

Figure 1.5 Manufacturing: labor productivity growth (%)

among workers) might take place as well. This can create further positive feedback as greater incentives for spatial division of labor arise, creating even greater spillovers. Chaney and Ossa (2012) put forward a recent model linking market size to an endogenous division of labor. It is worth noting that while increased market size does not necessarily imply spatial separation of production, it makes it more likely. This is because the gains from splitting production across locations, to take advantage of location advantages, become greater.

2.2 Increasing Returns to Scale and Positive Feedback in Exports

According to Syverson (2011), productivity of firms and the inherent heterogeneity is driven by (a) firm-internal factors (for instance, management, labor quality, R&D); and (b) by firm-external factors, which are of prime interest here (for instance, agglomeration and spillover effects, competition and sector effects, and the business environment). It is to be



Notes:
PRC = People's Republic of China; IND = India; JPN = Japan.
Years refer to endpoints of 5-year averages computed using compounded annual growth rates.

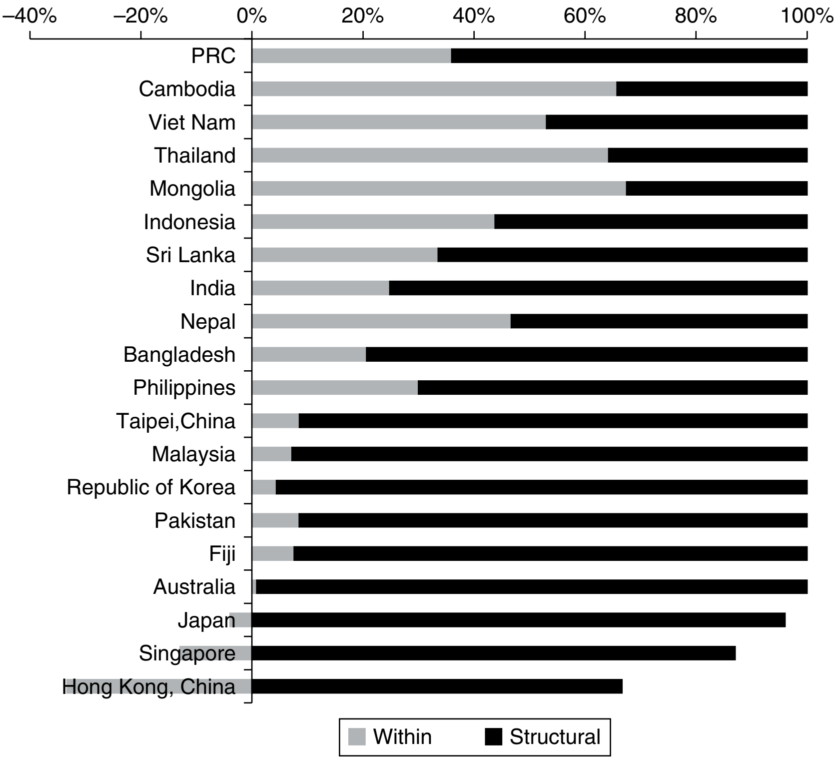
Source: Asian Productivity Organization database.

Figure 1.6 Services: labor productivity growth (%)

noted that causality does not run unidirectionally, but there are non-linear feedback mechanisms at play. Exporters tend to agglomerate in locations that provide a more conducive business environment, allow for positive (knowledge, information, innovation and so on) spillover effects and thus make exporters even more productive. Active exporters introduce more new products into new markets and, as a result, diversify their export activity (see Hausmann and Hidalgo, 2010). These positive externality and feedback effects, scale economies and so on allow for efforts to accelerate growth, through applied policy tools financed by public sector interaction with the private sector. According to Ciuriak (2010, p. 19), the heterogeneous firm view of trade puts the policy spotlight on the nexus of trade–RCI–investment–innovation–productivity–growth using such instruments as value chains and market access creation, and the clustering of investment (including FDI) in knowledge and technology-dependent sectors and on innovation-driven firm exports, for example, by small- and medium-sized enterprises (SMEs).

2.3 Regional Cooperation and Integration-driven Structural Transformation

Within sector heterogeneity, structural transformation can further enhance mobility, returns to scale and agglomeration-driven productivity growth. In this way, resources (human and capital) are moved from low value added and low productivity sectors to higher value added and higher productivity sectors. This can be driven by competition and trade in open regionalism. Figure 1.7 shows a mixed picture of structural transformation. For instance, in Bangladesh and Malaysia, structural change from



Notes:
PRC = People's Republic of China.
Period for Cambodia is 1993–2011.

Source: Computed from Asian Productivity Organization database.

Figure 1.7 Structural and non-structural labor productivity growth, 1990–2011 (%)

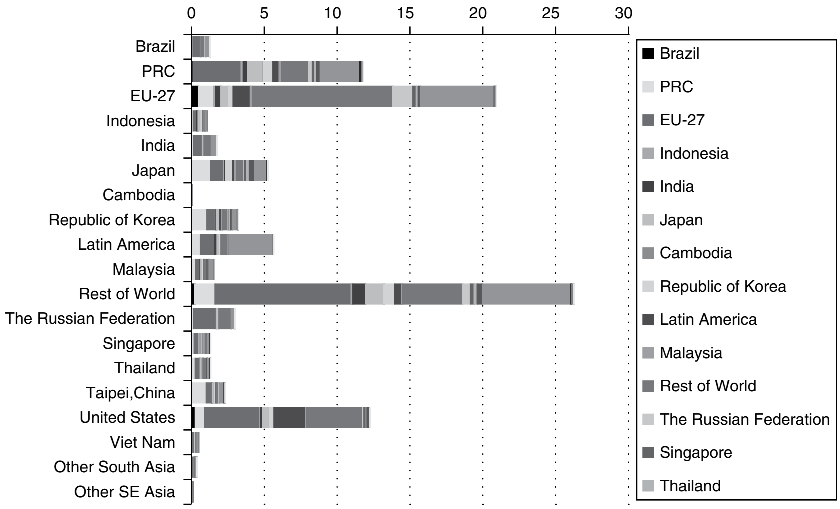
low labor productivity to higher productivity sectors was significant for productivity growth; in Cambodia, the Philippines, and Thailand, it was not (Figure 1.7).

2.4 Moving into and up Global Value Chains (Increasing Value-added Share)

Value chains, reflecting value-added trade and thus structural transformation, are a way of describing the full range of activities that firms and workers distributed over a wide geography perform to bring a product or service from its conception to the end-user (Cattaneo et al., 2013). Geography becomes an important variable in this concept as production takes place at different scales (local, national, regional and global), and is driven by relative differences between the local, national and regional scales. Costinot et al. (2013) offer a comprehensive theoretical exploration of how changes in technology and productivity – driven by local, regional to global value chains (GVCs) – affect participating countries. First, an increase in the complexity of value chains (which relates to the overall complexity of the final export good) leads all countries to move up the value chain; however, at different rates, with the countries at the upper end (close to markets) moving up relatively more, therefore inequality between countries and regions along global value chains increases (Costinot et al., 2013, p. 117). Second, as production processes along value chains become more standardized as goods mature (that is, as technology diffuses down the value chain), all countries move up the value chain; however, countries and regions at the lower end benefit relatively more. Therefore, inequality between countries and regions decreases (Costinot et al., 2013, p. 119).

Overall, GVCs increase the average skill intensity worldwide, and so skill-premiums rise. To elucidate value-added structural adjustments, the dynamic Asian Regional CGE (ARC) Global Trade Analysis Project model described in more detail in Appendix 1 traces sector shifts in bilateral trade flows in intermediate and final goods. Figure 1.8 illustrates our starting point, graphing global composition of trade in goods and services, bilaterally, as a percentage of the total, by origin (vertical axis), and destination (bars).

In Figure 1.9, by contrast, we provide global share data on *value added* in traded goods and services (estimated from domestic value-added shares in originating countries). The distinction between these two, goods movement versus national income embodied in trade, is an important one, and has supported a large policy research literature. Clearly, if the intent of trade is to achieve income growth, the value-added perspective is the more



Notes: PRC = People's Republic of China; EU-27 = the first 27 countries in the European Union; SE = Southeast.

Source: Global Trade Analysis Project (GTAP), www.gtap.org.

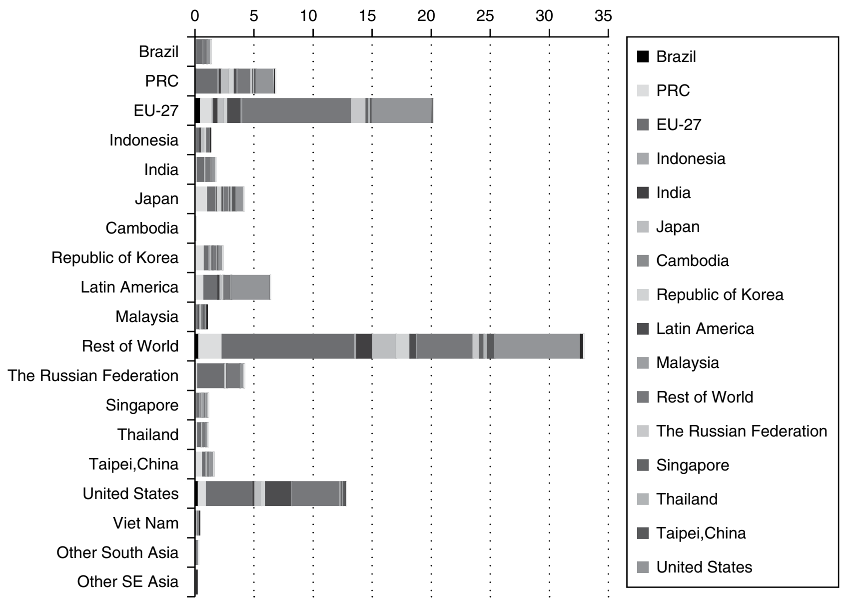
Figure 1.8 Bilateral trade flows, 2010 by origin (left axis) and destination (right key) (% of total)

appropriate. Comparing Figures 1.8 and 1.9 also makes clear that the two perspectives differ in important ways.

There are some key assumptions in this theoretical and empirical exploration, one of them being that intermediate goods along the value chain are *freely* traded; that is, they benefit from complete trade facilitation. Hence trade facilitation is another key RCI policy instrument that can (positively) influence regional inclusiveness and cohesion, as discussed below.

2.5 Trade Opening of Economy

Open regionalism (through RCI) helps improve productivity through an open trade environment. Open economies have higher productivity as firms are exposed to competition. This allows more efficient firms to thrive, with the inefficient ones disappearing in the process or losing market shares. Trade allows producers to choose from a variety of inputs, both local and foreign, making it possible to reduce costs and to improve technology of production. Boler et al. (2012) show how a greater variety



Notes: PRC = People's Republic of China; EU-27 = the first 27 countries in the European Union; SE = Southeast.

Source: Global Trade Analysis Project (GTAP), www.gtap.org.

Figure 1.9 Bilateral value-added flows, 2010 by origin (left axis) and destination (right key) (% of total)

of inputs and access to GVCs through trade opening complements innovation, and hence productivity growth.

3 FACTORS AND INSTRUMENTS

3.1 Policies Affecting Firm Structure (Competition, Skills, Innovation Incentives)

A diversified, heterogeneous-in-productivity firm structure obviates, as recent literature seems to indicate, the need to specifically support SMEs (for instance, Haltiwanger et al., 2013). What the recent literature is increasingly supporting is strong evidence that it is innovative firms, including small innovative ones, that create the jobs (Vivarelli, 2014). Smart innovation and specialization have become a recent focus of policy attention in Organisation for Economic Co-operation and Development (OECD) countries. Smart innovations and specialization are skill-based, going back to Griliches' seminal paper (1969). The new jobs created, which sustain income growth, are the skilled ones, and they are added in fast-growing new enterprises, small or not so small. This applies to economies at different income levels, as will be discussed. As described above, in high-income economies, the skill-biased job creation is rooted in R&D policies. In lower middle-income economies, skill-bias is rooted in imitation-based specialization, which can emanate from FDI (see section 3.5, below, on FDI and technology transfer), and from market integration (GVC) linkages.

The persistence of TFP growth in middle-income countries is dependent on existing external knowledge for innovation, as well as the continuing competitive pressure in firm-specific product markets. For markets to function effectively and competitively, a solid regulatory frame is necessary. Regulation and competition policies and institutions can also be instrumental at a regional level. Broadly, the literature finds a positive and significant relationship between effective, independent competition policy and TFP growth. Trade integration, which leads to increased market size of a region further increases competitive pressure, and this helps enhance regional productivity growth (Melitz and Ottaviano, 2008). The higher productivity effect is driven by more productive firms in a larger regional market.

3.2 Agglomeration Policies (Special Economic Zones, Clusters)

The development of GVCs creates patterns of regional development in the network connection between production agglomerations, zones and clusters (Henning and Saggau, 2012), more precisely concentrations of co-located economic activities in related fields. Despite powerful globalization dynamics, a large part of global production is performed in regional clusters.[1] What causes clusters and makes them work, the prerequisites, triggers, drivers and development processes are divided by Brenner and Muehlig (2013, p. 484) into: (a) aspects connected to labor skills; (b) research and imitation and/or innovation; (c) firm interactions and links and sector conditions; and (d) other local conditions. Greater regional integration strengthens tendencies to agglomerate economic activity in regional clusters, unless counteracted otherwise.

3.3 Economic Corridor Development and Connectivity

With the importance of networks between firms in clusters, agglomerations and along value chains, the increase in efficiency of the physical and information links becomes a conjoint, crucial driver that determines productivity and inclusive growth effects. RCI agreements include a variety of steps to reduce the costs and complexity of engaging in cross-border trade. This can include the facilitation of border crossings, as well as harmonization of regulations so that exporting and importing are simple, transparent and predictable.

3.4 Trade Facilitation

There is no universal definition of trade facilitation. It is useful to think of trade facilitation as reducing transaction costs other than tariffs and quotas. Trade facilitation includes both ‘hard’ and ‘soft’ dimensions. Hard dimensions include infrastructure investments in transportation, border crossings, ports and so on. Soft dimensions include easing regulatory burdens on trade, simplifying customs procedures and so on. Estimation of trade costs and their effects are discussed in Anderson and Van Wincoop (2004) and Portugal-Perez and Wilson (2012), and in a comprehensive way by Sourdin and Pomfret (2012). From their extensive survey, Anderson and Van Wincoop (2004) make a number of important points. First, that trade costs (all transport, border-related and local distribution costs) are large in global perspective. Second, infrastructure investments, law enforcement and property rights enforcement are more important than tariffs and other direct policy instruments. Third, trade costs have large welfare implications. And fourth, details of trade costs matter for economic geography. All of these imply that trade facilitation measures, when effective, will have very substantial effects. Portugal-Perez and Wilson (2012) develop indicators of ‘hard’ and ‘soft’ trade facilitation and estimate their effects on export performance in developing countries. They find that trade facilitation reforms have a positive effect, particularly so for physical infrastructure investments and regulatory reform to improve the business environment.

3.5 Foreign Direct Investment; Technology Transfer

Support for FDI is an important policy instrument to enhance the technology factor in production.

There is a longstanding and vast body of literature on the role of FDI in technology change and productivity growth. FDI is associated with increases in TFP, accompanied by output increase, and increased import and export intensity. The literature relating FDI’s role in development with regional integration is much narrower. This literature emphasizes the role of RCI and FDI in enhancing market access through regional and global value chain development.

4 REGIONAL COOPERATION AND INTEGRATION AND PRODUCTIVITY GROWTH AFFECTING WELFARE DISTRIBUTION

The Kuznets curve suggests that in the early stages of economic development, inequality increases and this increase reflects structural changes that drive growth and productivity. In the late stages of economic development, inequality decreases. Thus, most developed economies are classified as high income and low inequality countries. However, when welfare distribution is particularly unequal, structural change and resulting growth is impeded. Castells-Quintana and Royuela (2014) reference literature which indicates a Gini coefficient of 0.37 as maximizing growth effects from (a) trade agglomeration economies, and the human capital intensity of regional production; (b) regional economies of scale; (c) structural transformation and regional heterogeneity of production; (d) increases in regional value-added content in trade; and (e) trade opening of the economy.

A range of policies can counteract tendencies toward more unequal regional welfare distribution when RCI favors more productive centers. Technology differentials and the skill-based nature of regionally enhanced productivity growth are important factors in boosting welfare concentration effects from trade integration. While trade and regional integration drive upward to productivity heterogeneity among firms, inducing higher benefits from regional integration, models also show that the greater dispersion of firms leads to greater wage differential (Faggio et al., 2010).

This point was made at length in the *World Development Report* (World Bank, 2008):

> Economic growth will be unbalanced, but development still can be inclusive . . . As economies grow from low to high income, production becomes more concentrated spatially. Some places – cities, coastal areas, and connected countries – are favored by producers. As countries develop, the most successful ones also institute policies that make living standards of people more uniform across space. The way to get both the immediate benefits of the concentration of production and the long-term benefits of a convergence in living standards is regional economic integration.

Extensive literature of recent years demonstrates that regions can benefit from active government policies such as innovation policies, cluster policies, labor market policies, social protection and cohesion, and financial inclusion. In the European Union (EU), greater regional welfare dispersion has been counteracted with fiscal support and cohesion policies, as well as increased mobility in the regional labor market. As we see, the Baltic Sea Region effort in this respect has been quite successful. We summarize the basket of inclusionary and cohesive policies and measures in four categories: fiscal, cohesion, labor market and financial market.

4.1 Response Policies

Fiscal (Asian Development Outlook, 2014)

Fiscal policies that foster equality of opportunity coordinated on a regional level can tackle rising regional inequalities propelled by RCI-driven productivity growth. The EU has centrally driven and funded cohesion policies aimed at bringing economically lagging regions and areas closer to the average EU welfare levels. As the example of the Baltic Sea Region (BSR) will show, cohesion policies undertaken on national levels can be influenced by regional consensual coordination mechanisms.

Cohesion

EU cohesion policies allow lagging countries and regions to catch up with the European core economy. A very important part of the cohesion policies is the smart specialization regional policy framework for innovation-driven growth. This can be implemented as in the BSR 'macro-region' through an innovation steering group. The EU provides independence to such 'macro-regions' in their regional cooperation on programs such as regional innovation and skill-based cluster development and investment. Such regional grouping can, for instance, enhance coherence and collaboration of R&D and innovation activities in a region. Horizontal policy coordination can work by setting common goals in terms of regional technology platforms, innovation cluster networks, diagnostic and indicator based tools and infrastructure, and so on (see OECD, 2013, for details). It can develop free movement of researchers, knowledge and technology across a region.

Labor market (European Union: Association of Southeast Asian Nations study)

As has been shown, increasing firm heterogeneity in terms of productivity, which can be induced by regional integration, can lead to increased wage dispersion, where the most trained and skill-intensive part of the labor force benefits from welfare increase disproportionally to the rest of the labor force. For instance, Faggio et al. (2010) showed that most of the increase in individual wage inequality in the United Kingdom was accounted for by increased productivity dispersion between firms and between sectors. On a regionally coordinated basis, it is important to modernize national labor markets by facilitating labor mobility and the development of skills to increase the participation of labor in the formal economy and the better matching of regional labor supply and demand.

Financial inclusion: small- and medium-sized enterprise finance

Limited access to credit by SMEs limits their ability to purchase imports and technology and their ability to participate in higher value-added GVCs. Improved access to finance by SMEs can offer these firms a productivity boost, enabling them to help absorb increasingly skilled human resources. When SMEs co-locate with larger, especially foreign-owned technology companies, finance helps them integrate into regional and global innovation and production networks. Thus with the absorption of more skilled labor, employment-based welfare can spread through a more integrated region via an ecology of clusters. Key financial market-driven policies designed to enhance SME productivity can support trade and supply-chain finance. More unconventional, second generation regional integration finance tools can also be instituted. For instance, value chain finance can extend reverse factoring through multiple stages of a regional or global value chain, helping SMEs further down the chain to access finance (see ADB, 2014). However, SME finance misdirected to make productivity growth more inclusive across sectors can have an unintended effect of aiding a structural shift from capital intensive high-labor-productivity (manufacturing) sectors to low-labor-productivity (services) sectors, in which SMEs proliferate due to low barriers to entry. Hence it is important to have proper incentives in place that direct finance to innovative SMEs that are deemed to create productive jobs. This is a matter of small firm innovation and specialization policy as well.

NOTE

1. Clusters are modes of organization of the productive system, characterized by a geographical concentration of a critical mass of economic actors and other organizations, specialized in a common field of activity, developing inter-relations of a market or non-market nature, and contributing to innovation and competitiveness of its members and the territory. Clusters often include networks (OECD, 2011, p. 190).

2. The view from the Baltic Sea Region

1 CONTEXTUAL FRAME AND TRENDS OF REGIONAL COOPERATION AND INTEGRATION IN THE BALTIC SEA REGION

As part of its efforts to develop a second generation of RCI policies, the Asian Development Bank (ADB) draws insights from comparable efforts in other areas of the world. The purpose of this chapter is to provide a perspective on how regional integration across the BSR has developed over the last few decades. This chapter outlines how BSR economies have leveraged RCI drivers of productivity. Following the Baltic Sea Region experience, greater regional integration strengthens tendencies to agglomerate economic activity in clusters. In consequence, BSR economies have avoided productivity slowdown throughout the global financial crisis years, which is rather unique in the global comparative RCI experience. This discussion helps us assess how policies, data and knowledge platforms designed to support the economic integration process across the BSR might be successfully leveraged in Asia.

Again, unique in global comparative RCI experience, the BSR has continuously narrowed the dispersion of welfare. Cohesion and innovation policies have been successfully implemented. As the example of the Baltic Sea Region shows, European (inclusionary) cohesion policies undertaken on national levels can be influenced by regional consensual coordination mechanisms. This is implemented effectively in the BSR through an innovation steering group. Horizontal policy coordination can work by setting common goals in terms of regional technology platforms, innovation cluster networks, diagnostic and indicator-based tools and infrastructure. It can help develop free movement of researchers, knowledge and technology across a region. The chapter highlights lessons learned that may be applicable to the Asian context for inclusionary policies.

At its core, the Baltic Sea Region includes the Nordic countries (Denmark, Iceland, Finland, Norway and Sweden) as well as the Baltic countries (Estonia, Latvia and Lithuania). It also includes parts of Germany, Poland and the Russian Federation. Efforts to support regional integration across the Baltic Sea Region have gone through a number of phases over the last 25 years, largely driven by changes in the economic context, which, in turn, have shifted the needs of governments and economies across the region.

The EU Summit in Copenhagen in 1993 opened the door for Central and Eastern European countries to become members of the EU. A first step was taken with the Europe Agreement signed in 1995 (in effect from 1998) that created free trade and strong political ties. The same year the Baltic countries and Poland applied for full membership in the EU. Membership negotiations were concluded in 2002, and on 1 May 2004 the Baltic countries and Poland joined (together with seven other countries) the European Union. The Baltic Sea had turned from a borderline in the East–West conflict to a sea almost entirely surrounded by EU members. As an informal group, the Nordic and Baltic EU member countries created the North Baltic-(NB-)6 to coordinate their positions in the European Council and other EU bodies.

Once EU membership had been achieved, the focus shifted to implementing EU rules and regulations, in particular the Common Market, across the region. Most of the instruments and programs were available at the entire EU level, not with a particular focus on the Baltic Sea Region. For example, all countries in the region were eligible for participation in joint projects under the framework programs for research, as well as several company-focused programs, including the services offered through the European Enterprise Network. Nearly €80 billion ($86.5 billion) from European Structural Funds[1] were invested in the Baltic countries and Poland during the period 2007–13 (see Table 2.1 for details). A large portion of these funds targeted improvements in transport infrastructure (30 percent) and measures to protect and improve the environment (22 percent). Approximately 17 percent targeted measures to support R&D and innovation, and less than 5 percent targeted business and entrepreneurial support measures. EU members also had access to the funds provided by the European Investment Bank, which, at the time, had a total lending portfolio of about €45 billion ($48.6 billion). In parallel, the Baltic countries in 2005 also became co-owners of the Nordic Investment Bank, creating easier access to its long-term credit offering.

While many programs had a financial dimension, the EU also offered a wide range of technical support mechanisms and knowledge platforms, covering many aspects of policy making and tracking innovation and economic performance. Examples include support to development of regional innovation strategies, policy learning activities (for example, study visits, regional twinning exercises, and a series of InnoNet[2] projects), and regular innovation scoreboards (on regional and national levels). The first attempt at systematically mapping the presence of clusters was, for

Table 2.1 Use of structural funds in the Baltic countries and Poland (in billion €, 2007–13)

Country	Cohesion Fund			European Regional Development Fund			European Social Fund			Total Convergence Funds		Priorities
	EU	Natl	Total	EU	Natl	Total	EU	Natl	Total	EU	Natl	
Estonia	1.1	0.2	1.3	1.9	0.2	2.1	0.4	0.05	0.5	3.4	0.5	– Environment – R&D and innovation – Transport infrastructure
Latvia	1.5	0.5	2.0	2.4	0.7	3.1	0.6	0.12	0.7	4.5	1.3	– Transport infrastructure – Environment and sustainable growth – R&D – Education and training
Lithuania	2.3	0.5	2.8	3.4	0.9	4.3	1.0	0.2	1.2	6.7	1.6	– Transport infrastructure – R&D – Environment and sustainable growth – Business support
Poland	22	7.5	29.5	33	7.5	40.5	10	2	12	65	17	– Transport infrastructure – Environment – Innovation – Entrepreneurship support

Note: EU = European Union; Natl = national; R&D = research and development.

Source: http://ec.europa.eu/regional_policy/index_en.cfm.

example, initiated under the context of the Europe INNOVA program.[3] The European Cluster Observatory later provided options to look specifically at the clusters across the Baltic Sea Region.

Most of the EU programs did not have a specific focus on cross-border collaboration within a region; the implicit principle was to avoid creating a Europe of subgroups. The only exception was the INTERREG program, which had a much smaller budget than the national structural fund programs to which it was related. The INTERREG program for the Baltic Sea Region was developed by the eight EU member states of Denmark, Germany, Estonia, Finland, Latvia, Lithuania, Poland and Sweden in close cooperation with the three non-member states, Belarus, Norway and the Russian Federation, and adopted on 21 December 2007 by the European Commission.

In about 2007, a group of EU parliamentarians, largely from the Baltic Sea Region, started to talk about the need for a dedicated EU policy for the region. During the Swedish EU Presidency at the end of 2007, the European Council invited the European Commission to develop a strategy for the Baltic Sea Region. In October 2009, this strategy was adopted, including a regularly updated action plan of about 80 flagship projects. The strategy would then provide orientation for everyone actively engaged in regional integration, and that way create a more mutually reinforcing set of activities. The existing EU instruments would be fully integrated and aligned with the objectives of the strategy. Two key choices made at the outset were to create no new institutions and to dedicate no new or separate budget for the strategy. In March 2012, following an interim report in 2010 and the first implementation report in the summer of 2011, the European Commission published a communication that responded to a request from the EU's General Affairs Council to review the EU Baltic Sea Region Strategy. Further 'meta-regional strategies' were launched in other parts of the EU.

The EU Strategy for the Baltic Sea Region (EUSBSR) turned out to be effective in aligning cross-regional activities in economic development, the environment and other areas. The strategy provided a stronger set of priorities than had existed before. It also encouraged the collaboration of all regional entities that had an interest in a specific topic. There were also interesting new efforts, like the BSR Stars project in the area of innovation and cluster-based economic development. Building on a number of collaborative initiatives among innovation policy makers and agencies before the launch of the EUSBSR, BSR Stars was adopted in the action plan as a 'fast-track' flagship within the priority area of innovation. BSR Stars aims to strengthen competitiveness and economic growth in the Baltic Sea Region by fostering transnational linkages between specialized research and innovation nodes, leading to new collaborations that can deliver new products, services and business models for global markets.[4]

This overall structure to govern the EU Baltic Sea Region Strategy affected the way specific activities undertaken as part of the strategy were aligned with each other. The two informational and analytical tools (the European Cluster Observatory (ECO) and the European Observation Network for Territorial Development and Cohesion (ESPON)), which provide territorial evidence as input to policy making, do not operate together and are not actively used as an input to policy development processes on the macro-regional level. The Priority Area Innovation (PA INNO) Steering Group, which has the mandate for establishing strategic policy objectives and priorities at the macro-regional level, is linked to the operational level and to the joint Baltic Sea research program (BONUS) through its flagships (including BSR Stars). Yet there are much weaker links with other instruments that are in the scope of other priority areas (as the Baltic University Program is linked to the Priority Area for Education), or with instruments that are implemented at the EU level (such as the European Cluster Excellence Initiative). The various instruments are part of different governing frames. The EU Strategy for the Baltic Sea Region has improved the alignment and strategic focus within the macro-regional structure, particularly for those activities that have a primary focus on regional integration. But significant challenges remain, especially in connecting activities with broader ambition on national or local business environment conditions to the integration agenda.

The overall governance structure provides the context for an overall strategy that can align individual activities and set measurable goals to track impact. On aligning activities, the EU Strategy for the Baltic Sea Region has led to significant progress. The definition of overall objectives, further broken down into specific ambitions by objective area, has given orientation to the many organizations and projects operating in the region. This has led to a more coherent set of actions, promising more impact and effectiveness. With regard to setting measurable goals, progress has been more limited. Given the fact that most regional integration instruments in the BSR case have operated in separate policy and governance frames, there is no overarching framework or indicators to conceptualize the link between individual initiatives, priority area targets and progress toward the longer-term goals. Most indicators for tracking progress (such as number of engaged companies and politicians, amount of add-on financing secured, launch of a new database, implementation of a matchmaking event and so on) exist on a project level, and on a broader, macro effect level (with indicators and/or trends monitored in the EU's Innovation Union Scoreboard, in BSR State of the Region Reports and so on).

However, the lack of any dedicated funds and a strong governance structure turned out to be a challenge. The strategy process increasingly focused on activities directly related to interregionally financed projects or national efforts with a dedicated regional angle. It failed to engage a much broader set of activities that had a preliminary national focus but could have been opened up to include other parts of the region. The lack of a clear governance structure left the work without strong political leadership, handing the management to a group of high-level public officials that had a limited political mandate to move beyond the traditional areas of collaboration. A communication by the European Commission in 2014 tackled the governance issues of the strategy, and recommended that more responsibilities should be shifted from the Commission to member countries in the region.

The BSR is now home to close to 60 million people. About 43 percent of the region's inhabitants live in the Nordics, 12 percent in the Baltics, and the remainder in the parts of Germany, Poland and the Russian Federation bordering the Baltic Sea. Total employment in the region is at 28 million employees. In 2013 the region created an annual gross domestic product (GDP) adjusted for purchasing power parity (PPP) of around €1.3 trillion ($1.4 trillion). The Nordic countries account for 62 percent of the total. Northern Germany accounts for roughly 14 percent, followed by northwest Russian Federation's 12 percent. The Baltics contribute 7 percent and Northern Poland the remaining 5 percent.

The Baltic Sea Region has, over the last 25 years, become a strongly integrated economic space. For regions interested to learn from the BSR experience, it is important to review the evidence with regard to the following questions, with multiple linkages in terms of trade (Figures 2.1 to 2.3), investment (Figures 2.4 and 2.5), labor mobility (Table 2.2) and research collaboration (Figure 2.6).

- How critical has regional integration been for the economic performance of the Baltic Sea Region?
- What factors have been important in making regional integration possible and effective?

A rich structure of cross-border organizations and collaborative efforts supports and further develops these linkages. The region has over this period seen robust catch-up from the Baltic countries and Poland, even when the prosperity differences across the region remain large (Figures 2.7 to 2.9). And it is (with the Nordics) home to a number of countries that regularly rank among the most prosperous and competitive in the world.

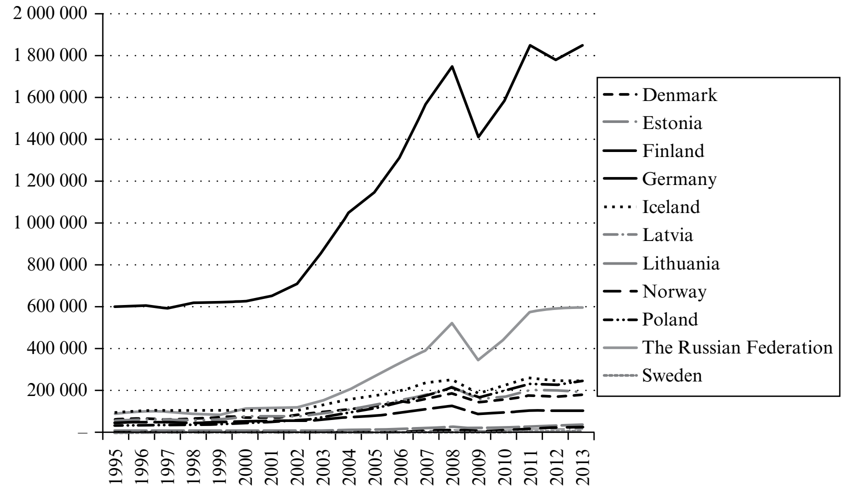
To answer the first question ('How critical has regional integration been for the economic performance of the BSR?'), one has to look at direct and

Table 2.2 *Migration flow from Baltic Sea Region countries*

2009	Other BSR	Other EU	Rest of the world	% Other BSR	% Other EU	% Rest of the world	Unknown	Total emigrants
Estonia	3551	779	338	76%	17%	7%	0	4668
Latvia	3318	1702	1280	40%	20%	15%	2059	8359
Lithuania	4308	10852	6807	20%	49%	31%	3	21970
Denmark	16590	8345	17878	37%	19%	40%	2061	44874
Finland	5124	3090	3861	42%	25%	32%	76	12151
Germany	160067	277225	286693	22%	38%	39%	9811	733796
Iceland	7745	1444	1400	73%	14%	13%	65	10654
Norway	11828	1834	6390	45%	7%	24%	6397	26449
Sweden	18853	4972	13516	48%	13%	34%	1899	39240
Poland	8626	6928	3064	46%	37%	16%	2	18620
The Russian Federation	5539	205	23487	17%	1%	72%	3227	32458

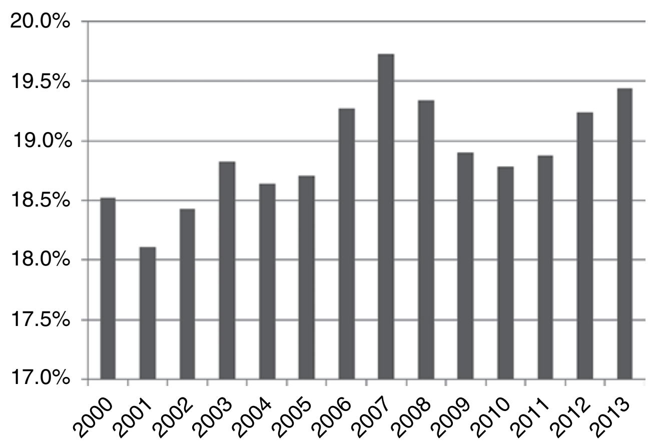
Note: BSR = Baltic Sea Region; EU = European Union.

Source: UN Population Division, data on international migration (http://esa.un.org/unmigration/MigrationFlows.aspx).



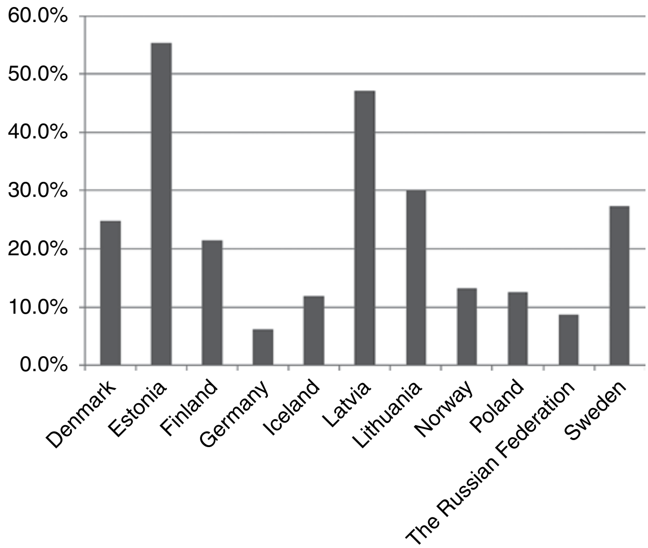
Source: UNCTADstat (2014), Goods and Services Trade Openness Indicators (http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx).

Figure 2.1 Total exports of Baltic Sea Region countries (US$ million)



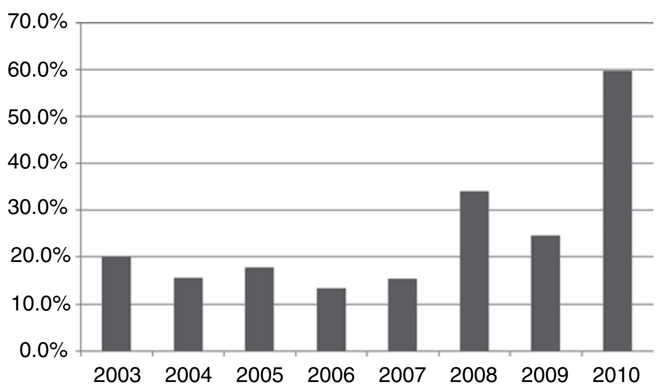
Source: UNCTADstat, Merchandise Trade matrix (http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx), Merchandise Trade, UNCTADstat (2014).

Figure 2.2 Intra-Baltic Sea Region exports as a share of total Baltic Sea Region exports



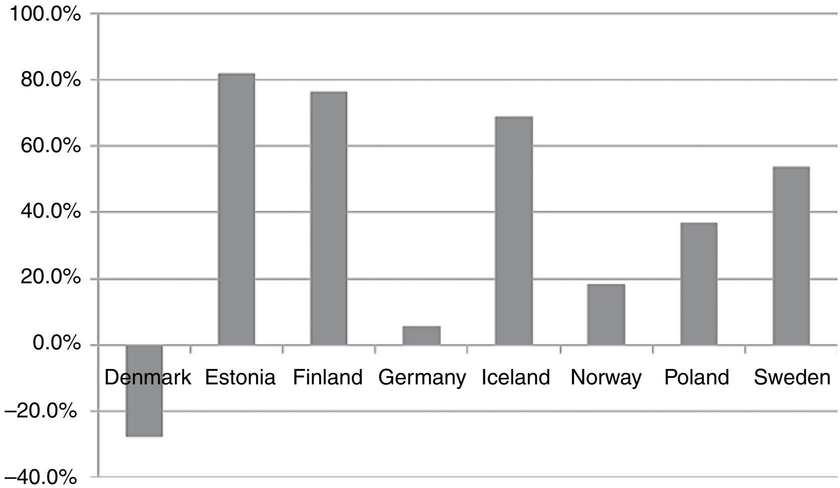
Source: UNCTADstat, Merchandise Trade matrix (http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx), Merchandise Trade, UNCTADstat (2014).

Figure 2.3 Share of 2013 exports to other Baltic Sea Region countries



Source: OECD.stat (http://stats.oecd.org/), Foreign Direct Investment Flows by Partner Country, OECD.stat (2014).

Figure 2.4 Intra-Baltic Sea Region inward foreign direct investment as share of total inward foreign direct investment

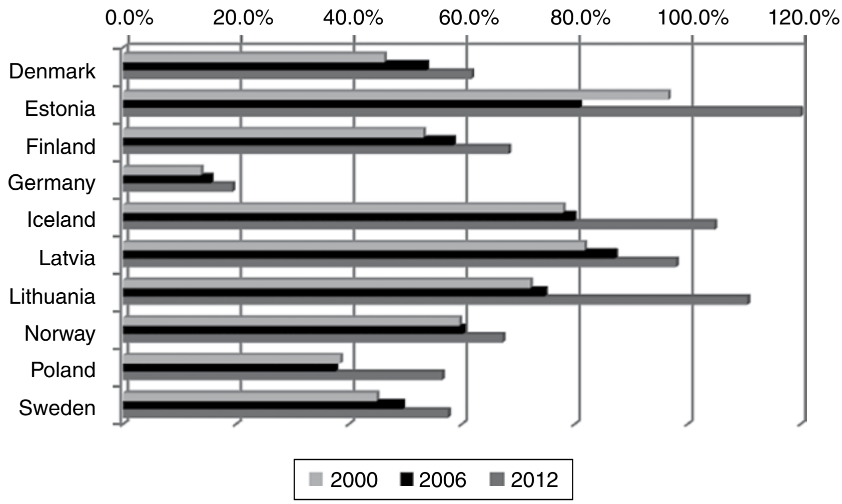


Source: OECD.stat (http://stats.oecd.org/), Foreign Direct Investment Flows by Partner Country, OECD.stat (2014).

Figure 2.5 Share of 2012 inward foreign direct investment from other Baltic Sea Region countries

indirect effects of regional integration. The direct effects, in the form of trade, investment and other linkages between the countries of the region (see Figure 2.10) have clearly been meaningful. Especially for the Baltic countries, these type of economic activities account for an important part of their overall trade and foreign investment relationships. They also quickly infused modern management techniques and a functioning, robust financial system to support the domestic economy. For the rest of the region, however, trade and investment across the Baltic Sea are often less critical. And, where they are the most important, they are more bilateral, occurring with direct neighbors rather than with the region as an overall entity.

One important factor that helps put these direct economic benefits into context is the comparison between the actual level of integration reached and the hypothetical level of integration expected, given prosperity levels, proximity and other relevant factors. The academic literature seems to suggest that the level of integration in the Baltic Sea Region is broadly in line with the predictions. This provides no clear indication that regional collaboration should have benefited the region through a higher level of direct economic integration. It remains true, for example, that companies



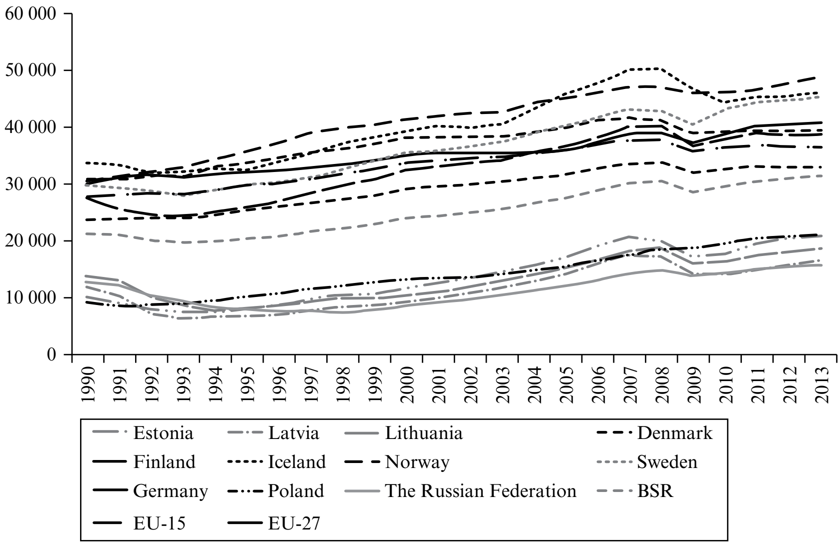
Note: International co-publications are determined based on the address of the authors. The fact that the percentage of intra-Baltic Sea Region co-publications exceeds 100 percent in 2012 (for Estonia, Iceland and Lithuania) is probably because there were multiple authors from the country.

Source: Thomson Reuters Web of Science (http://wokinfo.com/). Access for registered users only.

Figure 2.6 International co-publications with other Baltic Sea Region countries (as share of total international co-publications)

do not look at the Baltic Sea Region as one integrated market in terms of their strategies. For most of them, the region remains a group of individually small markets within the EU, each with its own dynamics, rivals and often even regulatory rules.

The indirect effects – in the form of creating an environment in which domestic policy reforms that enable growth and more effective integration with neighbors and the global economy are more likely – are much harder to measure, but potentially much more important. Some of this happens by creating higher economic returns for domestic reforms in the form of the direct benefits discussed above. Other changes happen through a combination of contractual commitments, peer pressure, learning, and access to technical and financial support within the context of regional collaboration. How critical both of these factors are depends on the level of political willingness and administrative capacity that already exists domestically, and the direction of change that the regional structures and/or tools support (see Figure 2.11).



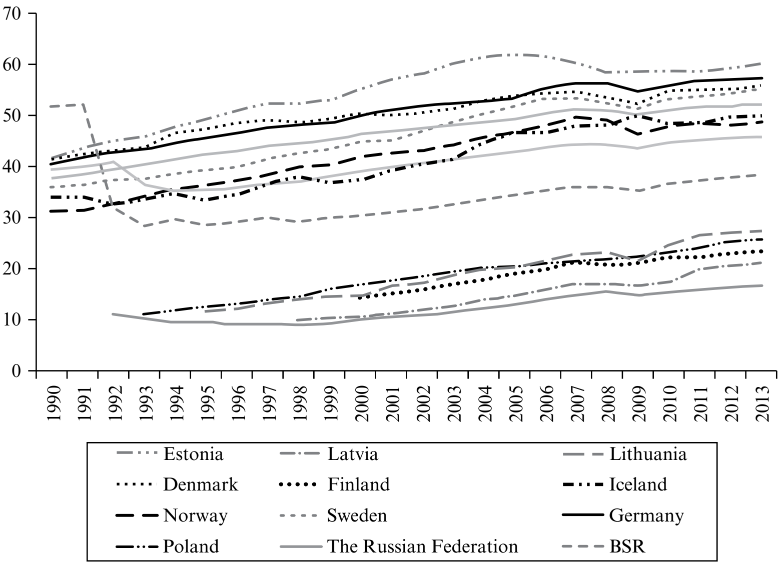
Note: BSR = Baltic Sea Region; EKS = Estonian Kroons; EU = European Union.

Source: Total Economy Database, The Conference Board.

Figure 2.7 Prosperity (gross domestic product per capita, in 2013 EKS)

The case of the Russian Federation illustrates how these direct and indirect effects are, in practice, interrelated. The direct level of economic integration with the Russian Federation's northwestern region and the rest of the Baltic Sea Region is much lower than in the region otherwise and lower than predicted by standard proximity models. This is likely to be driven by both higher trade and investment barriers between the Russian Federation and the rest of the region, and by the business environment conditions and lack of economic policy reforms in the Russian Federation itself. Regional integration can strengthen efforts to upgrade domestic competitiveness and enhance their returns, but without these domestic efforts neither are regional integration efforts likely to develop, nor will they have a strong impact on regional economic relations if they do.

The remainder of this chapter contains four sections. The first section details the interconnected layers of policy tools, how they stack up and connect for effect. The next section then details the indicator and measurement system of the interconnected layers of policy tools, and how they have come out in measuring BSR regional integration progress, for instance, in terms of innovation-driven productivity growth and increases



Note: BSR = Baltic Sea Region; EKS = Estonian Kroons; EU = European Union.

Source: Total Economy Database, The Conference Board.

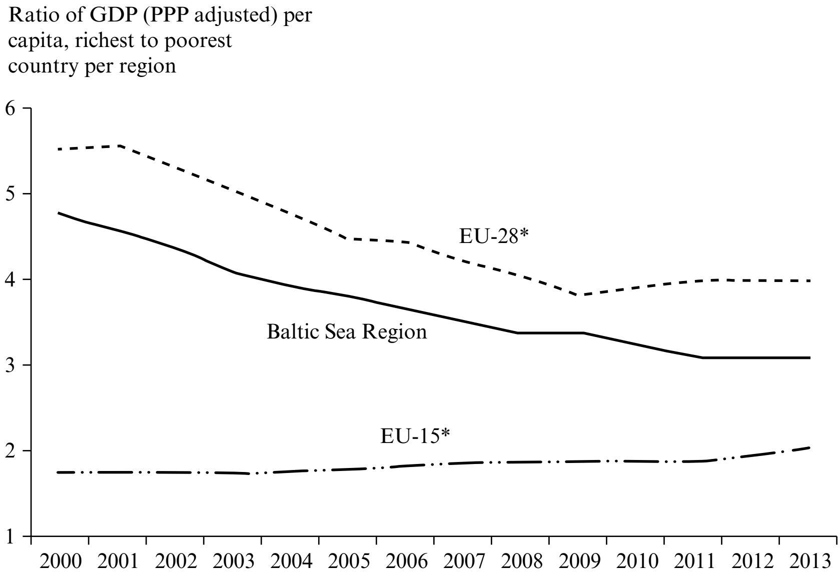
Figure 2.8 Productivity (gross domestic product per hour worked, in 2013 EKS)

in competitiveness. The third section focuses on one particular policy and knowledge tool, the BSR cluster observatory, and how it has fared in terms of achieving policy objectives. Finally, we draw lessons that may be strongly related to the Greater Mekong Subregion and ASEAN Economic Community contexts in Asia.

2 BUILDING BLOCKS AND TOOLS OF BALTIC SEA REGION COLLABORATION AND INTEGRATION: HOW THEY STACK UP AND CONNECT

2.1 Mapping of Tools

The progress that has been made in strengthening cooperation and integration in the Baltic Sea Region (BSR) is a result of sound domestic foundations, which foster flows of goods, capital, people and ideas that are supported and enhanced by a number of knowledge platforms, policy



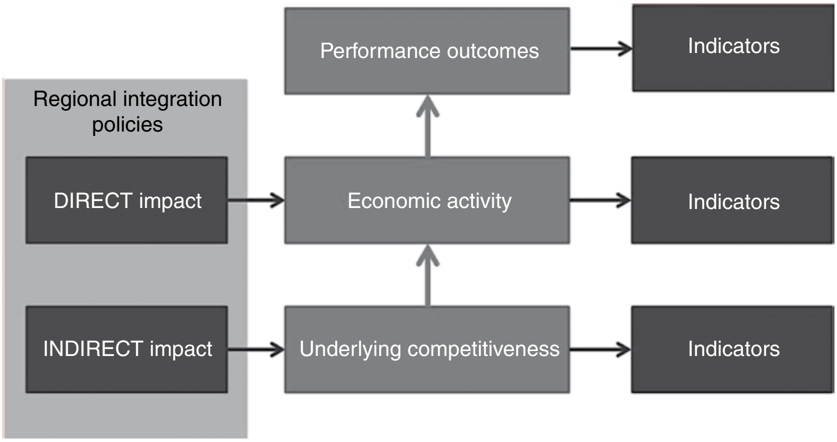
Notes:
Norway and The Russian Federation levels adjusted for natural resource sector; Luxembourg excluded.
GDP = gross domestic product; EU = European Union; PPP = purchasing power parity.

Source: Conference Board (2014).

Figure 2.9 Prosperity dispersion within cross-national regions, 2000–13

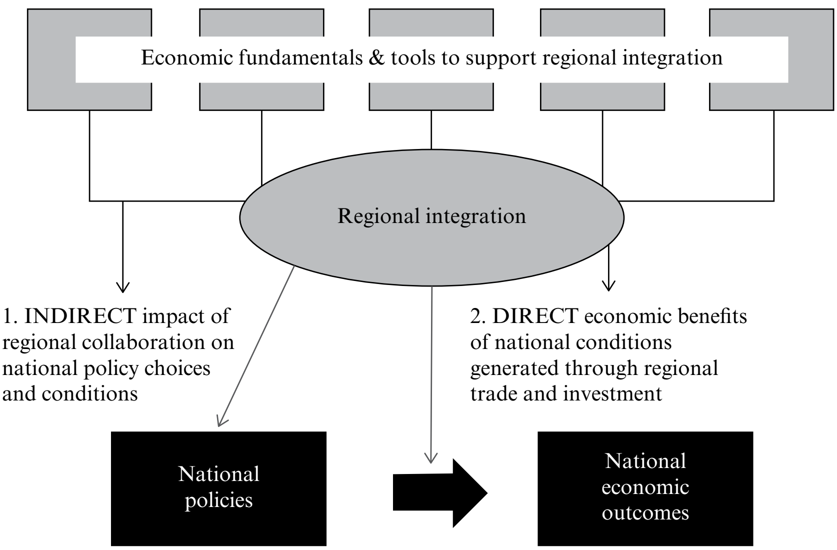
instruments and organizational structures (for detail on policy tools see Appendix 2). This section introduces an overall categorization and mapping of tools for regional cooperation and integration, and presents some reflections on how they have functioned[5] in the BSR and on the need for improvements.

The ultimate aim of these tools is to contribute to increased innovation capacity and productivity, and (in the longer term) growth and competitiveness for all countries in the BSR (see Figures 2.6 to 2.9). This book has already presented an array of toolboxes linked to an array of policy instruments aimed at maximizing impact (measured in terms of productivity, competitiveness, and cohesion). This section reflects on the function (and impact) of tools for regional integration by taking a closer look at the tools most closely related to cluster development and innovation collaboration, and that the EU, regional and national institutions have implemented at the BSR (macroregional) level (see Figure 2.12).



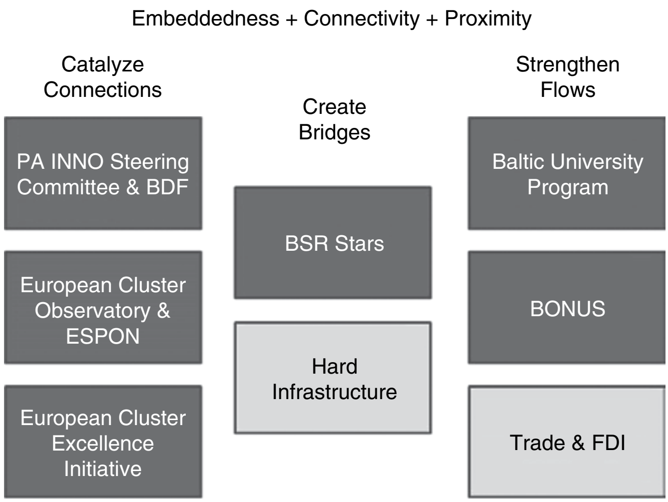
Source: Author.

Figure 2.10 Conceptual framework and indicators of regional integration



Source: Author.

Figure 2.11 Impact channels of regional economic integration



Note: BDF = Baltic Development Forum; BSR = Baltic Sea Region; FDI = foreign direct investment; PA INNO = priority area innovation.

Source: Author.

Figure 2.12 Tools for cluster development and innovation collaboration

Tools are also mapped according to the level of implementation – where activities are decided, governed and (often) financed. Many tools for regional cooperation and integration are implemented by the EU. Other tools are implemented at the level of a smaller subgrouping of countries, at the level of the macro region (Baltic Sea Region) or the grouping of Nordic countries. Still other tools supporting international cooperation and integration are implemented at the national (or subnational) level.

Many of the tools for regional cooperation and integration provide strategic frames, discussion platforms, capacity building and other information or advisory support – helping to strengthen engagement and prioritization of collaborative activities, as well as the 'capacity to collaborate' (embeddedness). Other tools are focused on facilitating and developing more 'operational linkages' of people, knowledge and/or ideas, investments (FDI) and trade (connectivity).

The Priority Area Innovation (PA INNO) Steering Group is a platform for developing innovation strategy, and the Baltic Development Forum (BDF) is a platform for mobilizing action in prioritized areas. The European Observation Network for Territorial Development and Cohesion (ESPON) provides applied research and territorial evidence as an input to cohesion policy, and the European Cluster Observatory (ECO) has similar aims of providing a factual basis for policy development related to clusters. The European Cluster Excellence Initiative (ECEI) aims at developing skills of cluster managers, helping them provide high-quality services to cluster firms. All of these tools are aimed at improving the policy frame, developing capacity and mobilizing different actor groups. These tools help strengthen underlying competitiveness fundamentals.

BSR Stars aims to foster linkages between clusters and other specialized innovation environments through matchmaking events, coordinated calls and other activities to strengthen operational collaboration in these transnational teams. This tool is designed to create bridges (connectivity) among institutions located in different parts of the region to enhance collaboration among them.

The Baltic University Program strengthens East–West collaboration among universities through the joint development of courses and support to student mobility. BONUS is a BSR-level program that supports collaborative research projects on sustainable development. These tools strengthen the flow of people, ideas and collaborative development, and boost economic activities.

As described above, the eight tools have two different profiles. One group of tools[6] is focused on policy and capacity development – strengthening underlying fundamentals. Another group of tools[7] is focused on boosting operational collaboration – strengthening economic activities. This has implications on the key features (target groups, financing and timeframes) for the various tools.

The first group of tools targets policy makers and researchers providing input to policy makers.[8] The tools support integration by providing data and knowledge that highlights the potential of integration and identifies areas in which to advance. The financing and timeframe of these activities is generally longer term, often driven by policy and/or program cycles (on a European level). Given that cluster development is not a separate policy area (but rather an integral part of regional development, research and innovation, and industrial policies), the tools that are more specifically focused on cluster development (ECO and ECEI) are not as strongly anchored to particular policy processes and programs. This is also reflected in levels of financial support (see Table 2.1, and details in Appendix 2). Whereas both ESPON and ECO have similar aims of providing a factual base for policy development and analysis of results and/or impacts, ESPON is linked to the area of cohesion policy (and has a corresponding mandate and financing for the seven-year program period), while ECO is not directly linked to specific policy processes or programs.

The second group of tools targets companies, research organizations, university students and clusters – the actors that conduct the operational activities. The aim is to enable either collaboration or even movement across regional borders by reducing existing barriers. Many of the tools with more 'operational' objectives are structured as programs that provide short-term (up to three years) project financing. This often leads to limited resourcing (time and funds) and a lack of continuity in activities, making it very challenging to achieve more complex and longer-term goals. In addition, many of the tools operate as independent mechanisms, rather than as an integrated set of tools, reinforcing the limited impact of individual activities or projects.

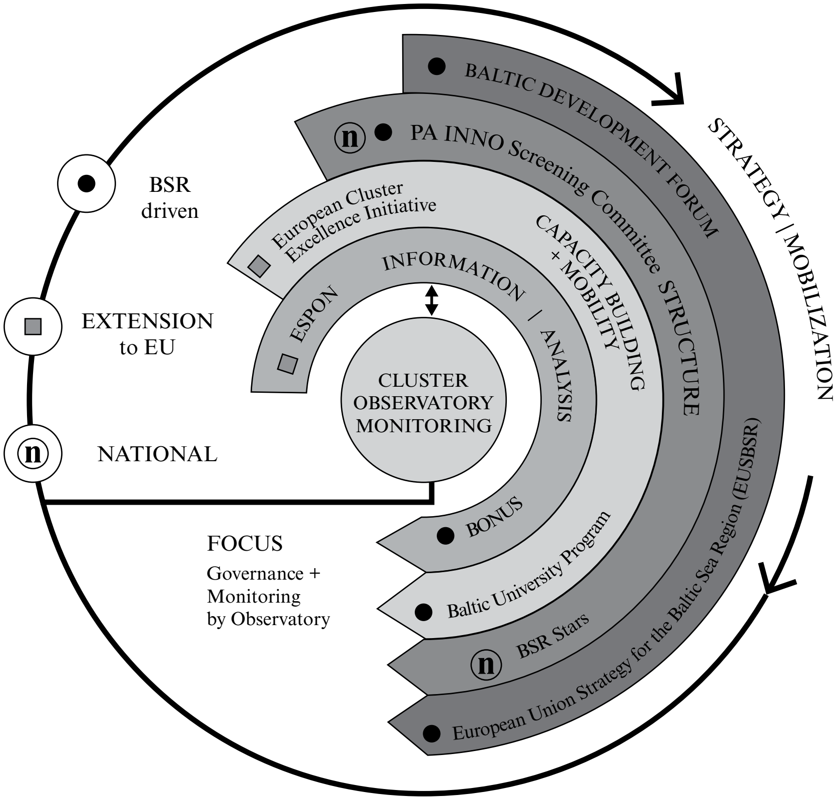
Until the adoption of the EU Strategy for the Baltic Sea Region in 2009, there was no integrated strategic frame to prioritize action areas (and particular activities and projects within these). The strategy has provided a frame and action plan, which establish clearer interlinkages. But matching strategy with prioritized actions, and prioritized actions with corresponding resources (people and funding) to drive results, remains a struggle.

One of the main reflections on the BSR case is that the tools (even those with similar aims of cluster development and innovation collaboration) do not function together in an integrated fashion. It is important to have linkages between tools at all stages of the policy cycle (information and analysis to policy and program development to operational implementation to monitoring and evaluation and continual improvements to policy).

Informational and analytical tools have a stronger impact when linked directly to policy-making processes. When examining ESPON (and comparing it with the European Cluster Observatory), it is clear that ESPON is used as a key input to cohesion policy at the EU level, with a clear mandate, a significant budget and strong capacity to influence and evaluate policy.

Policy strategies also need linkages to operational programs. In the BSR case, the strategic policy level (embodied in the PA INNO Steering Committee) establishes priorities and catalyzes operational action through flagship projects. However, the policy strategy and priorities are not directly linked to budget allocations. Rather, financing for operational activities is provided through various EU programs, Nordic and national funds. This disconnect limits continuity in activities, and makes it challenging to achieve more complex goals and longer-term impacts.

Although there is no way to trace the combined impact of the tools and provide evidence of their contribution to longer-term performance outcomes, the fact that certain tools have existed for nearly 20 years – continuing to drive new linkages and stronger flows – seems to indicate a useful contribution to regional integration. It is reasonable to expect that



Note: BSR = Baltic Sea Region; EU = European Union; PA INNO = Priority Area Innovation.

Source: Author.

Figure 2.13 Integrated tools for cluster development and innovation collaboration

the various tools would have a more notable (and measurable) impact if they existed in a more integrated and transparent frame as sketched above (see Figure 2.13).

We expect the impact of the tools discussed here to manifest in a slower process of much deeper integration between the economies of this region, taking the form of many different kinds of flows. This has been visible through further trade integration, robust investment flows that even survived the shock of the crisis in the Baltic countries, and increasing ties in education and research.

3 TARGETS FOR REGIONAL COOPERATION AND INTEGRATION IN THE BALTIC SEA REGION

3.1 The Indicator and Measurement System for Innovation-driven Productivity Growth

Network development and cohesion are central themes in BSR and in EU policy. The first theme is the translation of the common European market objective in transport infrastructure. From the early 1990s onward, the development of the Trans-European Transport Network (TEN-T) has been a central element in the European strategy to integrate markets and remove barriers to trade (see Appendix 2 for more details). The TEN-T network consists of a set of priority corridors for road and rail that connect different parts of Europe and that have priority with respect to transport infrastructure investments, in particular when European co-financing is involved. Such co-financing can come from EU funds or from the European Investment Bank.

A second main theme in European policy relates to regional cohesion, or the policy to bring regions with lagging (economic) development toward the European average. The regional cohesion policy is behind a financing instrument like the Cohesion Fund, by which billions of euros are invested in infrastructure works such as roads, railways, water supply and sanitation projects, environment projects, etc.

For both the TEN-T program and the Cohesion Fund, strategic choices need to be made regarding priority fields of investment. These are generally made at intervals of seven years, in line with the European budget cycle. Every start of a new budget cycle gives the opportunity to redefine investment priorities between sectors, regions and types of projects.

The indicator and measurement system in the BSR is driven by EU-wide objectives. Knowledge tools have accordingly been developed to assess investment impacts. The socioeconomic and special impacts (SASI) model (for infrastructure impact, especially transport and corridor infrastructure) and ESPON (for cohesion impacts) are critical tools guiding policy and investment decisions.

The SASI model (Spit, 2014) is a recursive simulation model of socioeconomic development of regions in Europe, subject to exogenous assumptions about the economic and demographic development of the European Union as a whole, and transport infrastructure investments and transport system improvements in particular of the trans-European transport network. The SASI model differs from other approaches to modeling the impacts of transport on regional development by modeling not only production (the demand side of regional labor markets), but also population (the supply side of regional labor markets).

A second distinct feature of the model is its dynamic network database, maintained by RRG Spatial Planning and Geoinformation (a German consulting company) based on a strategic subset of highly detailed pan-European road, rail and air networks, including major historical network changes as far back as 1981. The database also forecasts expected network changes according to the most recent EU documents on the future evolution of the trans-European transport networks.[9]

The ESPON 2013 database provides fundamental regional information provided by ESPON projects and EUROSTAT. This information can be used to support territorial development analysis at different geographical levels. The database contributes to a better understanding of the potentials and development perspectives of regions in the European context and globalized world, as its comparable data makes benchmarking of regions and cities feasible.

The ESPON 2013 database provides access to the following data categories: regional, local, urban, neighborhood (candidate countries), world, grid and historical data. Most of the datasets and information produced are publicly available and freely accessible. The datasets and indicators are related to the economy, finance and trade; population and living conditions; the labor market; education; health and safety; information society; agriculture and fisheries; transport and accessibility; environment and energy; science and technology; and governance and territorial structure.

4 KNOWLEDGE TOOLS AND INDICATOR MAPPING

Before this chapter distills policy lessons for utilizing an Asian Regional Economic Integration Observatory (AREIO) for RCI-driven productivity and inclusive productivity growth, it will now provide a short overview of best practice development observation platforms in use (for details refer to Appendix 3). There are a growing number of existing and developing observatory platforms, produced by development agencies, governments, universities, citizen advocacy groups, and companies (Table 2.3). Moreover, both interoperability and collaboration between these stakeholders are increasing. The reasons for this are varied. First, these developments are sourced in the context of an *ever-increasing availability of data*, which includes the digitization of legacy data products, as well as the development of new data products (Frankel and Reid, 2008;

Table 2.3 Existing and related observatory and mapping platforms

Organization	Project	Website
	Government	
USAID	AidData	http://aiddata.org/maps
UK Department for International Development	UK aid Development Tracker	http://devtracker.dfid.gov.uk/
United Nations	United Nations Global Pulse	http://www.unglobalpulse.org/
World Health Organization	Global Health Observatory	http://www.who.int/gho/en/
European Union	European Cluster Observatory: Clusters at Your Fingertips	http://www.clusterobservatory.eu/index.html
European Union	European Observation Network for Territorial Development and Cohesion (ESPON) Mapfinder	http://www.espon.eu/main/Menu_ToolsandMaps/OnlineMapFinder/
European Commission	Infrastructure for Spatial Information in the European Commission	http://inspire.ec.europa.eu/
European Commission	Eurostat: Regional Statistics Illustrated	http://ec.europa.eu/eurostat/statistical-atlas/gis/viewer/; http://epp.eurostat.ec.europa.eu/cache/RSI/#?vis=nuts2.economy
European Environment Agency	Environmental Interactive Maps	http://www.eea.europa.eu/data-and-maps/explore-interactive-maps#c5=&c0=5&b_start=0
United States Federal Geographic Data Committee	Geoplatform.gov	http://www.geoplatform.gov/
Baltic Sea Region observatory	Hosted at European Cluster Observatory	Part of http://www.clusterobservatory.eu/index.html
	Citizen advocacy	
InterAction	NGO Aid Map	http://www.ngoaidmap.org/
Open Aid Partnership	Open Aid Map	http://www.openaidmap.org/index.php
Development Gateway		http://www.developmentgateway.org/
Ground Truth Initiative	Map Kibera	http://groundtruth.in/

Table 2.3 (continued)

Organization	Project	Website
	Development agency	
United Nations Development Programme	International Aid Transparency Initiative	http://open.undp.org/#2014
African Development Bank Group	Map Africa	http://mapafrica.afdb.org/
World Bank	World Bank Open Data, Mapping for Results	http://data.worldbank.org/
	University or academic	
Harvard Business School	Cluster Mapping	http://clustermapping.us/
Stockholm School of Economics, Center for Strategy and Competitiveness	The Cluster Observatory	Part of http://www.clusterobservatory.eu

Notes: ESPON = European Observation Network for Territorial Development and Cohesion; NGO = non-government organization; UK = United Kingdom; USAID = United States Agency for International Development.

Source: Author.

Lohr, 2012; Mayer-Schönberger and Cukier, 2013; McAfee et al., 2012; Picciano, 2014; The Economist, 2010; United Nations, 2012). In both cases, the sources of these data are growing as the barriers for creating data anew or adding value to existing data are reducing.

Second, and critically, much of these data are available in *open access* formats and sharing of those resources in a community setting is now becoming common (Steiniger and Bocher, 2009). A central catalyst for these developments has been the emergence of open data that are free from licensing and exchange restrictions.

Third, *fusion across datasets* is now commonplace, as data are developed on open data standards and formats that are robust (and often supported by standards committees) and extensible (Egenhofer, 2002; Koperski and Han, 1995). Archiving and sharing of both data and their exchange formats is now relatively commonplace, with the result that users can fashion interoperability with relative ease (Goodchild and Hill, 2008). Moreover, tools for achieving data fusion (whether through geocoding, data integration, mapping, mash-ups, infographics, linking and brushing and so on) are also becoming more open, easy-to-use and standardized, often with minimal or no licensing costs (Sherman, 2008).

Fourth, the tools for developing *and using* portals of this nature, or the data that they contain, are much more accessible than ever before, due in part to the maturation of geovisualization (Dykes et al., 2005; Edsall, 2007; Tufte, 2001; Wilkinson and Friendly, 2009; Wood et al., 2007) and related human–computer interaction (Card et al., 1983) and user experience technologies (Garrett, 2010). Of significant relevance, here, is the idea that public users can now easily access, visualize, interpret, share and play with extensive datasets (huge in isolated size, and/or massive in expanse across subjects and domains). Maps and cartography have been instrumental in these developments, because of the ability of maps to synthesize, abstract, organize and communicate data and concepts across a wide range of sources, users and semantics (Newman et al., 2010; Reese et al., 2007).

Geovisualization (Andrienko and Andrienko, 2006; Dykes et al., 2005; Kraak, 2008; Orford et al., 1999; Thomas and Cook, 2005) leverages geography as the basis for interface design; user experience: display of data, attributes and relationships; scientific visualization; animation; and data compression. Together, they cast geography as the central mode of interaction with the system. Geovisualization is particularly important for the purposes of the proposed observatory (1) because of the significance of spatial attributes in providing unifying structure for the data; (2) because of the geographically disparate and heterogeneous nature of the likely data sources and users cases; (3) because of the significance of geography in providing context for the system and its use; and (4) because the system provides a common organization scheme, given that it has a broad, and likely growing, set of users.

All of the existing observatory systems noted in Table 2.3 rely on cartography as the main scheme for visualization and interaction. This is one form of geovisualization, although more could be done to expand on the interface systems that have been developed thus far (Lee et al., 2002), particularly if ADB is to leverage an AREIO to enable and empower particular policy-making pathways and decision support systems atop its own unique user base; data; indicators; policy instruments; and strategies and goals for broadening participation, building on existing and developing new capacity, and prioritizing activities. ADB is also relatively distinct from existing observatory platforms in its ambitions to dock the observatory with models, which will lend the observatory significant 'what-if' capabilities, requiring special consideration.

A dedicated visualization strategy therefore must be considered as an integral part of the observatory's system design, which should involve:

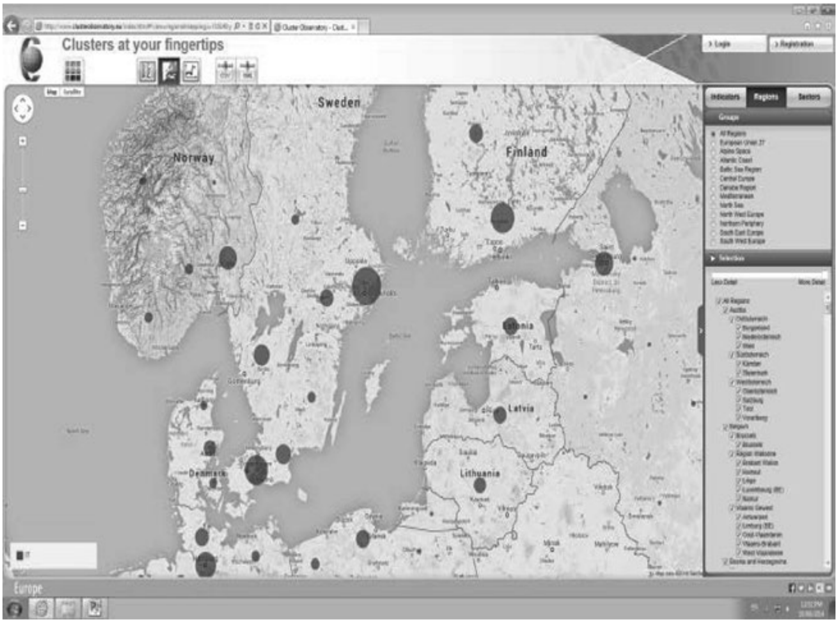
1. identifying the existing 'gold standard' user base for the observatory in this study, for example, but also through a review of ADB's own needs and that of its partner groups;
2. identifying occasional users of the observatory, particularly users of other, related information systems, that might connect to the observatory, dock elements of their platforms with the observatory, or ingest portions of the observatory into their systems;
3. identifying users that do know about but do not currently use observatories, but which may achieve additional advice, capacity, efficiencies and engagement were they to begin using observatories;
4. identifying users who have not yet at all considered using observatories, either because they (a) are not aware of them, (b) do not know how to leverage them, or (c) (and this group is usually important to engage) because they are critical of them.

In each of the cases beyond the 'gold standard' use case, this user engagement exercise could only begin once the observatory is up-and-running in prototypical form, as it requires that users interact with the system and convey its benefits and limitations. Additionally, the visualization strategy will also require an ongoing review of what data the system can accommodate, could accommodate, and ought to accommodate, which can only begin through an iterative process of usage, testing and solicitation of feedback.

4.1 The Cluster Observatory Tool: Success Factors

As the BSR experience demonstrates, an observatory is a useful knowledge tool to search evidence on innovation clusters and evaluate the consequence of different policies. The knowledge tool is instrumental not only as an academic and statistical tool, but also to support the development of better (fact-based) cluster policies. There is a demand for analysis (and tests of effectiveness) of cluster policies, and support to policy learning. The BSR cluster observatory has 74 socioeconomic indicators under five sections (see Figure 2.14): competitive drivers, fundamentals, outcome, intermediate performance, and cluster indicators. Cluster indicators cover 41 industrial sectors. The observatory also emphasizes the role of innovative industries. There are three categories of innovation sectors: creative and cultural industries, knowledge-intensive business, and life science are independently listed.

An observatory should be a data management center where socioeconomic data from different sources is standardized and stored in a database system. Since spatial patterns are critical in analysis, the data should also be



Source: European Cluster Observatory (http://ec.europa.eu/enterprise/initiative/cluster/observatory/index_en.htm).

Figure 2.14 Interface of Baltic Sea Region cluster

organized and presented by location. The whole dataset also should have features of hierarchy corresponding to the hierarchical structure of administrative entities. The EU and BSR efforts have succeeded in establishing and maintaining an effective cluster observatory; however, challenges remain.

4.2 The Cluster Observatory Tool: Challenges

The cluster observatory is useful only if embedded in other data management tools (see Figure 2.13). These need to be assured complementarity to better capture elements of dynamic development processes in cluster and economic corridor ecosystems.

Analyses of standard cluster categories (based on traditional NACE [statistical classification of economic activities in the EU] codes and employment data) do not necessarily capture changing boundaries between sectors and industries. Supplementary analyses (and other indicators of industrial change and cross-sectoral flows) are in demand. The core statistics are complemented by more detailed analyses of patenting, mergers and acquisitions, and venture funding data.

Observatory effectiveness also depends on equivalent data availability and quality across a region. Data availability and quality vary across Europe despite the effort of Eurostat to harmonize the data collection process. While the basic indicators (employees and enterprises) are relatively easy to obtain, there is much more difficulty with productivity indicators, such as wages and value added.

4.3 The Cluster Observatory Tool: Governance and Information Technology Infrastructure

The Cluster Observatory (cluster mapping) has been developed over time through a series of project grants from the European Commission DG Enterprise and Industry. The observatory started as a mapping of clusters in 10 EU member states in 2004, was expanded for all the EU in 2006, and further developed (in 2009 and 2011) to include data on the regional business environment, and an analysis of cross-sector fields of competency (or 'emerging industries'). The ongoing project grant (initiated in January 2014 for three years) is updating the statistical data and mapping, further developing data and information on clusters in 'emerging industries', as well as providing expanded analytical services for policy makers. The Cluster Observatory is one part (or work package) within a broader project (European Cluster Observatory II), led by Verband Deutscher Ingenieure (VDI/VDE-IT) in Germany, which also provides an analysis of European cluster trends, a regional ecosystem scoreboard, a 'stress test' of European cluster policies, and advisory support and policy learning activities for regional and national policy makers in Europe.

In more detail (until January 2014), the European Cluster Observatory website development and code-level support was procured from an external developer, while the team at the Stockholm School of Economics managed all the content and tracked the site's availability.

Some additional technical details:

- The computer systems used are a dedicated server running Ubuntu Linux, with Apache Tomcat as the web server and PostgreSQL as a database. As far as it is known, the developers used the Hibernate framework and many other open source and/or free solutions, such as OpenCMS for managing the content and Google Maps for mapping.
- The Stockholm School of Economics team had an internal person coordinating the overall design activities and an external company

doing all the coding. The costs for development were approximately €100 000 ($108 000) including three years of continuing improvements to the site. The costs for design (not graphical, but conceptual) are hard to quantify as it was done by people on a payroll as part of their everyday tasks.

- The annual cost of running the observatory is approximately €500 ($540) and includes server hosting and domain names.
- The cost of data purchased for the website (see above) is about €50 000 ($54 000) over five years (2009–13). (The cost of data is heavily dependent on the sources of data; much was attained for free, but some was very expensive.)
- Staff time is several person-hours per week, mainly for posting the news and moderating the user updates to the data on the website.
- In total, the European Commission invested €2.5 million ($2.7 million) in project funding for the development and implementation of the European Cluster Observatory over this first five-year period. (As a point of comparison, approximately $4 million (€3.7 million) was invested for developing and implementing the recently launched Cluster Observatory in the United States.)

The development of the system benefited from detailed and concrete specifications of functionality (detailed mockups, long discussions about how it should work), and a combination of extensive use of open code and tailor-made functions.

5 POLICY LESSONS FROM THE BALTIC SEA REGION FOR THE GREATER MEKONG SUBREGION AND ASSOCIATION OF SOUTHEAST ASIAN NATIONS ECONOMIC COMMUNITY CONTEXT

First, the specific policy instruments related to tools for regional integration need to be aligned with the key barriers towards changes at and behind the border. Policy makers might not understand the economic potential of integration. Entrepreneurs might not have the contacts in neighboring countries or information about their markets to spot opportunities. Government agencies aiming to support them might not have the necessary skills and information. Rules and regulations might need to be aligned to facilitate trade and growth. Capital might be missing to finance critical infrastructure links. For all of these, the Baltic Sea Region offers interesting tools and approaches worth studying.

Second, the BSR experience suggests a focus on activities that ‘catalyze connections' (embeddedness). An Asian Regional Economic Integration Observatory (AREIO) can provide data and knowledge about the context, the benefits of integration, and win–win results that activities in specific areas can offer. This type of data is undersupplied in Asia, both on the regional level, where it is a public good, but often also at the national and subregional level, where the necessary capacity is missing. A regional observatory providing this data would fill an important void.

Third, BSR experience recommends the use of this data management platform to encourage a policy dialogue along three strategic issue areas in which specific activities can be taken:

1. *Strengthening traditional global value chains oriented toward foreign markets by developing networks of strong clusters in the region*. This is a process that has already started as a fully market-driven process. Governments can build on this, improving both their individual clusters and the way these clusters are connected as uniquely differentiated parts of global value chains. Here, the new activities would build on many existing policies but would aim to overcome the traditional zero sum competition between locations across Asia.
2. *Assess investments and policy actions with a dedicated cross-border focus*. Asia has a tradition of specific cross-border actions, like the growth triangle between Malaysia, Singapore and Indonesia, where policy changes and infrastructure investments were made in a coordinated fashion, focused on a specific geographic area close to the border. Governments can make these choices in a more fact-based way, if the data provided has sufficient granularity for the border regions. This is a somewhat narrow but very practical application of the data that can open the doors to wider usage.
3. *Identify common competitiveness challenges and share learning about how to address them*. The largest potential benefits would be derived from domestic upgrading of competitiveness triggered by regional integration. Common data on underlying competitiveness can provide a useful facilitating device to establish groups of officials looking at the implications of this data, and at ways to improve the relevant policies. Following what the European Union has called the method of open coordination,[10] this would retain full sovereignty over decision making with national governments but enable them to learn from each other.

The focus on these three areas should inform the selection of indicators, the scope in terms of time, level of geography, industry and so on, and the combination of data with other activities to encourage data use and the creation of a community around an AREIO.

NOTES

1. This amount includes only funds targeting the convergence objective (cohesion, regional development, and social funds), which are allocated to regions characterized by low levels of GDP and employment, and which aim to promote conditions conducive to growth. In addition, European Structural Funds are allocated to each country for territorial cooperation.
2. As part of the Competitiveness and Innovation Programme (CIP), a number of InnoNet projects were initiated to foster transnational innovation policy learning and implementation activities. The BSR InnoNet was one of these projects (running from 2006 to 2009).
3. See Solvell and Ketels (2006).
4. Additional information can be found in the BSR Stars profile description in Appendix 2.
5. Based on the details presented in the description of tools, found in Appendix 2, and on perspectives collected in the field study to Latvia and Lithuania.
6. Including the PA INNO Steering Group, BDF, ESPON, the European Cluster Observatory and the European Cluster Excellence Initiative.
7. Including BSR Stars, the Baltic University Program, and BONUS.
8. Although capacity building activities target all actor groups.
9. From the website of RRG, it is possible that no updates have been carried out since 2008. See http://www.brrg.de/index.php?language=en.
10. http://europa.eu/legislation_summaries/glossary/open_method_coordination_en.htm.

3. The view from the Greater Mekong Subregion, Association of Southeast Asian Nations Economic Community, and the Central Asia Regional Economic Cooperation Region

1 CONTEXTUAL FRAME AND TRENDS OF CLUSTER DEVELOPMENT IN THE GREATER MEKONG SUBREGION AND THE ASSOCIATION OF SOUTHEAST ASIAN NATIONS ECONOMIC COMMUNITY

This chapter will trace and identify the development of innovation clusters in the Greater Mekong Subregion (GMS), as well as in parts of the Central Asia Regional Economic Cooperation (CAREC) areas. Here zones and clusters that provide skill-based products and services and that have actual or potential strong linkages to global and regional value chains are of prime interest. It is crucial to determine, for instance, if there is a history of development of an interlinked set of innovation clusters, as determined by increasing value-added trade flows among the set ('innovation–cluster–ecology'). As has been shown in the case of the BSR, a 'bottom-up' as well as 'top-down' driven institutional regional integration and skill-based innovation structure has been established successfully, under a somewhat integrated set of strategic knowledge tools, with which policy makers were able to build an innovation–cluster–ecology. Smaller states with less innovation capacity profited from integration with innovation leaders. In the Association of Southeast Asian Nations (ASEAN), and therefore for most of the GMS, regional innovation capacity-building is influenced by the relative importance of intraregional versus extraregional economic (especially trade in value-added) asymmetry (Krapohl and Fink, 2013).

GMS countries' trade structure is characterized by extraregional interdependence in global value chains. This is apparent from GMS regional value-added trade flow data (see Figures 1.8 and 1.9), and values are given by key sectors in Figure 3.1. The numbers are corroborated by field visits and interviews. The main export zones and research and innovation clusters in Thailand, Viet Nam and Yunnan Province, the People's Republic of China PRC depend on intermediate inputs from the industrialized East Asian economies and from the eastern coastal areas of the PRC. This is also where the bulk of value added is exported (plus the European Union and North America). Thus, the GMS can still be characterized as a region dependent on central, urban nodes located at the coast for the integration in GVCs. This situation in the GMS indicates clear opportunities for consensual governance, policies and tools that build up a cooperative innovation cluster investment plan in the region.

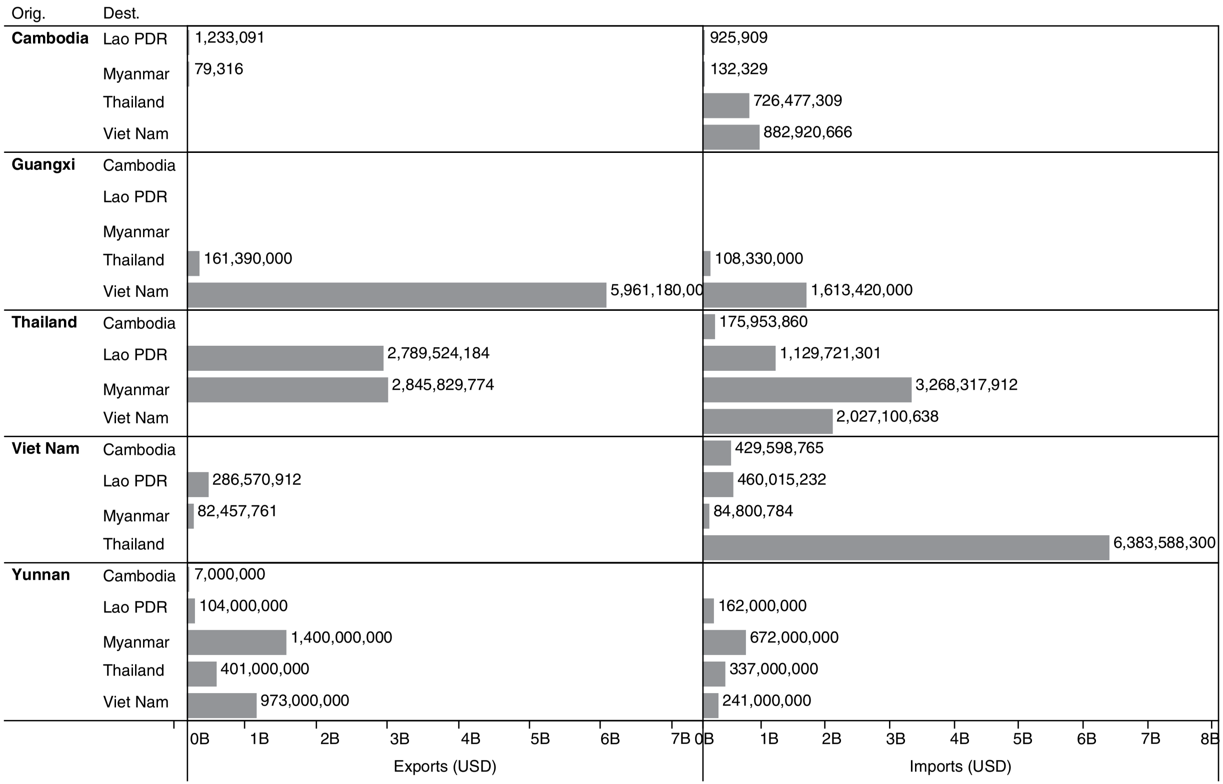
Nonetheless, intra-industry trade between PRC, Thailand and Viet Nam has been sharply increasing and is reflected in a deepening structure of value chain specialization between the PRC and each of its trading partners. Intra-industry trade in electronic, electrical equipment has expanded especially rapidly in this case. In the case of Yunnan Province, within-country inter-industry trade is heavy between the highly industrialized east coast regions and Yunnan.

The foremost investment needed in the GMS is the establishment of a regional coordinator (secretariat) of cluster-network-based cooperation. Such a coordination arrangement can be housed in a critical innovation hub of the GMS. The coordinator will act as facilitator, creating and maintaining connection with the public sector, the business community, and the non-profit education and research sectors (a triple helix), and the international networks in the related products and fields. Under the coordinator structure, priority innovation steering groups could be chaired by representatives from different countries, according to national priorities. The kinds of instruments and tools that can be employed in the GMS context are platforms and tools for dialogue and networking between the triple helix cluster stakeholders, including construction of actual and virtual meeting spaces, creation of knowledge-enhancing partnerships and twinning arrangements (such as under the proposed Asian Regional Economic Integration Observatory, AREIO), and the building of comparable innovation cluster statistics and data anchored in geography, that is, geographic information systems (GIS)-compatible.

1.1 History and Current State of Innovation Cluster Development

Thailand

The National Electronics and Computer Technology Center, a statutory government organization under the National Science and Technology



Note: Lao PDR = Lao People's Democratic Republic.

Source: ADB 2015. Pilot Observatory, Global Trade Analysis Project database.

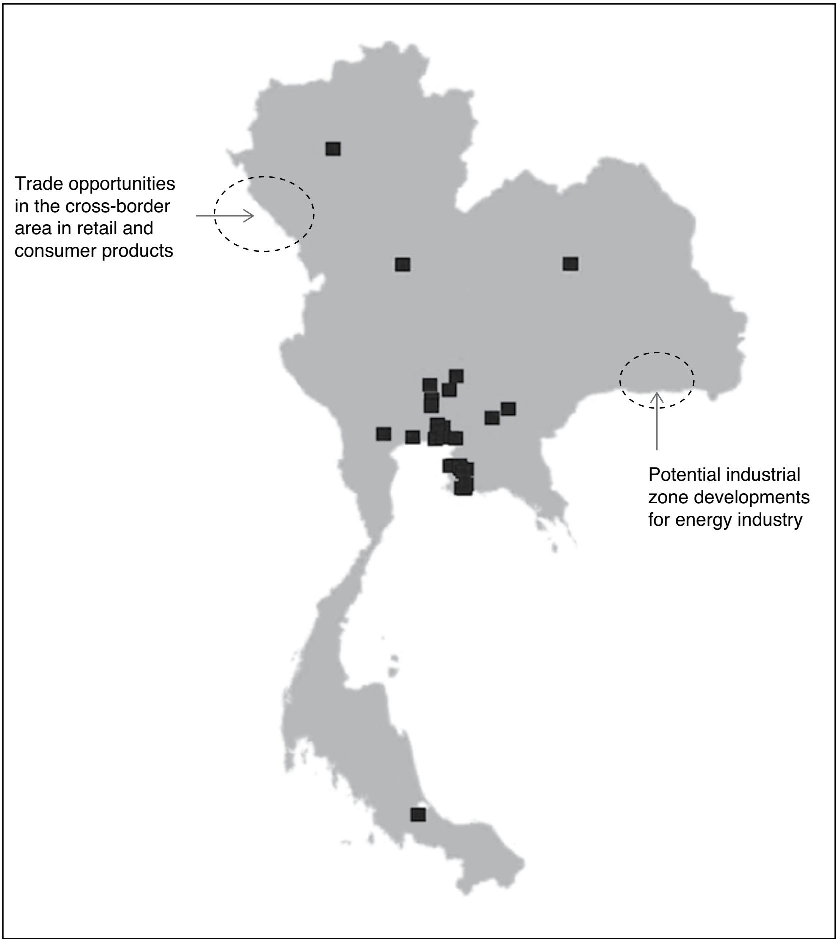
Figure 3.1 Value-added trade flows among GMS countries in 2011

Development Agency (NSTDA), Ministry of Science and Technology, was founded in 1986 to encourage technology transfers and collaborations between private and public sectors in the field of electronics and computer technologies (National Electronics and Computer Technology Center, 2014). The mission of NSTDA is to promote research and development activities, technology transfer, human resources development, and infrastructure development for the field of science and technology (NSTDA, 2014). The early stage of science and technology development in Thailand was also promoted through the 6th national economic and social development plan (implemented during 1987–91). The plan laid out several development guidelines to increase the efficiency of national development by improving the quality of the working population, utilizing science and technology, and improving the efficiency of government and state enterprises. One of the economic programs included in the plan specifically addressed the development of science and technology (Government of Thailand, 1987). In 2002, the Thailand Science Park, a fully integrated R&D hub for science and technology, was set up to continue the initiatives to strengthen Thailand's capabilities in research and innovation. With its advanced facilities and business space, the Thailand Science Park offers a full range of value-added services to support technology businesses. It currently houses the NSTDA headquarters as well as the four national research centers: the National Center for Genetic Engineering and Biotechnology, the National Metal and Material Technology Center, the National Electronics and Computer Technology Center, and the National Nanotechnology Center.

Most of the industrial zones in Thailand are privately owned, developed and managed. As presented in Figure 3.2, the majority of industrial zones are in the center and east of Bangkok. The Board of Investment in Thailand has divided the country into three zones based on economic factors. Based on the earnings and primary facilities as the key criteria of each province, seven cities, including Bangkok, Nakhon Pathom, Nonthaburi, Pathoum Thani, Samut Prakan and Samut Sakhon are in Zone 1. Zone 2 consists of 12 provinces, mostly located in the center of Thailand. The remaining 59 provinces are in Zone 3, due to low incomes and less-developed infrastructure. Each zone has different incentives, including both tax and non-tax incentives, which can be varied from zone to zone. The highest privileges are reserved for areas furthest from Bangkok.

There are three major industrial parks located in nearby Bangkok areas, as depicted in Figure 3.2.

- Nava Nakorn is located in Pathoum Thani (Zone 1): The zone is attractive to companies that are suppliers of companies already



Source: Danuvasin et al. (2015) mapped to Fu (2015) pilot GIS Observatory.

Figure 3.2 Overall key zones map in Thailand

located in the zone. Currently, the zone is home to over 200 foreign and domestic companies.

- Rojana Ayutthya Industrial Park is a Thai–Japanese joint venture, located a 30-minute drive farther out from Bangkok. It is Board of Investment Zone 2, with very large facilities to host a number of large manufacturers, such as the Honda Auto assembly.

- Amata Nakorn is located in Chonburi, Thailand (Zone 3). It is in the heart of the eastern seaboard, which allows for easy access to Laem Chabang Port and is home to major foreign and domestic manufacturing plants.

Viet Nam

In Viet Nam, until the 1980s, government policies had focused on constructing heavy industries. New guidelines for industrialization were introduced at the 7th Party Congress in 1991 to include new and advanced science and technology as a basis for growth and enhanced economic achievement (Van, 2012). In the same year, the first and most successful export processing zone in Viet Nam, Tan Thuan Export Processing Zone, was established in Ho Chi Minh City to promote economic development through high value-added industries, trading and services. Out of 146 companies in the Tan Thuan Export Processing Zone, more than 118 companies have increased their investment capital and/or expanded their production scale (Tan Thuan Corporation, 2012). In 2013 the Ministry of Planning and Investment took the lead in establishing a 'Strategy for Development of Industrial Clusters toward 2020 and the Vision of 2030 in Viet Nam'. This strategy is, for instance, prioritizing industries such as electronic, electrical equipment. The objective is to increase the domestic share of economic value added, and to catalyze industrial restructuring in favor of high-tech production.

With the exception of the PRC (of which Yunnan and Guanxi Provinces are part of the GMS), Viet Nam has been the most active GMS country in the use of zones for economic development. Viet Nam now has industrial zones, economic zones, export processing zones, and more recently high-tech zones. Approximately 250 industrial zones have been established with a total capital input of $70 billion from more than 8500 investment projects. The zones are located in the three major economic areas in northern, central and southern areas. However, Viet Nam's experience with zones has been decidedly more mixed in terms of economic benefits than has been case in the PRC.

The major industrial zones in the southern key economic area (see Table 3.1) are located in the following cities: surrounding urban centers of Binh Duong, Donh Nai and Ho Chi Minh City. These are cities with the highest infrastructure index (top three cities), especially in the score of industrial zones, which measure the availability and quality of local industrial zones. Additionally, Binh Duong, Donh Nai and Ho Chi Minh City have a high infrastructure score in the coverage of roads, the reliability of telecommunications and energy delivery, and information and communications technology. Figure 3.3 shows the locations of all industrial and exporting zones in Viet Nam.

Table 3.1 Viet Nam geographic distribution of key industrial zones

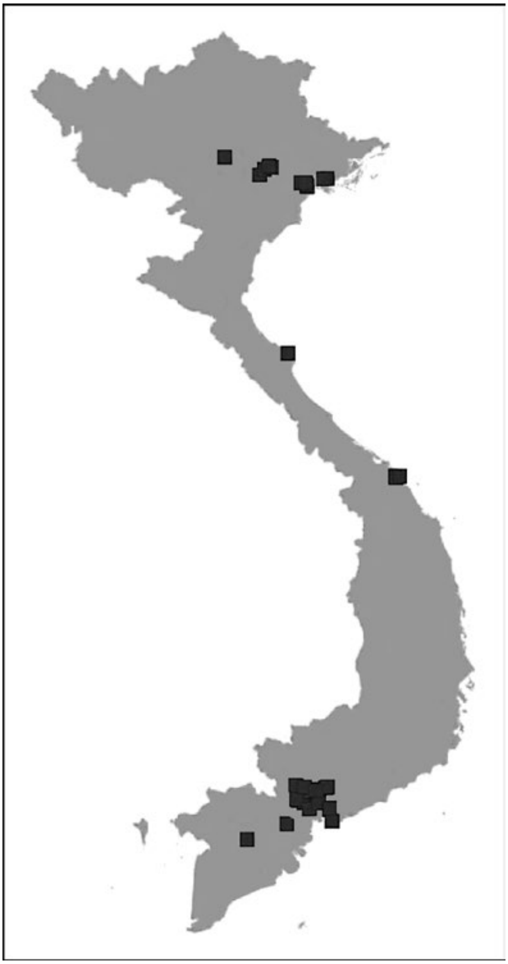
Geographical area	Number of industrial zones	GVIO (1994 constant VND, %)
Total	267	808 745 billion
Key economic areas (KEAs)	199	74.2
of which		
Northern KEA	52	24.0
Central KEA	23	5.4
Southern KEA	124	44.8
Outside KEAs	68	25.8

Note: GVIO = Gross Value Industrial Output; VND = Viet Nam Dong.

Source: Nestor (2013, p. 125).

The People's Republic of China (PRC)

The government of the People's Republic of China began to propose and implement national programs for science and technology in the 1980s. In 1982, the Key Technologies R&D Program was launched as the largest science and technology program in the country, with most funds invested, most personnel employed, and greatest impact on the national economy. The program focuses on national economic construction, engaging more than 1000 scientific research institutions in the field of agriculture, electronic information, energy resources, transportation, environmental protection, medical and health care, and other fields. In 1986, the government launched the National High-Tech R&D Program (also known as 863 Program), which covers 20 areas such as biotech, laser, automation and space flight. This program helps determine the future direction of research based on observation of the latest development of international scientific research, and facilitates the use of results in industries. Another science and technology program launched in 1986 is the Spark Program. The program's main objective is to expand the development of science and technology to rural areas. As a result, more than 100 000 science and technology projects are being carried out in 85 percent of rural areas throughout the country. The PRC's most important program for high-tech industries was launched in 1988, known as the Torch Program. The program promotes the development of high-tech products with economic value for both domestic and foreign markets, establishes high-tech industrial development zones around the country, and explores managerial and operational mechanisms to support high-tech industrial development. Lastly, in 1998, the 973 Program was launched to encourage scientists to conduct research on issues with



Source: Danuvasin et al. (2015) mapped to Fu (2015) pilot GIS Observatory.

Figure 3.3 Viet Nam's key industrial map

significant impact on economic and social development in the twenty-first century (China Internet Information Center, 2004).

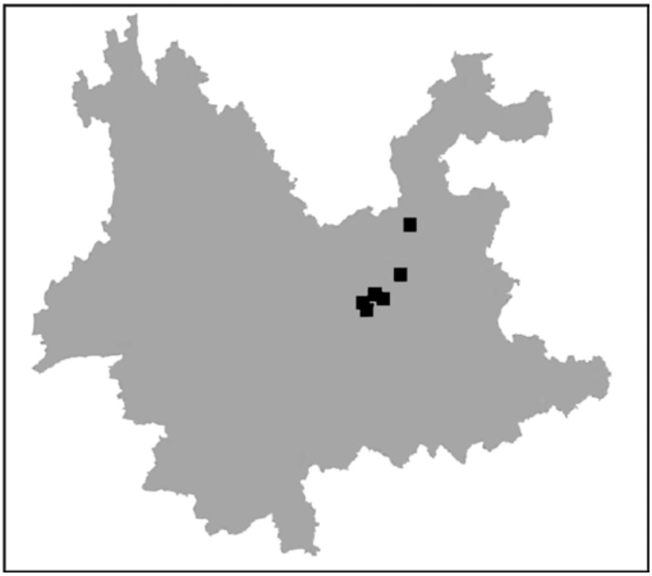
The PRC meanwhile has a wide range of zones, including special economic zones, economic and technological development zones, high-tech industrial development zones, free trade zones, export processing zones, bonded logistics zones, and cross-border economic zones.

Yunnan Province (PRC)

The Yunnan provincial government has launched a 'regionalization' project centered on Kunming. Around Kunming, the government plans to build and cultivate agglomerated networks of competitive clusters (Su, 2014). This, then, is intended to become a bridgehead for interaction and integration with emerging clusters in GMS. There are two major high-tech industrial zones in Kunming: Kunming Economic and Technological Development Zone and Kunming High-Tech Industrial Development Zone (KHIDZ), which are the only two national high-tech development zones in Yunnan Province. The GDP of the Kunming Economic and Technological Development Zone and KHIDZ is estimated at RMB17.85 billion ($2.88 billion) and RMB15.46 billion ($2.5 billion) respectively, which accounted for about 10 percent of the city's total in 2012 (Chinaknowledge.com).

Kunming Economic and Technological Development Zone is located in the eastern part of the center of Kunming and is only 1.8 km from Kunming International Airport. The utilized FDI of the zone was estimated at $254.05 million, which is about 16 percent of Kunming's total FDI. Kunming Economic and Technological Development Zone is one of the major high-tech zones in Kunming, Yunnan. Established in 1992, it is one of the industrial parks with the highest degree of manufacturing gathering and is the only zone which integrates national-level development and export processing, facilitating scientific and technological trading in Yunnan Province. The zone has attracted investments from over 22 countries, including Germany, Thailand and the United States. The value of import and export was estimated at $2.14 billion in 2012 and increased significantly to $5.96 billion in 2013 (178.5 percent increase). The key manufacturing groups are in tobacco processing, mechanical manufacturing, optoelectronics and information technology industries, biopharmaceutical, and food and beverage.

Kunming High-Tech Industrial Development Zone (KHIDZ) is located in the northwestern part of the city. The new zone of KHIDZ is located in the southern Kunming's Majinpu Village. KHIDZ's value-added industrial output was estimated at RMB15.46 billion. Originally, KHIDZ was set up in 1992 by the (People's Republic of) China State Council and is the only national high-tech development zone in Yunnan Province. The KHIDZ consists of five function zones, including New Industrial Zone, High-Tech Business Zone, Bio-Innovation Zone, Entertainment Zone, and Bio-Protection Zone (see Figure 3.4). In particular, in this industrial zone, innovative clusters are developed in the following special industrial parks: (1) bio-pharmaceutical; (2) electric equipment manufacture; (3) new material; (4) university science and technology park; (5) new energy, water science, and technology and environment protection parks (http://www.



Source: Danuvasin et al. (2015) mapped to Fu (2015) pilot GIS Observatory.

Figure 3.4 Geographic maps of key industrial zones in Kunming, Yunnan

kmhnz.gov.cn/html/ehopv.html). See Figure 3.4 for the location of the key zones near Kunming, Yunnan.

1.2 Description of Products

In this chapter we have focused on zones and clusters that provide (potential) innovation products and services (electrical equipment focus), and that have (potential) linkage to major GVCs. These electronic electrical equipment products can be categorized in subgroups as follows (according to the Board of Investment):

1. *Manufacture of electronic products* including consumer electronics, office electronics, industrial electronics, telecommunication equipment, and agricultural electronics.
2. *Manufacture of electronic parts and components used for electronic apparatus* including semiconductors, memory storage equipment (hard disk drive), transmission cables, parts for telecommunication equipment and medical electronics, and printed circuit boards.

3. *Manufacture of automobiles* including automobile engine, vehicle parts, fuel cells, industrial machinery or equipment.

Additionally, we also focus on any innovative products located in the high-tech zone in each country, such as manufacture of scientific equipment, medical equipment, printers, ATM machines, or mineral and ceramic power products used in mobile phones such as liquid crystal displays (LCDs), light-emitting diodes (LEDs) and antennas.

1.3 Success Factors

Judging by global good practice as outlined in earlier sections, key success factors of high-tech zones and innovation clusters are geographic location, labor market conditions in skilled versus unskilled labor, access to market conditions, government policies and the related business environment, localization of knowledge flows through collaboration among think tanks, private and public sector institutions and facilities (the triple helix), and the state of regional integration. A key source looking at these drivers causing successful cluster emergence is Brenner and Muehlig (2013).

In the GMS, market access on the import and input side is well developed, less so on the export side. As already discussed, the GMS region is externally connected with global value chains; however, intraregional linkages are weak, hence, the central, urban characterization of the region. The labor force in the zones interviewed is mostly medium-skilled and wages are competitive in this segment. Government innovation and competition policies are nascent. Interviewed companies reported high variability of government policies. Triple helix linkages of zones and clusters are only at an initial stage. Businesses interviewed are focused on the local market and sometimes on national market opportunities, and many are linked locally and nationally to low to medium-tech GVCs. There is little perception and awareness of a regional GMS market. (See Table 3.2 on success factors, based on questionnaire answers.)

1.4 Challenges

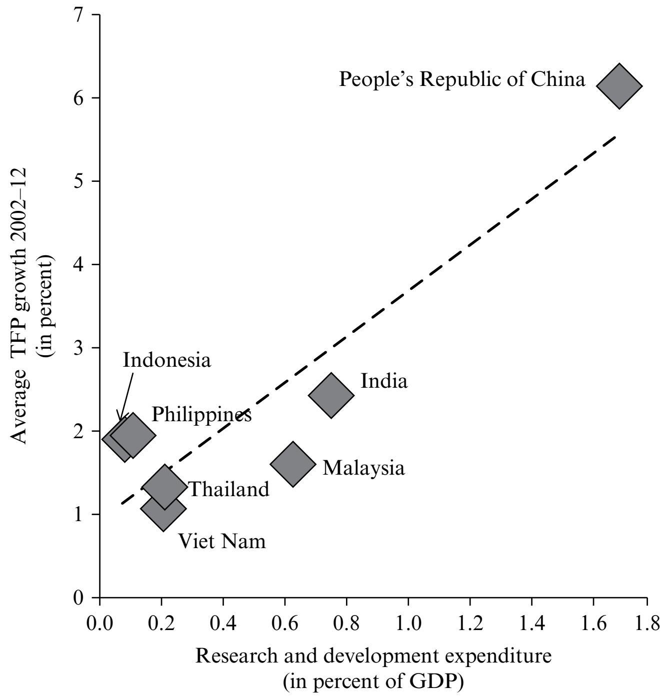
One challenge facing GMS countries is the low level of R&D resources and activities. All GMS countries spend less than 0.5 percent of GDP on R&D, with a concomitant effect on TFP growth (Figure 3.5; Anand et al., 2014). Thailand aims to increase R&D spending to 1 percent of GDP, according to the National Science and Technology Development Agency (NSTDA). However, fieldwork revealed that most R&D activities supported by the NSTDA improve the efficiency of production

Table 3.2 On success factors, based on questions (8 respondents)

Q#	Factors	Responses of firms interviewed (GMS)				
	Geographic location	Percent international sales				
		1–25	26–50	over 50		
5.1.	Market access	3	0	4		
	Primary mode of shipment	Road	Rail	Air	Ship	Other
7.1.	Of inputs	3	1	2	6	0
	1) Labor market	Percent by type of workers				
3.1.1.	Low skill	29.38				
3.1.2.	Medium skill	56.38				
3.1.3.	High skill	35.38				
3.2.1.	Avg wage low skill	2 to 5		ratio high/low		
3.2.2.	Avg wage medium skill	2.5		ratio high/medium		
3.2.3.	Avg wage high skill	$300 to $2000 monthly				
	2) Access-to-market conditions	Percent of sales				
		0–25	26–50	over 50		
5.2.	Direct exports	3	1	3		
5.3.	Indirect exports	4	1	1		
6.1 a).	Home imports	1	3	3		
6.1 b).	Foreign imports	3	1	3		
	Government policy/business environment	Very good	Good	Avg	Poor	Very poor
1.2.	Public service quality	4	1	4	1	0
1.3.	Variability of service	1	5	4	0	0
10.5.	R&D incentives (Yes/No)	4 (Yes) 3 (No)				
10.6.	Environmental incentives (Yes/No)	2 (Yes) 5 (No)				
	Localized knowledge flows	Yes	No			
3.3.	Formal training	8	0			
3.4.	TVET/universities	5	3			
3.5.	Think tanks/labs etc.	5	3			
4.3.	R&D expenditure ($)	Variable answers				
	State of RCI					
7.2.	Primary mode of shipment	Road	Rail	Air	Ship	Other
	Of products	4	1	1	3	2
	Logistics difficulty	High cost	Delivery date uncertain		Multimodal connect	
		4	3		1	
6.2.	Value-added ($)	No answers				
8.1.	Cross-border programs (awareness Yes/No)	Yes	No		Other	
		2	6		(e-business portal)	

Notes: Avg = Average; GMS = Greater Mekong Subregion; Q = question; R&D = research and development; TVET = technical and vocational education and training.

Source: Author.



Source: Anand et al. (2014, Figure 7).

Figure 3.5 Research and development expenditure and total factor productivity

processes, rather than product innovation. In Viet Nam, it was revealed that companies in high-tech zones often have their own R&D centers; however, there is little linkage between these centers, universities and public sector institutions and facilities. In Kunming, several interviewees confirmed that there are collaborations between local companies and universities (for example, Yunnan University, Yunnan Normal University, Johns Hopkins University); most R&D activities are privately funded and focus on products and processes for the domestic market. Due to an insignificant amount of FDI in Yunnan, there is no strong R&D linkage between local and foreign companies, and the rest of the world (see Table 3.2).

A key strategy of Thailand, Viet Nam and Yunnan Province has been increasing attraction of FDI through high-quality infrastructure inside zones (see Table 3.3). However, this attraction does not apply to the area outside zones and especially in the hinterlands. Therefore, backward linkages from zones and clusters are weak or altogether missing. From interviews, it is clear that most companies in the zones are willing to do business within the zone rather than outside.

Third, skilled labor in GMS countries is undersupplied. Executives of companies in the Tan Thuan Export Processing Zone in Viet Nam admitted that their companies need to provide their own training programs to the employees to improve their professional skill sets. One interviewee also stated that high-tech companies investing in Viet Nam, such as Samsung and Intel, provide their own training for the employees. Such companies sometimes work with local universities on curriculum development.

Vietnamese locals generally take it for granted that there are no high-quality universities in the country. In Yunnan, corporate executives also said that job training provided by companies is necessary to equip their employees with job-specific skills. While there are several globally renowned universities in the PRC, most of them are located in Beijing or Shanghai. In Yunnan, even the top universities in the province such as Yunnan University and Yunnan Normal University are still ranked below the top 100 universities in Asia (Times Higher Education, 2014).

One interviewee from a hard disk drive company in Thailand expressed concerns that the quality of education in Thailand lags behind that of its neighbors, and that the Thai labor force, even after graduating from college, do not have sufficient skills required for jobs in high-tech and innovative industries. This interviewee also mentioned that most high-tech

Table 3.3 On challenging factors, based on questions (13 respondents)

Q#	Challenging factors	Responses of firms interviewed (GMS)				
	Quality (level) of insfrastructure	Very good	Good	Avg	Poor	Very poor
		3	4	2	1	
2.1.1.	Water		9	1	0	
2.1.2.	Waste		8	4	1	
2.1.3.	Telecom ICT		5	4	1	
2.1.4.	Electricity		7	3	0	
	Labor shortage (skilled) issue	High cost	Low skill	High turnover		Other
3.6.	Issue mentioned (no.):	4	1	2		1

Note: ICT = information and communication technology; GMS = Greater Mekong Subregion.

Source: Author.

companies, when looking for a FDI destination, take each country's university ranking into account. Since Thai universities are not among the top universities in Asia, Thailand is not a very attractive location for investments of high-tech and innovative industries. Out of all the universities in Thailand, only two are ranked in the top 100 Asian universities. One is ranked 50th; the other is ranked 82nd (Times Higher Education, 2014).

Fourth, language and culture differences even within a region like the GMS are still key barriers for foreign business expansion. Regional trust creation takes time, and needs to be facilitated through regional integration narratives (for example, the silk road, the old Hanse trading network in the historic BSR).

Finally, regional collaboration among R&D institutions (the triple helix) does not (yet) exist in the GMS. There is currently no institutional initiative that has earned the trust to initiate such collaboration.

Global linkages (global value chains)

From the fieldwork undertaken, we found that there is a high linkage between foreign firms and local firms in Thailand and Viet Nam along global value chains. Most international firms in Thailand have local suppliers in Thailand. Many investors in Thailand, especially the electronics and automobile companies located in industrial and exporting zones, export the majority of the products abroad. For Viet Nam, fieldwork established that there is a strong linkage among only the firms located in the same zone. One interviewee in the Tan Thuan Export Processing Zone mentioned that 95 percent of products made in the industrial zone are exported into global value chains. In the Kunming zones, most firms located in the zones are local companies, and these companies produce their products largely for the domestic markets.

2 OPPORTUNITIES FOR INNOVATION CLUSTER DEVELOPMENT AND SKILL-BASED CLUSTER DEVELOPMENT INITIATIVES

2.1 Cluster Maps in Asian Regional Economic Integration Observatory and their Relation to Regional Interconnections

Inspecting the mapping of zones and clusters in GMS, they appear clearly disconnected. The GMS inland networks necessary for an emerging cluster ecology are absent. As the field investigations confirm as well, imports are supplied by sea, and then processed in global value chains. Yunnan

Province is somewhat of an exception, as production is more domestic. This situation in the GMS indicates clear opportunities for consensual governance, policies and tools that build up a cooperative innovation cluster investment plan in the GMS region. An evidence-based strategy can provide strong regional priorities aligned with productivity growth impacts and regionally inclusive distribution of associated costs and benefits. A governance structure for the investment plan can deliver measurable goals to track impact.

2.2 Skill Development Initiatives

As skilled workers are scarce in the emerging market economies, such as in the GMS, the regionally enhanced transmission of ideas and adapted technologies would make this scarce labor resource more productive, and also would enhance productivity in cutting edge innovation locations by allowing 'farming-out' of 'imitative innovation'. However, field work has not indicated the existence of substantive regional initiatives that would strengthen flows of skilled labor within the region and among emerging innovation clusters.

2.3 How the Components are (to be) Linked

We have found evidence of cluster development in the GMS; however, there is no indication of collaboration among the components in the clusters. Unlike the BSR cluster ecology, GMS clusters tend to stand alone. The clusters in Cambodia, the Lao People's Democratic Republic (Lao PDR), Myanmar and Viet Nam tend to be labor intensive, while countries such as PRC (Yunnan) and Thailand can successfully create innovative clusters. As a result, there is a potential for the collaboration and integration among clusters in the GMS area. For example, suppliers of the low-end products that require labor-intensive production in the countries such as Cambodia, Lao PDR and Myanmar can provide input material for innovative clusters in the countries such as PRC and Thailand.

2.4 What Tools are Needed? Available? Missing?

Currently, there is some collaboration between companies, universities and public institutes on the development of science and technology in Thailand. However, these collaborations seem to occur on a small scale, not providing a very noticeably positive impact on the country's innovative cluster development. In Yunnan, although some companies have linkages with universities with respect to R&D activities, these linkages are primarily for individual companies' own benefits, and little spillover effects have taken place. Collaborations on R&D activities between the private and public sectors in Yunnan are not widely observed. The situation of private–public collaborations in Viet Nam is similar to that of Yunnan, with an even lower level of R&D activities taking place. For the other GMS countries, public–private R&D activities are very rare, and the development of the innovation cluster has not been observed.

Cluster observatory and information systems do not exist in the GMS. The governance and monitoring of clusters are not known by most industrial zone managers, company executives and government officials. Regional cluster integration among the GMS countries, while currently not existing, is perceived by the countries as being helpful in enhancing the GMS economic status. However, GMS countries are not likely to be able to get regional cluster integration started on their own, as no country is proactive enough to raise the idea. A catalytic, trusted agent in the form of an international organization, like ADB, would be needed.

2.5 Silk Road Plans: How Locations Play a Role in the Success of the Cluster(s)

Above we have looked at the software and hardware components that, for instance, in the GMS could lead to a regional ecology of clusters and economic corridors. What can merge software and hardware factors into a successful agglomerating dynamic is a history of sociocultural and economic ties. The silk roads of Asia, old trading routes leading south to north from coastal areas into central Asian hinterlands, and leading east to west across the Eurasian continent, can provide such narrative for future development of an ecology of clusters and economic corridors, as has been the case in the BSR. Silk roads functioned because they were trading on principles of comparative advantage, based on differing resource endowments and technology (know-how) within and across regions. Hard and soft infrastructure, together with mediating institutional (formal and informal) structures, is driving success. The GMS (and to a lesser extent the CAREC region) have put into place some of the prerequisites for development of regional clusters and economic corridors, such as improved connectivity infrastructure, industrial structures, links into GVCs, national policy improvements, and deepened financial markets, as detailed in regional ADB-sponsored strategic frameworks (ADB, 2011).

As we have experienced in field interactions in GMS and CAREC economies, the missing parts are policy instruments and knowledge tools, which can drive a region into a successful ecology of clusters linked with economic corridors via agglomeration economies, increases in value-added shares in and along regional and global value chains, structural transformations into high skill industries and services. These drivers, taken together, will exploit increasing heterogeneity in production and trade across borders. Key national policy instruments such as labor market policies (migration, skill development), technology and innovation policies, cluster and corridor policies, and competition arrangements need strengthening, and at the same time they require regional coordination so that regional growth and welfare can be augmented. The BSR 'bottom-up' development of a set of decision tools for cluster development and innovation collaboration, which catalyze business connection (embeddedness), create bridges among stakeholders (physical and figurative, connectivity), and strengthen economic flows (proximity) in value-added along historic trading routes or modern silk roads can and should inspire commensurate action in Asian regions. The knowledge toolbox for this has yet to be built. This includes foremost an Asian Regional Economic Integration Observatory (AREIO).

4. Roadmap to innovation and skill-based cluster ecology development initiatives

Policy and investment recommendations depend on the Asian regions' geographies, resource profiles, technology profiles, production and trade structures, and institutional frameworks (OECD, 2011, 2013). Regions differ, for instance, in the central, urban and non-central, industrial- and agriculture-based set-up in Asia. As we have indicated in Chapter 3, the GMS is prone to a central, urban character in its innovation cluster set-up. In contrast, CAREC countries have a more non-central, industrial- and agriculture-based character, with quite different policy and investment implications. This chapter will specify and elaborate on these, especially for the GMS, and features a short section on CAREC.

This chapter draws on the lessons from the BSR that are related to the GMS context. It then outlines innovation-cluster-ecology-directed development initiatives using degrees of proximity, embeddedness, and connectivity across the GMS, as examined in the preceding analysis. Regional institutional frameworks embed innovation cluster ecologies in collaborative networks and in relationships between firms and all other innovation actors. Actions in those three categories relate to policy instruments (labor market, skill development, FDI technology, corridor and cluster development, innovation and competition; see Figure 1.1), and related to RCI drivers of welfare impact as in Figure 1.1. BSR-inspired toolboxes (refer to Figure 2.12), which catalyze connection (embeddedness), create bridges (connectivity), and strengthen intraregional flows (proximity) will be proposed and outlined for the GMS context. To make policy action sustainable, it is essential to formulate metrics that make achievements visible. Special emphasis is on the need to introduce and use an Asian Regional Economic Integration Observatory (AREIO). Thus, this chapter outlines a plan for an AREIO by drawing on the details of other chapters in this book. From this, an initial roadmap can emerge.

1 INNOVATION AND SKILL-BASED CLUSTER ECOLOGY DEVELOPMENT IN CENTRAL, URBAN REGIONS OF THE GREATER MEKONG SUBREGION

Given that the GMS can be characterized as a central, urban region in terms of its innovation cluster ecology set-up (as indicated in the previous chapters and as visualized in the respective maps), it typically faces issues related to agglomeration spillover effects and to structure transformation. One such issue is the inadequacy of the skills profile – apparent, for example, in Thailand and Viet Nam – to generate higher value-added trade shares in GVCs, and to better exploit open regionalism for economies of scale, and for backward (intraregion) linkages. In the GMS, innovation cluster development is devoid of economies of scale. Only a larger scale of regional activities will support the requisite hard and soft infrastructure, together with mediating institutional (formal and informal) structures necessary. If the labor skill profile cannot be adapted to an ever more competitive global environment, it will increasingly lead to a bimodal income distribution dominated by high skills for a few in central urban agglomerations, and by a large number of low wage groups at the other end of the distribution. Regional action in this type of region needs to focus on tools and drivers of productivity and welfare by supporting spillover effects and structure transformation through catalyzing knowledge connections in a network of emerging innovation clusters (cluster ecology).

1.1 Embeddedness and Connectivity

Clusters evolve and are embedded in specific geographic (regional), sociocultural and regulatory and institutional environments (World Bank, 2010, p. 319). The evolution of the BSR cooperation and collaboration institutions, formal and informal, is instructive (see Figure 2.13 and Table 4.1, for an overview).

What roles need to be played by formal governance structures, and informal innovation policy and capacity-building structures?

The BSR set up a decision forum at the ministerial level, the Baltic Development Forum, very similar to the GMS ministerial meetings. At this level, decision-making is not entirely focused on productivity-enhancing policy instruments and related tools aimed at inclusive growth drivers. Rather, the BDF is a network for high-level decision makers from business, government, academia and other civil society (triple helix). As such, BDF provides a platform for all interested regional stakeholders. It is more

Table 4.1 Roadmap of Baltic Sea Region cooperation and integration efforts in innovation clusters

	1990	1995	2000	2005		2010	2015
Regional Integration Policies							
Catalyze Connections			Baltic Develop-ment Forum (1998)	ECO (2004)	ESPON (2006)	ECEI (2009)	PA INNO Stg Committee (2014)
Create Bridges						BSR Stars (2010)	
Strengthen Flows	Baltic University Programme (1991)					BONUS Research and Innovation Programme (2009)	

Notes: BONUS = Joint Baltic Sea Research and Development Program; BSR = Baltic Sea Region; ECEI = European Cluster Excellence Initiative; ECO = European Cluster Observatory; ESPON = European Observation Network for Territorial Development and Cohesion; PA INNO = Priority Area Innovation.

Source: Ketels and Wise (2015).

evidence based in its policy-making agenda than seems the case in the GMS, as it has various knowledge tools at its disposal (ECO, ESPON) which enable prioritization, key success indicator measurement and monitoring on a comprehensive regional and continuing basis. The BDF offers a neutral ('trustworthy, honest broker') platform, as does ADB in the GMS case, for catalyzing and facilitating cooperation and collaboration throughout the region.

Regional trust creation takes time and effort, especially in regions with a set of differing histories, clusters, practices and languages. This has been apparent from field surveys, where key stakeholders emphasized the need for trusted, neutral brokers, such as ADB, in forging a regional narrative rooted in common histories. In the case of Asian regions, the silk road narrative could function as such a unifier, supported by formal and informal cooperation and integration institutions, which use evidence-based and consensual decision-making processes.

In the BSR example, the trustworthy informal meeting and decision-making structure, which focuses on innovation-related policies and tools – their prioritization, deployment and implementation, as well as the monitoring of their impact – is the Innovation Screening Committee (PA INNO). PA INNO catalyzes connections among clusters and networks (see Figure 2.12). BSR Stars aims to strengthen competitiveness and economic growth in the Baltic Sea Region by fostering regional, transnational linkages between specialized research and innovation nodes, leading to new types of collaboration that can deliver new products, services and business models for global markets.[1]

Foremost needed in the GMS is the establishment of a regional coordinator (secretariat) of cluster-network-based cooperation. Such a coordination arrangement can be housed in a critical innovation hub of the GMS. The coordinator will act as facilitator, creating and maintaining connection with the public sector, the business community, and the non-profit education and research sectors (triple helix), and the international networks in the related products and fields. Under the coordinator structure, priority innovation steering groups could be chaired by representatives from different countries, according to national priorities. The kinds of instruments and tools that can be employed in the GMS context are platforms and tools for dialogue and networking between triple helix cluster stakeholders, including construction of actual and virtual meeting spaces, creation of knowledge-enhancing partnerships and twinning arrangements (such as under the proposed AREIO), and building of comparable innovation cluster statistics and data anchored in geography (GIS-compatible).

The ESPON 2013 database provides fundamental regional information provided by ESPON projects and EUROSTAT. This information can be used to support territorial development analysis at different geographical levels. The database aims to contribute to a better understanding of the potentials and development perspectives of regions in the European context and globalized world as its comparable data makes benchmarking of regions and cities feasible. There is no comparable regional data and knowledge platform in Asia.

The heterogeneity of experience and capacity that exists among GMS member states requires that certain higher capacity countries or provinces take stronger leadership responsibilities. At all levels of governance, a strong, cross-cultural and cross-linguistic and inspirational core of leadership (comprised of at least two countries' representatives) is key.

This is demonstrated by BSR Stars, one of the priority areas under PA INNO. The mission of BSR Stars is to shape a more integrated and dynamic resource base for innovation clusters by stimulating flows among research environments, clusters and SME networks. Similar to the BSR Stars' body of expertise, the GMS requires an expert body that can fund and implement types of collaboration in the emerging cluster ecology. It needs to build 'bridges', which translate into regional cluster connectivity.

The ECEI aims to develop management capacities in cluster organizations. From fieldwork in the GMS, it is clear that such an initiative would be very welcome in the region. It would catalyze a viable cluster ecology, ultimately strengthening firm-level productivity in the region. This could be one of the initiatives taken up by the regional coordinator.

1.2 Proximity

In the BSR experience, the Baltic University Program aims at strengthening East–West collaboration among universities through the joint development of courses, degrees and support to student mobility. A basic idea of the program is to foster intercultural understanding by student groups undertaking research together. BONUS is a BSR-level program that supports collaborative research projects focused on sustainable development. BONUS members are the national research funding institutions. These tools are aimed at strengthening the flow of people, ideas and collaborative development. Similar programs focused on innovation clusters can be instituted in Asian regions. An informal arrangement among national research funding institutions could be crafted. Institutions that have high research capacity and are advanced technically can twin with the lagging nations' institutions in regional projects. It is important to enhance the skilled-labor flows, for instance, in GMS. Such programs should involve the triple helix.

The lack of intraregion innovation cluster proximity (that is, intraregion knowledge linkages of innovation cluster investments) can guide a policy and investment roadmap that makes use of agglomeration spillovers and structural transformation. Figure 4.1 provides an overview of policy instruments affecting key regional drivers.

What kind of instruments and tools contribute to productivity growth from cluster and corridor development initiatives?

On a regional basis, coordinated among a network of clusters, governments and businesses should establish innovation service platforms (public–private). Innovation clusters are well suited to harbor the regional connections that enable knowledge flows. These platforms are conceived broadly, for instance, encompassing science and technology literature access, technology transfer enhancements, standard and quality testing cooperation, and scientific equipment sharing.

The emphasis will be particularly strong for SMEs. For instance, technology platforms can link technical and vocational schools and SMEs. Technology transfer centers in a relevant sector can be co-founded by

POLICY INSTRUMENT	TOOL BOX	DRIVER	WELFARE IMPACT
Regional Innovation Coordinator (Secretariat)	Structure	Structure Transformation	Competitiveness
Priority innovation steering groups	Mobility	Agglomeration	Productivity + Distribution
Intra-regional cluster support	Mobility	Agglomeration	Productivity + Distribution
Innovation vouchers	Mobility	Agglomeration	Productivity + Cohesion
Innovation awareness raising events	Mobility	Agglomeration	Productivity + Cohesion
Regional benchmarking data platform	Analysis	Agglomeration	Productivity + Cohesion
Asian Regional Economic Integration Observatory (AREIO)	Analysis/ Research	Structure Transformation	Competitiveness

POLICY INSTRUMENT	TOOL BOX	DRIVER	WELFARE IMPACT
Technical university collaboration programs	Research, Analysis	Structure Transformation	Competitiveness
Technology platforms linking technical schools and SMEs	Analysis	Human Capital Intensity	Competitiveness
Technology transfer centers (PPP)	Analysis	Structure Transformation	Competitiveness
Branded excellence hubs	Structure	Structure Transformation	Productivity + Cohesion
Vocational training for low-skilled and unemployed	Mobility	Agglomeration	Productivity + Distribution
Connecting SMEs with export finance, insurance	Mobility	Agglomeration	Productivity + Cohesion
Capacity building platform for cluster management	Structure	Structure Transformation	Productivity + Cohesion

Note: PPPs = public–private partnerships; SMEs = small- and medium-sized enterprises.

Source: Author.

Figure 4.1 New Asian regionalism: Greater Mekong Subregion to productivity and welfare governments in a public–private partnership set-up. One effective way of administering a public service platform is to issue 'knowledge vouchers' to SMEs for their usage. The knowledge voucher is a coupon that entitles eligible firms in a regional cluster network to a number of free services from exchange platforms, observatories, common research, and vocational technical training institutions. In 2009, a similar scheme was set up in Singapore to encourage SMEs to create new growth opportunities (OECD, 2011, p. 248). Introduction of innovation vouchers allow SMEs to vote for those services offered in a service menu of innovation platforms that promise the highest productivity effects for firms. The KHIDZ in Kunming is in the process of establishing a good part of this soft and hard infrastructure; however, this is not generally the case across the GMS.

Benchmarking instruments and platforms to global quality standards plays an important role in securing the success of such arrangements. Here, the role of an AREIO is critical, as further detailed below.

2 CLUSTER ECOLOGY DEVELOPMENT IN NON-CENTRAL INDUSTRIAL AND AGRICULTURE-BASED REGIONS

Non-central and agriculture-based regions do not exhibit highly dispersed systems focused on very large urban and core geographies. Such non-central areas also exist in the GMS (that is, Lao PDR) and even more so in other Asian regions, for instance, CAREC. In this case, a policy and investment focus will be on specific local and interregional network-building. FDI and technology policies will have high priority in this context. Such areas can be important transit regions with logistics and production hubs using information and communication technology (ICT)-based systems. A program developing 'branded excellence logistics hubs' by international standards could be given high priority funding.

Furthermore, building interregional proximity is critical. This can be implemented by enhancing interregional and cluster flows of resources. The greater the local and regional multiplier effects of these demand-oriented efforts are, the greater is the embeddedness of the overall regional system. Specialized skill training will focus on local demands. However, this will be most beneficial if done in a regional network approach, comprising vocational training programs in cluster skill centers.

Due to difficult access, CAREC-related field work was limited in PRC, Xinjian Province (Urumqi) and in Kazakhstan (Almaty). The special economic zone (SEZ) 'Innovation Technologies Park' is located in an Alatau village 20–25 km away from Almaty. The key objective of this innovation zone is to diversify sectors, which is crucial to Kazakhstan's overall economic diversification.

As company representatives pointed out, one of the difficulties is the relative remoteness of the SEZ from Almaty. Some of the companies keep their offices in the SEZ, but actually work in Almaty. This may indicate that companies stay, nominally, in the SEZ just to stay in the loop, communicate with other companies, and monitor opportunities that may emerge. Still, companies that are active in the SEZ reported success in their activities and the fact that the infrastructure, taxes and regulations within the SEZ are attractive for them. Nevertheless, they also indicated high logistics and transport costs as regards equipment delivery, import and so on. Overall, the companies that are based in the SEZ are poorly represented in global value chains and hardly export abroad at all. In addition, serious market knowledge gaps exist.

As for forthcoming development plans, the Kazakh Institute of Oil and Gas seeks to establish a scientific research center in the SEZ. Kazakhtelekom (the major telecommunications company) plans to establish a special data center that would store and process huge amounts of data used by the company. Kazakh-British Technical University (Almaty) and International University of Information Technologies (Almaty) plan to build their campuses there.

Instruments for benchmarking and platforms to global quality standards play as important a role in non-central, industrial and agricultural regions as they do in central, urban ones. The need for an AREIO extends to CAREC.

3 WHAT INDICATORS IN CLUSTER DEVELOPMENT INITIATIVES CAN/SHOULD BE USED BY AN ASIAN REGIONAL ECONOMIC INTEGRATION OBSERVATORY? WHAT GOVERNANCE STRUCTURES SHOULD BE IN PLACE TO MAINTAIN OBSERVATORY OPERATION?

For the roadmaps to be implementable, it is important that knowledge platforms for prioritization, monitoring, sharing and learning are developed. In the case of building innovation cluster ecologies, which, by its very nature, requires experimentation, it is even more important than in other cases of policy and investment to observe what works and what does not. Hence the need for an AREIO.

The ECO in the BSR has been developed over time through a series of European grants. The current grant project is updating open data, maps of innovation cluster networks, and related indicators. Data for a regional competitiveness and inclusive growth analytical frame is linked to indicators of resource fundamentals, drivers and outcomes. The Stockholm School of Economics is assigned as the content manager to ensure sustainability and accessibility of ECO. Appendix 2 details the European ECO experience. In Asia, significantly better open data, indicators and analysis platforms for regions need to be developed to allow triple helix stakeholders to develop an objective and detailed understanding of regional integration assets and constraints, as well as of distribution of benefits and costs. Multilevel governance arrangements (local, national, regional) need to be continuously informed about developments in the regional productivity and income distribution landscapes. This requires static and dynamic data analysis on a regionally standardized basis. Very importantly, Asian regions need to institute a site content manager who ensures the quality of a trusted web source for decision makers and, ultimately, the AREIO's long-term sustainability. Appendix 2 outlines the ECO budget and management framework, which can serve as initial guidance.

As part of this study, a pilot, web-based observatory was set up for GMS and CAREC cases, and details on design, data, indicators and visual interface are given in Appendix 4. This is only a start, as many opportunities for further development loom. Almost limitless opportunities are laid out, based on global best practice, in Appendix 3. To realize such opportunities it will be necessary to use existing ICT infrastructure service provision in Asia. Such infrastructure needs to offer large bandwidth to handle large volumes of data transfer among AREIO clients and participants. It needs to offer extensive data storage and management capacities. It needs to provide sizable computing power because the AREIO service requires distributed and parallel computing capacity for stakeholders. Finally, the infrastructure service provision needs to include fine network capillarity across Asian regions to allow for interaction with data producer and user stakeholders. This includes also the requisite network and data management integrity, authentication and authorization service by the provider. Such a network service provider does exist now in Asia, with the Asia Pacific Advanced Network. How such an arrangement could be achieved, with ADB as initial AREIO host and content manager, and Asia Pacific Advanced Network as the infrastructure platform and service provider, is detailed in bullet points in Appendix 4.

With a full-fledged, sustainable AREIO, regional, national and local governments and decision makers can improve both their individual clusters and the way these clusters are connected as uniquely differentiated parts of global value chains. Here, the new activities would build on many existing policies but aim to overcome the traditional zero-sum competition between locations across Asia. Governments can make these choices in a more fact-based way, if the data provided has sufficient granularity for the border regions. This is a somewhat narrow but very practical application of the data that can open the doors to wider usage.

Geovisualization leverages geography as the basis for: interface design; user experience; display of data, attributes and relationships; scientific visualization; animation; and data compression. Together, they cast geography as the central mode of interaction with the regional GMS system. Geovisualization is particularly important for the purposes of the proposed observatory: (1) because of the significance of spatial attributes in providing unifying structure for the data; (2) because of the geographically disparate and heterogeneous nature of the likely data sources and users cases; (3) because of the significance of geography in providing context for the system and its use; and (4) because the system has a broad and likely growing set of users, it provides a common organization scheme.

All of the world's existing observatory systems noted in Table 2.3 rely on cartography as the main scheme for visualization and interaction. This is one form of geovisualization, although more could be done if ADB is to leverage the AREIO to enable and empower particular policy-making pathways and decision support systems atop its own unique user base, data, indicators, policy instruments, and strategies and goals for broadening participation – building on existing capacity and developing new capacity – and prioritizing activities. ADB is also relatively distinct from existing observatory platforms in its ambitions to dock the observatory with models, which will lend the observatory significant 'what-if' capabilities, which require special consideration.

The largest potential benefits would be derived from domestic upgrading of competitiveness and inclusion triggered by regional integration. A common data frame on underlying competitiveness can provide a useful facilitating device to establish groups of officials looking at the implications of this data, and at ways to improve the relevant policies. The way it is set up as proposed here would mean that full sovereignty over decision making with national governments would be retained, but it would enable them to learn from each other.

NOTE

1. Additional information can be found in the BSR Stars profile description in Appendix 2.

Appendix 1 Detailed description of computable general equilibrium model exercises and data matrices

In this research, we evaluate the importance of supply chains across Asia, especially as these help share the benefits of productivity, growth and higher incomes. What we see in today's global economy is a process of supply chain decomposition, where foreign direct investment (FDI) is distributing production tasks across an international matrix of intermediate producers. Individual components of this production matrix are chosen for a variety of reasons, including traditional Ricardian or Heckscher–Ohlin criteria (relative resource cost), market access, investment and/or administrative climate, and network externalities.

In Asia, this process has advanced very rapidly and pervasively, facilitated by both FDI and regional integration, where more advanced Asian economies reallocate production to less advanced ones. In the process of distributing supply chains, foreign investors in the region create new nodes of production (innovation clusters) in different localities, and with firms beginning as intermediate contractors and eventually producing and marketing their own brands. Under favorable conditions, industries and technology transfer can, as a result, replicate around the region at an unprecedented date.

To better understand the empirical significance of these phenomena, we use new data on the structure of regional industry and trade. To capture supply chains in terms of the trade of intermediate goods, we rely on the World Input–Output Database, which details domestic industrial structure, supply, demand, and trade for 35 commodities, including bilateral trade flows of both intermediate and final goods. This database currently exists for 41 countries, 27 of which are European Union members and six of which are in Asia (the People's Republic of China (PRC), India, Indonesia, Japan, the Republic of Korea and the Russian Federation). In addition to this data, we are using the Global Trade Analysis Project database to extend our sample of Asian countries, where World Input–Output

Table A1.1 List of Asian economies modeled

		GDP nominal (USD millions)	GDP PPP (USD millions)	GDP PC (USD)
1	PRC	9181377	13395400	9844
2	Japan	4901532	4698800	36899
3	India	1870651	5069200	4077
4	Republic of Korea	1221801	1666800	33189
5	Indonesia	870275	1292900	5214
6	Taipei,China	489213	929500	39767
7	Thailand	387156	673700	9875
8	Malaysia	312433	525700	17748
9	Singapore	295744	348700	64584
10	Philippines	272018	456400	4682
11	Viet Nam	170565	359800	4012
12	Cambodia	15659	39700	2576

Notes: GDP = gross domestic product; PC = per capita; PPP = purchasing power parity; PRC = People's Republic of China; USD = United States' dollars.

Source: Global Trade Analysis Project (GTAP), www.gtap.org.

Database trade data are being used to impute intermediate trade. The result will be a final database with nearly twice the sectoral detail (57 instead of 35) and 12 leading Asian economies.

This new database will be used to calibrate Asian Regional CGE (ARC), a dynamic Asian regional CGE model with the regional detail shown in Table A1.1. These twelve economies comprise 95 percent of gross domestic product (GDP) in Central, East, South and Southeast Asia. Two more regional aggregates (the rest of South Asia and the rest of Southeast Asia) have also been included in the model.

The most authoritative and up-to-date source of data on trade in intermediate goods is the World Input–Output Database, a time series of world input–output tables for 41 countries worldwide and a model for the rest of the world, covering the period from 1995 to 2011. For our purposes, the World Input–Output Database is a starting point, but it only offers direct data on seven of the Asian economies listed in Table A1.1. Although these seven still comprise over 88 percent of Asian GDP, we would like to disaggregate the other five economies to investigate their potential to capture regional supply chain spillovers.

To accomplish this, we leveraged the Global Trade Analysis Project database (www.gtap.org), comprising detailed input–output and bilateral trade data for 118 countries and regions to 2007. The Global Trade

Table A1.2 Economic structure of the Asian regional CGE model

		Economy			Sector
1	cam	Cambodia	1	agric	Agriculture
2	chn	PRC	2	mining	Mining and Quarrying
3	ind	India	3	foodpr	Food Processing
4	idn	Indonesia	4	textap	Textile and Apparel
5	jpn	Japan	5	woodpap	Wood and Paper Prod
6	kor	Republic of Korea	6	fuels	Energy Fuels
7	mys	Malaysia	7	chemical	Chemicals
8	phl	Philippines	8	metal	Metal Products
9	sgp	Singapore	9	machinery	Machinery
10	twn	Taipei,China	10	electronics	Electronic and Optical
11	tha	Thailand	11	vehicles	Transport Vehicles
12	vnm	Viet Nam	12	othermfg	Other Manufactures
13	xsa	Other S Asia	13	utilities	Electric, Gas, and Water Utilities
14	xse	Other SE Asia	14	construct	Construction
15	rus	The Russian Federation	15	whretrade	Wholesale and Retail Trade
16	eur	EU27	16	transport	Transport Services
17	usa	United States	17	telcomm	Post and Telecom Services
18	bra	Brazil	18	fininsre	Finance, Insurance, Real Estate
19	lac	Latin America	19	othprvsrv	Other Private Services
20	row	Rest of World	20	publicsrv	Public Administration

Note: PRC = People's Republic of China; EU = European Union; S = South; SE = Southeast.

Source: Global Trade Analysis Project (GTAP), www.gtap.org.

Analysis Project data are recorded at a 57-sector aggregation, which we have bridged to the World Input–Output Database's data using comparisons of countries covered in both databases. Based on this correspondence, we then disaggregate import flows for the other five Asian economies we wanted to include in the regional model. For practical dynamic scenario work, we then aggregated all country structure and trade flows to 20 sectors, yielding the economic structure summarized in Table A1.2.

The advantage of explicitly modeling intermediate trade is to capture the network spillover effects that reach across geographic boundaries and sectors in the region, conferring productivity and other growth benefits as a by-product of regional cooperation and integration (RCI). The complexity of these linkages is such that it would be quite impossible for policy makers or trade negotiators to anticipate them by intuition alone. Such 'general equilibrium' growth linkages are responsible for a large and growing share of international value creation and factor employment and/or income. For this reason, the conventional view of gains from trade in final goods and services seriously understates the economic potential of RCI.

Global supply networks have leveraged the world's resource base and a more liberal trading environment to increase incomes in ways more pervasive than most of us can imagine, and broadening the basis for these activities can only amplify these benefits, distribute them more widely, and reduce the risks of economic concentration and instability. The approach here strengthens the evidence of these network effects and improves visibility about them for policy makers. Our analysis is designed to reveal the complex indirect linkages in Asian RCI trading systems, largely mediated by intermediate supply and intra-industry trade. These can often represent the majority of value creation, and also form the basis for productivity and growth spillovers.

SCENARIO DEVELOPMENT

The baseline is a status quo or 'business-as-usual' scenario, where we assume national and multilateral policy regimes are not changed and no external shocks occur. Under these conditions, steady aggregate growth and moderate structural change are to be expected, yet a modern history of the Asian region has been much more dynamic. The difference has been due to a combination of public and private agency, with the former providing reformist guidance and the latter responding quickly to changing opportunities and challenges. To capture these events in a forecasting framework, we specify counterfactual policy scenarios we are interested in, using simulation analysis to predict how private actors across the region will respond according to the economic theory embodied in the CGE model (see Table A1.3).

One of the hallmarks of Asia's modern growth experience has been technological progress and skill development. The most dynamic regional economies have all promoted productivity growth effectively, achieving some of the world's highest rates of total factor productivity growth (see Figure A1.1). Capital productivity generally increased through determined public–private partnerships for industrial modernization and technology transfer. At the same time, the most dynamic economies intensified and extended their early commitments to education and promotion of skill-intensive employment, first in manufacturing and eventually in higher value-added service sectors. The product of these strategies, in the most successful cases, has been a dramatic expansion of the middle classes, with

Table A1.3 Scenario menu

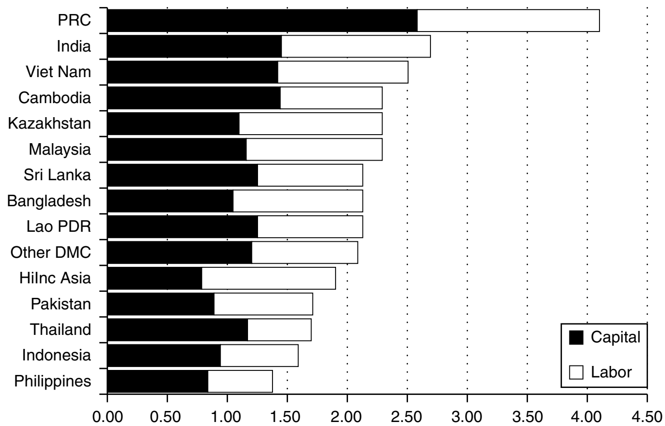
	Scenario Class	Characteristics
1	Baseline	Baseline ('business-as-usual') scenario
2	EU Lost Decade	Assume baseline growth elsewhere, but the European Union economies average zero growth, 2015–25
3	PRC Hard Landing	Assume the PRC averages 5% real GDP growth, 2015–25
4	Skills	Assume baseline conditions, but also that Asian economies sustain growth rates of labor productivity as indicated in Figure A1.1, with rates for all countries converging to the regional average by 2030.
5	Technology	Assume the skills scenario, but also that the Asian economies sustain growth rates of capital productivity as indicated in Figure A1.1, with rates for all countries converging to the regional average by 2030.
6	ASEAN plus 3	In addition to Scenario 5, assume the regions achieve conformity with an ASEAN plus 3 Free Trade Agreement
7	Infrastructure	In addition to Scenario 6, assume that investments and institutional changes effect a 50% reduction in average trade, transport and transit margins for lower-income Asian countries.
8	Financial Integration	In addition to Scenario 7, assume that, for low-income Asian economies, the stock of FDI rises to at least 10% of GDP by 2030.

Notes: ASEAN = Association of Southeast Asian Nations; EU = European Union; FDI = foreign direct investment; GDP = gross domestic product; PRC = People's Republic of China.

Source: Scenarios developed by David Roland-Holst (2015).

their attendant capacity for self-sustaining domestic growth and expanding public goods and services.

To examine how national and regional policy initiatives can advance and expand long-term Asian prosperity we consider eight representative policy scenarios, summarized in Table A1.3; the results appear in Table A1.4. These fall into three general categories: risks of adverse growth trends, productivity improvements, and private sector promotion. Under the two productivity growth scenarios, we assume that Asian economies return to



Notes: PRC = People's Republic of China; DMC = developing member country (of the Asian Development Bank); HiInc Asia = high income Asia; Lao PDR = Lao People's Democratic Republic.

Sources: International Labor Organization (ILO) (2000–10); Iyar and Dalgaard (2005); Young (1995).

Figure A1.1 Labor and capital productivity growth in Asia, 1999–2008 (% per annum)

their pre-global-financial-crisis trajectories of productivity growth. We also assume that long-term growth disparities among Asian economies decline, and, in such scenarios, productivity levels converge to regional averages by 2030. Then we decompose factor productivity growth, attributing capital productivity growth to technological change, and labor productivity growth to skill increase and technology.

Successful Asian economies have been technology-driven and continually striving to upgrade the skills of their population. The benefits of this human resources approach to growth and development become even more pronounced with the application of regional policies that facilitate trade and capital flows. Thus, we see that national investments in human resources can contribute to growth, but their full potential can only be realized with complementary financial investment. This is true regardless of the source of the investment, a fact that should not be ignored by countries that have not committed fully to a favorable investment climate. In these circumstances, *every* public dollar spent on human capital is underperforming without the complementary private dollar to enhance productivity – directly via on-the-job training, and indirectly via technology infusion.

Table A1.4 Average wage growth (% change from baseline in 2030: cumulative over scenarios)

	EURHL	PRCHL	Skills	Tech	APlus3	Infra	FDI
PRC	−2	−14	13	40	39	47	65
Indonesia	−5	−5	9	38	38	52	101
India	−2	−1	12	37	35	43	90
Japan	−1	−2	11	28	37	46	50
Cambodia	−2	0	3	28	26	44	116
Republic of Korea	1	1	8	27	31	42	47
Malaysia	0	0	8	41	42	59	64
Philippines	0	−2	5	42	39	54	131
Singapore	0	0	8	33	35	44	52
Thailand	−3	−8	7	50	54	74	120
Taipei,China	−2	−7	17	34	30	40	45
Viet Nam	−5	−2	9	35	43	67	108
Other S Asia	−7	−1	7	24	23	28	111
Other SE Asia	−3	−2	7	49	44	59	126
All Asia	−1	−2	11	32	34	44	53

Notes: APlus3 = ASEAN +3 (Scenario 6 from Table A1.3); PRC = People's Republic of China; PRCHL = PRC Hard Landing (Scenario 3 from Table A1.3); EURHL = European Union Hard Landing (Scenario 3 from Table A1.3); FDI = (Scenario 8 from Table A1.3); Infra = (Scenario 7 from Table A1.3); S = South; SE = Southeast.

Source: Author.

Conversely, countries that merely invite capital investment without making their own financial commitments to human capital development will be trapped in long-term structural bias toward resource-extractive, low-value-added, low-wage production.

Appendix 2 Mapping of Baltic Sea Region tools

The progress that has been made in strengthening cooperation and integration in the Baltic Sea Region (BSR) is a result of sound domestic foundations, which foster flows of goods, capital, people and ideas that are supported and enhanced by a number of knowledge platforms, policy instruments and/or programs and organizational structures. This Appendix introduces an overall categorization and mapping of various tools for regional cooperation and integration, and presents some reflections on how they have functioned[1] in the BSR.

The tools are mapped according to the type of tool and the level of implementation.

The following types of tools have been included:

- *Platform building* tools are strategies, institutions or organizational structures that establish overall objectives and activities, mobilize and facilitate action, and monitor progress.
- *Information and analysis* tools help provide a factual basis to guide policy action and monitor progress and change over time.
- *Capacity building* tools help enhance individuals' or organizations' existing knowledge and skills in particular areas.
- *Soft infrastructure* tools develop intangible connections (such as collaboration and trust or social capital) and knowledge spillovers across borders.
- *Hard infrastructure* tools develop tangible and physical connections (such as transport corridors, energy grids and so on) across borders.
- *Mobility* tools enhance movement of, for example, students, researchers, entrepreneurs and civil servants across borders, to enhance knowledge and experience and contextual understanding of different geographies.
- *Research* tools support cross-border research activities.
- *Trade and foreign direct investment* tools catalyze or enhance market interactions.

Table A2.1 Tools for regional cooperation and integration: platform building

Type of Tool	Implemented at EU level (included BSR-specific instruments)	Implemented at BSR (or Nordic) level	Implemented at national level
Platform Building	Smart Specialization Platform EIB EUSBSR InterReg Programs (BSR, Central and South Baltic, etc.)	CBSS BSSSC NIB NCM and Nordic Innovation BDF HELCOM PA INNO Steering Committee (see right)	PA INNO Steering Committee (see left) Baltic Institute of Finland Swedish Institute

Name of Tool:	**European Union Strategy for the Baltic Sea Region (EUSBSR)**
Type of Tool:	Platform Building
Implementation Level:	European Commission (Director General Regional and Urban Policy is leading facilitation of implementation), together with member states and stakeholder organizations (as described in the EUSBSR Action Plan, chapter 'Governance of the Strategy')
Motivation and Aim:	Macroregional strategies are integrated frameworks endorsed by the European Council, which may be supported by the European Structural and Investment Funds among others, to address common challenges and take advantage of common opportunities that are faced by a defined geographical area relating to member states and third countries located in the same geographical area, which thereby benefit from strengthened cooperation contributing to achievement of economic, social and territorial cohesion. The EUSBSR was the first macroregional strategy (adopted in 2009). This was followed by the Danube Region (adopted in 2011), the Adriatic and Ionian Region (adopted in 2014), and the Alpine Region (forthcoming 2015).
Profile:	The EUSBSR was the first comprehensive EU strategy to target a macroregion and is often used as a benchmark. The eight EU countries that make up the Baltic Sea Region (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden) have a long history of cooperation and face several common challenges and opportunities, reflected in the jointly agreed action plan for the strategy. Although not officially part of the strategy, Iceland and Norway are involved in implementation through the Northern Dimension framework.

Table A2.1 (continued)

Profile:	The strategy includes a number of priority and horizontal action areas to address its three objectives: save the sea, connect the region and increase prosperity. Each of the 17 priority areas and 5 horizontal action areas is accompanied by concrete flagship projects as well as by clearly identified targets and indicators (which are reviewed and modified if needed). The strategy (fully aligned with the Europe 2020 strategy) helps to mobilize all relevant EU, national and regional funding, and to coordinate the policies and actions of the European Union, EU countries, regions, pan-Baltic organizations, financing institutions and non-governmental bodies. The governance of the strategy includes policy, coordination and operational responsibilities. The European Level (the European Commission, European Council and High-Level Group) is responsible for setting the strategic policy framework, with increasing strategic leadership responsibilities being taken on by member states. Member states are responsible for coordinating activities and monitoring progress (through priority area coordinators, horizontal action leaders, priority area focal points and national contact points). On the operational level, member states (as well as regional organizations, NGOs, etc.) lead various flagship projects (and other contributing projects), and take on other tasks (such as facilitating generation and implementation of initiatives and projects, setting indicators and targets, reinforcing bridges to the relevant funding programs, and participating in program committees). These activities receive financing through programs and other financial instruments on European, regional and member-state levels.	
Key features of design and implementation:	Target groups:	European Commission Regional and national governments (line and/or sectoral ministries in particular) in participating member states Organizations (intergovernmental and non-governmental) working for collaboration across the Baltic Sea Region Implementing actors (including clusters and other business support organizations, research organizations and firms)
	Level of financial support:	Although the strategy does not come with extra EU financing, a considerable amount of funding is already available to the macroregion through EU regional policy, other EU programs and financial instruments, various international financial institutions, as well as national and regional organizations. (The aim of the strategy is to mobilize existing funding sources around prioritized actions.)

Table A2.1 (continued)

	Timescale:	The strategy and action plan are aligned with the Europe 2020 strategy (with deadlines for targets and indicators for 2020 and 2021). However, the action plan does not have a particular time horizon. It is a living document that is reviewed and revised according to needs.
Main results/ lessons learned:	The Commission publishes regular reports on the implementation of the EU Strategy for the Baltic Sea Region. The main results since the launch of the strategy include: More efficient working structures around priority areas, selected in a bottom-up process of consultation – providing momentum to existing or new transnational projects (which deliver concrete results e.g. reduced pollution from ships, collaboration among fisheries, etc.); Political leadership in priority areas taken by participating countries, regions or organizations (supported by the Commission as facilitator) – providing improved policy development frameworks (which has resulted in e.g. an integrated maritime policy, macroregional perspectives in infrastructure investments, etc.); Improved value for money, as the macroregional approach helps align EU programs to act together on major shared goals; and Strengthened cooperation and integration along multiple levels of government (regional, national and local). The concept of macroregions (i.e. smaller or sub-continental groups of countries with shared contexts and challenges) and framework of the EUSBSR and action plan is a complement to EU-wide activities. With dispersed coordination and operations, macroregional activities can mobilize a broader range of stakeholders in activities. The success of the strategy is dependent on continuous political support, commitment and ownership. The recent Commission report (May 2014) on governance of macroregional strategies highlighted the need for: Stronger political leadership and decision making from countries and regions concerned: Ministers and national authorities coordinating the work need to take full ownership, and more clearly direct what is happening on the ground; Greater clarity in the organization of work: For authorities working on day-to-day implementation, there is a need for explicit lines of responsibility, effective coordination and sufficient resources.	

Table A2.1 (continued)

Main results/ lessons learned:	Awareness of projects and initiative results should be increased, as concrete stories of progress help to keep up momentum and broaden involvement. Coordinated objectives and activities (through flagship projects) need to be supported by similarly coordinated funding instruments; however, it is extremely difficult to create common pots and simplified application procedures across multiple countries and multiple funding programs (with different legal bases). It is important to focus on priorities and actions that are relevant and of strategic importance at macroregional level (i.e. those with a clear 'macroregional value added'). Actions within the strategy should not duplicate work done in other formats and frameworks. The strategy should be an integral part of relevant national, regional and local policy frameworks. Currently, there is too much emphasis on the EU level.
Name of Tool:	**Baltic Development Forum (BDF)**
Type of Tool:	Platform Building
Implementation Level:	Baltic Sea Region
Motivation and Aim:	The Baltic Development Forum (BDF) was founded in November 1998 by Uffe Ellemann-Jensen (former Danish foreign minister). The BDF was established in light of a perceived need for a platform for decision makers to discuss joint public–private strategies for the development of the Baltic Sea Region. BDF is the only BSR organization that gathers not only politicians, but also business, academia and media. The mission of BDF is to position the Baltic Sea Region in the EU and on the global map by advancing the growth and competitive potential through partnership between business, government and academia.
Profile:	BDF is a leading regional think tank and network for high-level decision makers from business, politics, academia and media in the Baltic Sea Region (situated in Copenhagen, Denmark). The BDF fulfills its mission by acting as a catalyst, facilitator and developer of concrete projects and strategies; providing a platform for all interested regional stakeholders; and influencing and shaping the regional policy agenda of tomorrow. BDF differentiates itself from other organizations and institutions promoting regional integration and cooperation in the BSR with its focus on and involvement of the business community. Main activities include publishing thematic analyses and flagship reports (including State of the Region and Political State of the Region); and facilitation of numerous projects, task forces and knowledge platforms. BDF also has a formal role within the EU

Table A2.1 (continued)

Profile:	strategy for the Baltic Sea Region as Horizontal Action Leader. Every year, BDF organizes a high-level summit in one of the Baltic Sea countries, and BDF currently organizes thematic conferences, round tables etc. on topics related to growth and competitiveness in the Region. The BDF focuses on three thematic areas: digital economy, smart sustainable growth, and competitiveness. The main activities are in information and communication technology, water and blue growth, energy, smart cities, and promotion and investment. The BDF is an independent, non-profit organization. BDF's activities are implemented by an international staff, led by Director Flemming Stender. The overall strategy and activities are set by the BDF Board, chaired by Lene Espersen (former foreign minister and minister for business), honorary and advisory boards (consisting of people from all parts of the Baltic Sea Region that possess strong competences, experience and knowledge), as well as strategic partners and partners who also provide input to the strategic direction of the organization. The BDF is supported by a broad variety of partners that contribute and enable the work and activities carried out by the Baltic Development Forum. Partners are both public and private actors with a profound interest in contributing to the Baltic Sea Regional Agenda. In addition, BDF works with various partners, and has close collaborations with other networks and organizations at the Baltic Sea Regional, European and global level.	
Key features of design and implementation:	Target groups:	Business Government Academia Media NGOs
	Level of financial support:	The BDF Secretariat is funded by partners and members and through project and networking activities.
	Timescale:	Established as a permanent institution
Main results/ lessons learned:	The work of the BDF has resulted in a number of main achievements over the last 16 years, including the organization of 16 annual summits; the publication of 11 State of the Region Reports and numerous thematic reports; and the facilitation of many projects, conferences and knowledge platforms. In 2014, BDF launched a new regional ICT think tank 'Top of Digital Europe' to promote the Baltic Sea Region as one of the leading digital regions in the world. Also, BDF is coordinator	

Table A2.1 (continued)

Main results/ lessons learned:	for the Fehmarn Belt Days 2014 and is involved in activities related to the emerging Fehmarn Belt Region. Furthermore, BDF strengthened its capacity in the area of water and environment, publishing a report on corporate water stewardship and facilitating dialogue on marine and maritime issues. BDF is viewed as a neutral platform ('honest broker') for catalyzing and facilitating cooperation all over the region. A strong network developed over many years among business, government and others regional stakeholders is important to the creation of public–private partnerships in various areas. Close collaboration and involvement of the business community is imperative to drive action in prioritized areas. The focus on and prioritization of regional integration and collaboration can vary over time for both political and business stakeholders. It is important to have a core group of strategic partners across the macroregion to be able to adjust to trends.
Name of Tool:	**Priority Area Innovation (PA INNO) Steering Committee**
Type of Tool:	Platform Building
Implementation Level:	Baltic Sea Region and National (in collaboration)
Motivation and Aim:	As part of the EU Strategy for the Baltic Sea Region (EUSBSR) and Action Plan, 17 priority areas and 5 horizontal action areas have been established to fulfill the three overall objectives (save the sea, connect the region, and increase prosperity). The Priority Area of Innovation (PA INNO) is one of the priority areas that contribute to the objective of 'increasing prosperity'. PA INNO has four overall aims: 1. to enhance coherence and collaboration of R&D and innovation activities in the Baltic Sea Region; 2. to establish a common BSR innovation strategy; 3. to develop the fifth freedom (free movement of researchers, knowledge and technology); 4. to be recognized as a leading knowledge and innovation region in the world. The Priority Area is led by a coordinator (PAC) and each priority area has a Steering Group. The PA INNO Steering Group is charged with setting the overall strategic goals, targets and indicators for this priority area, as well as monitoring progress towards achieving these goals. Progress is achieved through the work of the six flagship projects within PA INNO: BSR Stars, BSR Fund, Health Port, Science Link, Baltic Ring and Submariner.
Profile:	The PA INNO Steering Group is one of the governance structures of the EUSBSR – charged with setting the strategic goals (including targets and indicators) of the priority area, as well as

Table A2.1 (continued)

Profile:	monitoring progress towards these goals (through coordination of the six flagship projects included in PA INNO and development of new projects). The PA INNO Steering Group is made up of representatives from ministries and implementing agencies with a mandate for innovation policy in each of the 10 Baltic Sea Region countries (the 8 EU member states, plus Iceland and Norway). Representatives are primarily from national-level government; however, regional-level governments are also represented. In addition to governmental representatives, the PA INNO Steering Group includes representatives from each of the Flagship Projects. The PA INNO Steering Group was established in early 2014. Prior to this, the group existed as a 'high-level group' guiding implementation of one of the flagship projects within PA INNO (BSR Stars). The PA INNO Steering Group meets three to four times a year. The organization and implementation of the meetings, as well as the time spent developing strategic frames, targets and indicators, is financed primarily by funding and in-kind contributions from participating ministries and agencies (on national and regional levels). Some financial support has been provided through BSR program-funded projects. (All flagship projects and other activities to achieve the goals of PA INNO are funded separately.)	
Key features of design and implementation:	Target groups:	Ministries and innovation agencies (on national and regional levels) in the Baltic Sea Region European Commission Leaders of flagship projects (and other projects contributing to realizing the goals of the PA
	Level of financial support:	There is no established budget for the PA INNO Steering Group. Time and expenses are covered by participating ministries and innovation agencies.
	Timescale:	PA INNO (and other priority areas) follow the EUSBSR, which has a time horizon of 2020. The action plan is reviewed and adjusted regularly, according to needs.
Main results/ lessons learned:	The priority area has achieved a number of results including establishing targets and indicators, providing input and guidance to the BSR Program (and EU InterReg fund), and strengthening the strategic policy-level network in the BSR. Flagship projects within the priority area have contributed to additional concrete results (e.g. engaging small companies in transnational activities, developing prototypes, etc.).	

Table A2.1 (continued)

Main results/ lessons learned:	The ambitions and success of the Priority Area are very dependent on the anchoring and drive coming from the members of Steering Group, and the commitment of each of their organizations. Without strong backing from participating member states (including allocation of human and financial resources), the Steering Group and the activities it coordinates would not move forward. The heterogeneity of experience and capacity that exists among the member states requires that certain countries take stronger leadership responsibilities. At all levels of governance, a strong and inspirational core leadership (comprised of at least 2 countries) is key. Management and implementation of specific tasks should be distributed among a broader range of stakeholders (to ensure ownership and engagement). Having a mandate but no accompanying budget is a challenge, requiring close collaboration with funding programs (such as the EU's interregional funds). The development of transnational partnerships – gathering complementary competencies from different places – to address common societal issues is an asset. However, getting each partner to work as a transnational team (prioritizing joint goals) is a challenge. Strengthening cooperation and integration on the innovation policy level is also a challenge, as individual organizations still have their own 'home' mandates as the main guide. It will probably take at least 5–10 years before any larger effects are seen from this coordinated transnational policy work.

Notes: BDF = Baltic Development Forum; BSSSC = Baltic Sea States Subregional Co-operation; CBSS = Council of Baltic Sea States; EIB = European Investment Bank; EUSBSR = European Union Strategy for the Baltic Sea Region; HALs = Horizontal Action Leaders; HELCOM = Baltic Marine Environment Protection Commission; ICT = Information and communication technology; InterReg = interregional; NCM = Nordic Council of Ministers; NGO = non-governmental organization; NIB = Nordic Investment Bank; PACs = priority area coordinators; PA INNO = Priority Area Innovation; R&D = research and development.

Source: Author.

The next two tools are examples of information and analysis (both implemented at EU level) that help provide a factual basis to guide policy action, and monitor progress and change over time.

Table A2.2 Tools for regional cooperation and integration: information and analysis

Type of Tool	Implemented at EU level (included BSR-specific instruments)	Implemented at BSR (or Nordic) level	Implemented at national level
Information and Analysis	• EU Innovation Scoreboard • European Cluster Observatory • European Cluster Collaboration Platform • ESPON	• State of the Region Report • BSR Innovation Monitor	

Name of Tool:	**European Observation Network for Territorial Development and Cohesion (ESPON)**
Type of Tool:	Information and analysis
Implementation Level:	European Commission (Directorate General Regional and Urban Policy); ESPON is a program within EU Cohesion Policy
Motivation and Aim:	The first program for European Observation Network for Territorial Development and Cohesion (ESPON 2006) was established as a result of ministerial discussions about European Spatial Development (see European Spatial Development Perspective from May 1999). The discussions proposed strengthened support to transnational activities under InterReg as well as testing the idea of a European Observatory on Territorial development. At the end of the period, the ESPON 2006 program was continued, establishing the ESPON 2013 Program. An ESPON 2020 Cooperation Program is currently under consultation, becoming a third generation of ESPON. The proposed mission of ESPON 2020 is: 'ESPON 2020 shall continue the consolidation of a European Territorial Observatory Network and grow the provision and policy use of pan-European, comparable, systematic, and reliable territorial evidence.' Building on this overall mission statement, the draft Cooperation Program sets out five specific objectives for activities during 2014–2020 to: (1) produce territorial evidence through applied research; (2) upgrade knowledge transfer and support to users in targeted analyses and policy briefs and working papers; (3) improve territorial observation of Europe and tools for

Table A2.2 (continued)

Motivation and Aim:	analyses; (4) widen outreach and uptake of territorial analyses; and (5) deliver a more streamlined administrative structure to promptly inform policy processes.
Profile:	ESPON supports EU Cohesion Policy by providing evidence on territorial developments on a large number of relevant themes as well as useful tools and analyses, to support the most efficient spending of funds (on both EU and member state levels). The ESPON 2013 Program covers the entire territory of the European Union (EU) plus Iceland, Liechtenstein, Norway and Switzerland, and includes the following operational areas: ● Applied research on themes of European territorial dynamics, providing scientifically solid facts and evidence at the level of regions and cities. The applied research is conducted by transnational groups of researchers and experts. ● Targeted analyses developed upon stakeholders' requests and conducted together with them. ● Scientific platform development is supported by an ESPON database, actions dealing with territorial indicators and monitoring, as well as tools related to territorial analyses, typologies, modeling and updates of statistics. This operational area has included a project on 'Territorial Monitoring of the Baltic Sea Region', led by NordRegio. ● Capitalization of ESPON results that includes media activities and different ESPON publications, transnational networking activities, and events (such as ESPON seminars and workshops, organized in collaboration with a network of national ESPON Contact Points). ● Technical assistance, analytical support and communication ensure the sound management of the program and the ability of processing scientific output towards the policy level. ESPON uses an open competitive process in the selection of projects, which shall include a partnership involving at least three countries. Calls have been launched regularly. The ESPON Coordination Unit (located in Luxembourg) acts as the secretariat for the ESPON 2013 Program. It provides technical support for the monitoring committee, the certifying authority and the audit authority in relation to the management of

Table A2.2 (continued)

Profile:	the program. In addition, due to the specific nature of the ESPON 2013 Program, the coordination unit also performs analytical tasks, processing the research results and feeding territorial evidence into the policy arena to ensure the achievement of the objectives and mission of the program. The renewal envisaged for the ESPON 2020 Program includes the creation of an ESPON EGTC (replacing the coordination unit), which will be contracted to carry out all content-related actions. This new setting is also decided to provide for a leaner administrative burden.
Data covered and data sources:	The ESPON 2013 database provides fundamental regional information provided by ESPON projects and EUROSTAT. This information can be used to support territorial development analysis at different geographical levels. The database aims to contribute to a better understanding of the potentials and development perspectives of regions in the European context and globalized world as its comparable data makes benchmarking of regions and cities feasible. The ESPON 2013 database provides access to the following data categories: regional, local, urban, neighborhood (candidate countries), world, grid and historical data. Most of the datasets and information produced are publicly available and freely accessible. The datasets and indicators are related to economy, finance and trade; population and living conditions; labor market; education; health and safety; information society; agriculture and fisheries; transport and accessibility; environment and energy; science and technology; governance and territorial structure. The data and indicators cover the entire European Union plus Iceland and Liechtenstein, Norway and Switzerland (ESPON space). The regional and local data and indicators use the Nomenclature of Territorial Units for Statistics references. The other types of data use similar statistical units or grid. Moreover, the ESPON database is documented by technical reports describing the main topics addressed during the implementation of the ESPON 2013 database supporting the understanding of the data categories available. Most of these technical reports are public and freely accessible on the ESPON website. The search interface allows the user to search for relevant data and indicators via themes, policy aspects, projects

Table A2.2 (continued)

Data covered and data sources:	or keywords. The search results can be further filtered using 'where' and 'when' filters. Metadata on the data and indicators can be viewed and the data itself can be downloaded. The search interface gives access to regional data and metadata collected or produced in the framework of ESPON projects.	
Key features of design and implementation:	Target groups:	● Public authorities (on national, regional and local levels) in EU member states, plus Iceland, Liechtenstein, Norway and Switzerland ● Program authorities on European level ● Research groups focused on territorial development
	Level of financial support:	The ESPON 2020 program is envisaged to be co-financed by the European Regional Development Fund (ERDF) with an amount of €41.3 million ($44.6 million). Member and partner states are envisaged to add their financial contribution, making a total budget of slightly above €50 million ($54 million) for the 2014–20 period.
	Timescale:	The ESPON Program coincides with European programming periods (and is currently under preparation for the 2014–20 period).
Main results/ lessons learned:	● Key results from the ESPON program over the past 15 years include: structured data on territorial developments for evidence-based policy making, strengthened networks among both researchers and policy makers working on territorial development and cohesion policy, as well as the development of targeted analyses, tools and methodologies. ● The recent consultation prior to the elaboration of an ESPON 2020 Program highlighted a number of needs for the coming period:	

Table A2.2 (continued)

Main results/ lessons learned:	– more specific identification of target groups; – a focus on future-orientated approaches and forecasting territorial impacts; – greater emphasis on cross-border, mountain and peripheral rural regions; – stronger scientific quality of results; – a greater focus on governance and policy implementation; – a more systematic application of territorial impact assessments across all EU programs; and – stronger cooperation with local and regional authorities. ● Outreach, communication and capitalization of output are the greatest challenges. ● The recent consultation also highlighted suggestions for improving the role of territorial evidence in informing policy, including: – ESPON evidence needs to be in sync with political processes and not merely academic exercises. – A more user-friendly and interactive website, and simplified communication strategies such as videos, social media, short messages, newsletters should be developed. – There should be more use of seminars, workshops and conferences, including at the local level. – Researchers and policy makers should foster a closer partnership. ● Additional lessons learned regarding the storage, management and query of different types of regional data are related to acknowledging the different characters of data, i.e. core data and data resulting from ESPON projects, and developing most suitable approaches for both; the use of web services to make data accessible not only to other people but also computer programs; and continuing to explore new frontiers for data collection and innovative territorial approaches in support of evidence-based policy making.

Table A2.2 (continued)

Main results/ lessons learned:	• The next ESPON 2020 Cooperation Program will represent a renewal and upgrade of ESPON including a new institutional setting and take-up of the challenges mentioned above.

Notes: BSR = Baltic Sea Region; ESPON = European Observation Network for Territorial Development and Cohesion; ERDF = European Regional Development Fund; EGTC = European Grouping for Territorial Cooperation; EU = European Union; EUROSTAT = European statistics; InterReg = interregional.

Source: Author.

Table A2.3 Tools for regional cooperation and integration: capacity building

Type of Tool	Implemented at EU level (included BSR-specific instruments)	Implemented at BSR (or Nordic) level	Implemented at national level
Capacity Building	• Administrative Capacity Building (Directorate General for Regional Policy) • European Cluster Excellence Initiative		• Swedish Institute (Baltic) Leadership Program

Name of Tool:	**European Cluster Excellence Initiative (ECEI)**
Type of Tool:	Capacity building
Implementation Level:	European Commission (a project funded under the responsibility of Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs – Unit for SMEs: Clusters and Emerging Industries)
Motivation and Aim:	The European Cluster Excellence Initiative (ECEI) aimed to develop skills for managing cluster initiatives. The project developed a set of cluster quality indicators and a quality label for professional cluster management, as well as knowledge and training materials. These efforts contribute to

Table A2.3 (continued)

Motivation and Aim:	stronger professionalism and increased capacity of cluster management (an example of soft innovation infrastructure). This, in turn, is aimed at contributing to strengthened firm-level productivity.
Profile:	The ECEI was a European-funded project running for 3 years (from 1 September 2009 to 31 August 2012). The ECEI (see www.cluster-excellence.eu) put together a consortium of experienced persons and organizations to identify and put into place a set of quality indicators and peer-assessment procedures for cluster management. The aim was to develop training materials and set up an approach for quality labeling of cluster management, to help cluster managers achieve high levels of excellence in their duties and to succeed in the peer assessments. At the completion of the project, the services (including cluster management benchmarking, training and networking) have been set up on a self-sustaining basis. Quality indicators and peer-assessment procedures for cluster management, and cluster organization labeling activities are continually developed and implemented through the European Secretariat for Cluster Analysis (see www.cluster-analysis.org). The Foundation for Clusters Excellence offers courses for trainers of cluster management excellence based on the ECEI curriculum, and administers the ECEI training materials (see www.clustercompetitiveness.org). The European Cluster Group (ECG) is the organizational structure for the future of the European Cluster Managers' Club, with strong cooperation links to the TCI Network. International cluster-to-cluster networking is facilitated through the European Cluster Collaboration Platform (see www.clustercollaboration.eu). The European Commission has validated and applied the benchmarking tool and the training materials developed within the ECEI through eight projects funded from two calls for proposals (targeting officials working

Table A2.3 (continued)

Profile:		in regional or national public organizations managing cluster activities). In the spring of 2014, the European Commission launched a new call for proposals targeting consortia of cluster organizations and business networks. This call was the first action in the framework of the Cluster Excellence Program supported under the Competitiveness of Small and Medium-sized Enterprises Program (under Directorate General Enterprise and Industry). The aim of the call was to pursue EU efforts to strengthen cluster management excellence in the EU as a way to provide more professional business services to European SMEs through clusters and therefore contribute to the development of more world-class clusters in the EU.
Key features of design and implementation:	Target groups:	● Cluster managers in the European Union (as well as associated and neighboring countries) ● Policy makers (particularly those working with implementation of cluster programs at regional or national levels) ● Educators (who are involved in developing and disseminating knowledge and teaching cases)
	Level of financial support:	The EU investments in cluster excellence activities (including the initial ECEI project and the projects validating and applying results) in the previous programming period (2007–13) totaled €3.3 million ($3.6 million). The total budget for EU investments in cluster excellence activities in the current programming period is €7 million ($7.6 million).
	Timescale:	The initiating ECEI project had a 3-year duration. Current actions to strengthen cluster management excellence are pursued within the Cluster Excellence Program under Competitiveness of Small and Medium-sized Enterprises, which will last through the current programming period (2014–20).

Table A2.3 (continued)

Main results/lessons learned:	● The ECEI project (and follow-on projects) have contributed to the following results: – the development of quality indicators and peer-review assessment procedures for cluster management; – the development of a curriculum and case-based teaching materials for cluster managers and officials working in regional and national organizations managing cluster activities; – the benchmarking and labeling of more than 570 cluster organizations from 36 countries; and – the training of 40 cluster instructors on how to improve the individual management skills of cluster managers. ● Although SMEs are considered as crucial engines for growth and job creation, their competitiveness is affected by a limited exploitation of international opportunities and innovation prospects in the single market and beyond. Clusters are viewed as relevant vehicles to catalyze and support SMEs (and other firms) in fostering internationalization and innovation efforts. It is thus viewed as important to support the quality of cluster management and business support services that clusters provide. ● Investments in cluster excellence not only build capacity of cluster management, but also facilitate linkages and increased cooperation between clusters. The labels provide legitimacy and evidence of clusters that have similar levels of management practice and quality. ● With a structured framework of quality indicators and benchmarking activities, there is an incentive for continuous improvement. Cluster managers have a clearer grasp on areas of improvement. One of the challenges for the future is finding ways to leverage existing European tools (benchmarking and training) in a more integrated fashion (i.e. areas of improvement identified through analysis leads into development and

Table A2.3 (continued)

Main results/lessons learned:	implementation of new training modules) to support continuous capacity-building in clusters. ● The EU level can provide support to develop uniform frameworks (e.g. quality indicators and training materials) and platforms to disseminate and continually develop knowledge and build capacity in this area. But EU-level investments (through the competitiveness of small- and medium-sized enterprises) are not enough. These efforts need to be complemented by additional efforts on regional and national level.

Notes: BSR = Baltic Sea Region; ECEI = European Cluster Excellence Initiative; ECG = European Cluster Group; EU = European Union; SMEs = small- and medium-sized enterprises; TCI = The Competitiveness Institute.

Source: Author.

Table A2.4 Tools for regional cooperation and integration: mobility

Type of Tool	Implemented at EU level (included BSR-specific instruments)	Implemented at BSR (or Nordic) level	Implemented at national level
Mobility	● ERASMUS ● Marie Curie	● Baltic University Program ● Nordic Mobility Program	● National programs for researcher and student mobility

Name of Tool:	**Baltic University Program (BUP)**
Type of Tool:	Mobility
Implementation Level:	Baltic Sea Region
Motivation and Aim:	Prompted by the historic changes taking place in the region and recognizing the central role that universities play in societal development, the Baltic University Program (BUP) was established in 1991 with the intention of contributing

Table A2.4 (continued)

Motivation and Aim:	to development of the Baltic Sea Region by strengthening international cooperation between East and West. The BUP was established as a network of universities in the BSR aimed at developing novel ways to strengthen interaction among universities and between universities and society, with a focus on sustainable regional development.
Profile:	The BUP is a network of about 225 universities and other institutes of higher learning located in 14 countries around the Baltic Sea Region. It is coordinated by the Baltic University Program Secretariat (under the leadership of a Program Director), established as a unit at Uppsala Centre for Sustainable Development (CSD Uppsala) at Uppsala University, under the governance of an international board. The program focuses on questions of sustainable development, environmental protection, and democracy in the Baltic Sea Region. The aim is to support the key role that universities play in a democratic, peaceful and sustainable development. This is achieved by developing university courses, and by participation in projects in cooperation with authorities, municipalities and others. The Program plans, produces and coordinates undergraduate and master's-level courses (on topics such as environmental science, Baltic Sea Region history and regional development, water management and environmental management) and runs joint research projects. The chosen subjects are of common concern for the entire region, and international cooperation is of key importance. The activities concentrate on different aspects of sustainable development in the region. At present almost 10 000 students participate in the program each year. The program is funded by a number of national and multinational sources, including: the Swedish Government and Uppsala University, the Swedish Institute, the Baltic Sea Unit of SIDA, Finnish funds, the Nordic Council of Ministers, and some EU programs. In addition, the participating universities contribute to the program.

Table A2.4 (continued)

Profile:	The participating universities include classical universities, as well as universities of technology, agriculture, culture economics, pedagogics etc. All countries within or partly, within the Baltic Sea drainage basin are represented: Belarus, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, the Russian Federation and Sweden, and, more marginally, the Czech Republic, Norway, Slovakia and Ukraine. A large network of researchers and teachers at the universities has developed. The role of the BUP Secretariat is to support and promote regional cooperation and contacts between the universities and corresponding institutions of higher learning in the Baltic Sea Region. The secretariat administers the economy of the program, including contacts with funding organizations. The production of courses and course material, including books and film series, are organized from the secretariat in cooperation with the national centers and individual teachers and researchers in the network. The Baltic University Program is one of the flagships within PA Education (of the EUSBSR).	
Key features of design and implementation:	Target groups:	• University students in the BSR • University professors and educators in the BSR • Researchers
	Level of financial support:	The annual budget for the BUP Secretariat is approximately €550 000 ($594 000) (funded by national and multinational sources, and member universities). In addition, the BUP gets separate financial support for research and applied projects.
	Timescale:	Established as a program at Uppsala University
Main results/ lessons learned:	• The work of the BUP has resulted in a number of main achievements over the last 23 years, including the transnational development of four bachelor-level and seven master's-level courses, the transnational publication of several books and other material, the mobility of about 250 students (annually) in educational programs and other activities (e.g. conferences, student Parliament and summer sailing).	

Table A2.4 (continued)

Main results/ lessons learned:	• It is effective to start with a concrete joint activity (such as developing joint courses) with additional activities (such as joint research and applied projects) developing out of this. • The financing of student mobility (through e.g. ERASMUS) is a useful complement to joint university programs. • Recent interest is focused on mobility at the PhD-level, avoiding the administrative obstacles faced at the undergraduate level. • One basic idea of the BUP is to foster international and intercultural understanding among students, which is done by gathering multinational student groups together to work and learn together in courses and conferences (in contrast to a one-to-one exchange).

Notes: BSR = Baltic Sea Region; BUP = Baltic University Program; CSD Uppsala = Uppsala Centre for Sustainable Development; ERASMUS = European Community Action Scheme for the Mobility of University Students; EU = European Union; EUSBSR = European Union Strategy in the Baltic Sea Region; PA = priority area; PhD = doctor of philosophy; SIDA = Swedish International Development Cooperation.

Source: Author.

Table A2.5 Tools for regional cooperation and integration: research

Type of Tool	Implemented at EU level (included BSR-specific instruments)	Implemented at BSR (or Nordic) level	Implemented at national level
Research	• Horizon 2020	• BONUS program	• Bilateral programs between SE/VINNOVA and FI/Tekes, etc.

Name of Tool:	**BONUS**
Type of Tool:	Research and innovation
Implementation Level:	Baltic Sea Region

Table A2.5 (continued)

Motivation and Aim:	Building on experience from previous transnational research activities (in e.g. ERA-NET and BONUS+ programs), and following the adoption of the EU Strategy for the BSR in 2009, the European Parliament and Council decided on the participation of the Union in a Joint Baltic Sea Research and Development Program (BONUS) undertaken by several member states (Decision No. 862/2010/EU). BONUS aims to combine research and innovation related to the Baltic Sea ecosystem into a joint and durable interdisciplinary and focused multinational program that supports the Baltic Sea Region's sustainable development, and produces knowledge and technological solutions to support the development and implementation of regulations, policies and management practices tailored for the Baltic Sea Region.
Profile:	BONUS is a policy-driven research and development program that supports the sustainable development and ecosystem-based management of the Baltic Sea Region, the HELCOM Baltic Sea Action Plan, and the EU Marine Strategy Framework Directive (as well as other European, regional and national coastal and marine environmental policies and plans). The BONUS program and its strategic research agenda has been developed together with over 800 stakeholders across the region. The program is dynamic and flexible, and takes into account future demands during its regular updates, most recently published in early 2014. The five strategic objectives deal with ecosystem, coast and catchment area, marine goods and services, societal responses, and observation and data management in the Baltic Sea Region. BONUS is one of five existing programs under Article 185 (defined by the EU treaty). These programs are jointly funded by the member states (50%) and the European Commission (50%). BONUS is supported by a total of €100 million ($108 million) for the years 2011–17. BONUS members are the national research funding institutions in the eight EU member states around the Baltic Sea (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden) who fund BONUS jointly with the EU's Seventh Program for research, technological development and demonstration.

Table A2.5 (continued)

Profile:		In addition, call-specific funders support BONUS calls. The Russian Federation participates in BONUS through bilateral agreements. BONUS issues calls for competitive proposals and funds projects of high excellence and relevance based on its strategic research agenda. BONUS facilitates researchers' collaboration, networking, human capacity-building, and joint use of research infrastructures.
Key features of design and implementation:	Target groups:	● Researchers (from academia and industry) in the eight BSR member states ● Companies in the eight BSR member states ● Other organizations participating in research and innovation activities in the eight BSR member states ● Decision makers and other end-users of the knowledge and innovation generated within the program
	Level of financial support:	€100 million of funding is available over 7 years (2011–17)
	Timescale:	7 years (2011–17)
Main results/ lessons learned:		● Since its establishment in 2010, the BONUS program has strengthened collaboration among national funding institutions, launched 3 calls for proposals, from which 15 collaborative research and 13 collaborative innovation projects are or will be funded (for a total of approximately €48 million ($52 million)), and engaged over 100 research institutes and universities in 9 Baltic Sea countries. At least one more call will be launched in 2015. ● It has been a challenge to bring together actors across sectoral borders. BONUS collaboration has brought not only scientists but more importantly the science policy makers and funders around the same table (covering the areas of environmental, transportation, agriculture, energy, employment, economy and other policy areas). ● Expanding on experience with calls for joint research projects, BONUS has worked together with BSR Stars (see profile description below) to develop and launch

Table A2.5 (continued)

Main results/ lessons learned:	calls for innovation projects. It has been an enlightening experience to work with innovation agencies in the BSR – adjusting call texts and selection criteria to attract company participation ensuring a focus on innovation. ● BONUS has succeeded in tailoring the program according to the priorities of 8 countries and adjusting the program to research and innovation projects. BONUS is a truly multinational program, as all participating countries are involved in each call. BONUS has developed a mechanism for combining national and EU funding, and applying common funding rules regardless of the source of the funds. BONUS has developed good relationships with relevant end-users and other stakeholders, which ensures a wide exploitation of the program's outputs as well as wide participation in the program planning.

Notes: BONUS = Joint Baltic Sea Research and Development Program; BSR = Baltic Sea Region; ERA-NET = European Research Area Network; EU = European Union; FI = Finland; SE = Sweden.

Source: Author.

Table A2.6 *Tools for regional cooperation and integration: soft infrastructure*

Type of Tool	Implemented at EU level (included BSR-specific instruments)	Implemented at BSR (or Nordic) level	Implemented at national level
Integration (soft infrastructure, focused on clusters)	● European Strategic Cluster Partnerships	● BSR Stars program ● Scanbalt network	● Norwegian Innovation Clusters program

Table A2.6 (continued)

Name of Tool:	**BSR Stars Flagship Program**
Type of Tool:	Integration – soft infrastructure
Implementation Level:	Baltic Sea Region (under PA INNO of EUSBSR) and national
Motivation and Aim:	The aim of BSR Stars is to strengthen competitiveness and economic growth in the Baltic Sea Region. This will be achieved by fostering transnational linkages between specialized research and innovation nodes, leading to new types of collaboration that can deliver new products, services and business models for global markets.
Profile:	BSR Stars is a flagship within the priority area of innovation of the EU Strategy for the BSR (see previous profile descriptions of both EUSBSR and PA INNO). The BSR Stars flagship was designed in connection with the adoption of the EUSBSR (and accompanying action plan) in 2009–10, building on national experience with innovation policies and cluster programs and previous collaboration activities in the area of cluster policy in the region. The program design was, in itself, a collaborative effort, involving 40 people from 10 countries' ministries and national innovation agencies. The countries involved are: Denmark, Estonia, Finland, Germany, Iceland, Latvia, Lithuania, Norway, Poland and Sweden. The mission of BSR Stars is to shape a more integrated and dynamic resource base by linking strong research environments, clusters and SME-networks, creating a number of globally leading research and innovation hubs in the BSR to achieve stronger critical mass, attractiveness, and a competitive international position. These hubs (or transnational innovation partnerships) will be skilled in identifying market potentials in 'grand challenges', mobilizing competencies that may be dispersed over different sectors and geographies, and providing open platforms from which various actors can work together to create innovative solutions that tackle these challenges. The BSR Stars program is a long-term initiative working toward four overall objectives: 1. Facilitating transnational networks, partnerships and strategic alliances between cluster organizations, companies, universities and public authorities, which lead to: – new collaborative business models, commercialized applications, products and services;

Table A2.6 (continued)

Profile:		– increased export activities (both between countries within the BSR and outside of the BSR); and – new firms and jobs 2. Sharing, developing and utilizing open and demand-driven innovation methods 3. Improving innovation policy capabilities to leverage specialized national strongholds – bringing added value to all involved (i.e. macroregional smart specialization) 4. Strengthening the international visibility and attractiveness of the BSR's innovation capabilities These objectives have been addressed through the continued development of the innovation policy framework (via the PA INNO Steering Committee), implementation of the StarDust project (2010–2013) – including facilitation of five transnational innovation partnerships, implementation of annual cluster-to-cluster matchmaking events (in 2013 and 2014), and joint development and implementation of two transnational calls for proposals (BSR Innovation Express and BONUS Innovation calls). BSR Stars is governed by a 'high-level group' of innovation policy makers from the ten countries. This same group also serves as the Steering Committee for PA INNO. Financing for program activities is secured from EU programs, Nordic institutions and national and regional contributions.
Key features of design and implementation:	Target groups:	● Clusters and business networks in the Baltic Sea Region (including small and large firms, research organizations) ● Other research and innovation nodes in the BSR ● Regional and national policy makers (working in the field of innovation and cluster policy, smart specialization and transnational collaboration) ● European Commission (parts addressing policy fields mentioned above)
	Level of financial support:	There is no fixed financial support for flagships with EU's macroregional strategies. Rather, flagships must secure financing from EU programs (including territorial cooperation programs, Horizon 2020, etc.), other

Table A2.6 (continued)

	Level of financial support:	multinational sources (such as Nordic institutions), and from participating countries (on national and regional levels). Between 2011 and 2013, BSR Stars secured financing from the BSR Program, the Nordic Council of Ministers, and national sources totaling nearly €7 million ($7.6 million).
	Timescale:	The BSR Stars program is planned to run until 2020.
Main results/ lessons learned:	● BSR Stars has implemented a number of activities since its launch in 2010, including: implementation of the StarDust project, development of the Demola network, initiation of the Central Baltic Testbed and Demonstration Facility, development of the BSR Innovation Express concept (including annual matchmaking events and transnational calls), and implementation of two innovation calls within the BONUS research program. These activities have resulted in: – the engagement of more than 50 clusters or business networks, 15 universities, more than 900 SMEs and 850 students in transnational innovation activities – the development of more than 40 new product and service concepts – the attraction of more than €11 million ($11.9 million) in add-on financing to these actors – the mobilization of €7.5 million ($8.1 million) of national financing to transnational calls (BONUS Innovation call 2012 and Innovation Express call 2013) ● The scope of activities pursued within BSR Stars is highly dependent on both political priorities within participating countries, and on financing levels. As transnational activities are generally still 'out of scope' for regional and national organizations, BSR Stars is reliant on financing from EU and other multinational sources. ● BSR Stars helps to engage actors in transnational innovation activities and develop these activities into longer-term partnerships. The results of such 'soft infrastructure' programs are in the form of closer-knit networks and increased trust and social capital (which are difficult to measure), as well as in the form of increased	

Table A2.6 (continued)

Main results/ lessons learned:	stakeholder engagement, development of prototypes and increased investment. It is difficult to measure how these results contribute to increased integration, innovation and productivity growth in the region. For this reason, the program works with an 'effect logic' – describing how certain activities and outputs are foreseen to contribute to particular outcomes and effects over time.

Notes: BONUS = Joint Baltic Sea Research and Development Program; BSR = Baltic Sea Region; CeBa = Central Baltic Testbed and Demonstration Facility; DK = Denmark; EU = European Union; EUSBSR = European Strategy for the Baltic Sea Region; PA INNO = priority area innovation; SE = Sweden; SMEs = small- and medium-sized enterprises.

Source: Author.

Table A2.7 Tools for regional cooperation and integration: hard infrastructure

Type of Tool	Implemented at EU level (included BSR-specific instruments)	Implemented at BSR (or Nordic) level	Implemented at national level
Integration (hard infrastructure)	• TEN-T policy and program • European Spallation Source		• Transport infrastructure • Energy infrastructure • Research infrastructure

Name of Tool:	**Trans-European Network for Transport infrastructure (TEN-T) policy and the Connecting Europe Facility (CEF)**
Type of Tool:	Integration – hard infrastructure
Implementation Level:	European Commission – Directorate General Mobility and Transport
Motivation and Aim:	At the beginning of the 1990s, the then 12 member states had decided to set up an infrastructure policy at community level to support the functioning of the internal market through continuous and efficient networks in the fields of

Table A2.7 (continued)

Motivation and Aim:	transport, energy and telecommunications. The result was the first set of 'community guidelines' for the development of a Trans-European Network in the transport sector (adopted by the European Parliament and Council in 1996), which established a 'master plan' for connecting national networks of all transport modes. The guidelines determine projects' eligibility for EU funding (through the Connecting Europe Facility (CEF)). CEF financial support has two main forms: grants, which are non-reimbursable investments from the EU budget; and contributions to innovative financial instruments, developed together with entrusted financial institutions such as the European Investment Bank.
Profile:	Since 1996, the Trans-European Network for Transport infrastructure has regularly updated the guidelines for TEN-T and the CEF. Other EU funds – notably the Cohesion Fund and the ERDF – also contributed to developing the TEN-T. At the same time as the guidelines helped prioritize project funding, they also constituted a reference framework for member states' infrastructure policy. The concept of 'core network corridors' was introduced to facilitate the coordinated implementation of the core network. They bring together public and private resources and concentrate EU support from the CEF, particularly to remove bottlenecks, build missing cross-border connections and promote modal integration and interoperability. They also aim to: (1) integrate rail freight corridors; (2) promote clean fuel and other innovative transport solutions; (3) advance telematics applications for efficient infrastructure use; (4) integrate urban areas into the TEN-T; and (5) enhance safety. These nine core network corridors are strong means for the European Commission not only to boost investments but also to advance and showcase the achievement of wider EU transport policy objectives. As of January 2014, the European Union has a new transport infrastructure policy that connects the continent from East to West, North to South. This policy aims to close the gaps between member states' transport networks, remove bottlenecks that still hamper the smooth functioning of the internal market and overcome technical barriers such as incompatible standards for railway

Table A2.7 (continued)

Profile:	traffic. It promotes and strengthens seamless transport chains for passenger and freight, while keeping up with future technological trends. The policy, and the accompanying Connecting Europe Facility, will help the economy in its recovery and growth, with a budget of €26 billion ($28 billion) up to 2020. This new policy framework brings innovations and significant progress in a number of areas: governance at European level, a strong legal form, a genuine network approach, a powerful instrument for TEN-T funding, etc. The European Commission nominated a European Coordinator for each of the nine core network corridors. It has also nominated European Coordinators for two horizontal priorities: the European Rail Traffic Management System (ERTMS) and Motorways of the Sea. These European coordinators – individuals with long-standing experience in transport, financing and in European politics – will lead the drive to build the core network corridors, which represent the strategic heart of the TEN-T and therefore deserve a concentrated amount of effort and attention for their financing, cooperation efficiency and quality. A work plan will be drawn up for each corridor that will set out the current status of its infrastructure, a schedule for removing physical, technical, operational and administrative bottlenecks, and an overview of the financial resources (EU, international, national, regional and local; public and private).	
Key features of design and implementation:	Target groups:	● Policy makers and implementing and/or funding agencies in the field of transport ● Other funding institutions (such as the EIB) ● Researchers, companies and local and/or regional-level public sector organizations that respond to calls for proposals (to take on prioritized projects)
	Level of financial support:	€26 billion ($28 billion) over the program period
	Timescale:	7 years (2014–20)

Table A2.7 (continued)

Main results/ lessons learned:	• The smooth connection between the east and the west of Europe in the aftermath of the 2004 enlargement has been one of the most important achievements of TEN-T policy in the last decade. • Over time, the guidelines (and priorities) established in the TEN-T policy have been used to guide transport policy in member states, creating a more integrated strategy (and investments) for European transport infrastructure. • Having a policy with an accompanying financing instrument (the Connecting Europe Facility) has helped drive implementation of prioritized projects. The increased use of various EU funds (i.e. the CEF, the Cohesion Fund and the ERDF) in connection with one another has provided even stronger mobilization and action on prioritized projects. • The establishment of 'core network corridors' (each with its own coordinator to drive activities) helps to focus efforts on addressing issues/prioritized projects in each corridor. Through such a governance structure, more attention and more significant investments are made in particular areas, speeding progress and helping achieve targeted results.

Notes: BSR = Baltic Sea Region; CEF = Connecting Europe Facility; EIB = European Investment Bank; ERDF = European Regional Development Fund; ERTMS = European Rail Traffic Management System; EU = European Union; TEN-T = Trans-European Network for Transport infrastructure.

Source: Author.

Table A2.8 Tools for regional cooperation and integration: trade and foreign direct investment

Type of Tool	Implemented at EU level (included BSR-specific instruments)	Implemented at BSR (or Nordic) level	Implemented at national level
Trade and FDI	• Enterprise Europe Network (and cluster contact points)	• BSR investment promotion agencies collaboration	• National and regional export promotion and inward investment agencies (some of which have activities targeting clusters)

Notes: BSR = Baltic Sea Region; EU = European Union; FDI = foreign direct investment.

Source: Author.

NOTE

1. Based on the details presented in the description of tools, found in Appendix 2, and on perspectives collected in the field study in Lithuania and Latvia.

Appendix 3 Usage case for the design of an Asian Regional Economic Integration Observatory

We are in the midst of a data science revolution (Mayer-Schönberger and Cukier, 2013) that is transforming what we might observe and infer about the world around us; deepening the level of insight that we can build in specific domains of interest; expanding the number and reach of connections that we can establish between people, places and things; and growing our collective ability to ask questions and solve problems. In particular, two catalysts have emerged that have shifted how we now think about data and how we might use it. The first is the widespread availability of massive silos of big data; the second is the expansion of the resources now available to query, interpret and add value to those data. Together, these developments have created efficiencies and economies of scale that have never before been presented, while also lowering many traditional barriers to data resources that have long persisted (Frankel and Reid, 2008; The Economist, 2010).

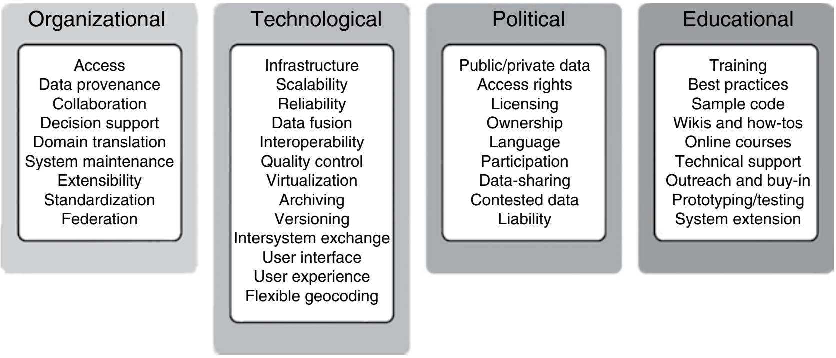
Nevertheless, at the same time, a growing 'data deluge' (Baraniuk, 2011; Bell et al. 2009) is emerging, and presenting new problems. Chief among these are issues of data privacy and ethics amid data abundance (Dobson and Fisher, 2003; Jacobs, 2009; Mayer-Schönberger and Cukier, 2013; Tene and Polonetsky, 2012). New concerns have arisen around ownership and control over the shadows that our big data cast (Clarke, 1994) and this is particularly salient when data are associated with places and times, as is usually the case with geographic information (Bilton, 2011; Dobson, 2009; Goodchild, 2011; Lessig, 2000; Monmonier, 2002; Seely Brown and Duguid, 2000; Smith et al., 2005). While data has grown more abundant, and the machinery to 'feed on' data has grown more ravenous, so too has the intractability, intricacy and complexity of those data and the connections between them (Ouellette, 2013; West, 2013). Long the domain of official data-collection agencies, much big data is now being generated within the commercial sector, with concerns that the knowledge and computer resources to leverage the benefits of those data might be cloistered behind the companies that have the scale to search and serve it (Picciano, 2014). Similarly, many worry that traditional forms of training and education might be outmoded in the face of entirely new ways of doing business (Anderson, 2008; Nature Publishing Group, 2008; Trelles et al., 2011).

While these concerns must be considered when planning any data platform, there remain significant opportunities for the Asian Development Bank (ADB) and its partner communities to build a landmark knowledge platform that, with careful planning and robust design, could leverage many of the benefits of the emerging data science revolution, while mitigating potential complications. The development of a knowledge platform design with an open architecture, atop diverse community data resources, with flexibility to adapt to future innovations and scale for growth, and providing varied paths to entry and use could establish ADB as a leader in next-generation architectures and platforms for regional cooperation and integration.

Achieving this practically and usefully will require some work. It necessitates innovative – and innovatively applied – *dataware*. By dataware, we refer to the tools necessary for collecting, collating, managing and communicating data, as well as techniques for adding value to data, via models, dashboards, statistical analyses, economic metrics, impact assessments, visualization and so on. Developing this dataware and leveraging it in service of an agile and scalable knowledge platform requires negotiation of technical and operational challenges that could potentially span diverse geographies, organizations, data sources, data types, systems and interaction schemes, as well as languages, cultures, topics, ontologies and domains of expertise. Moreover, navigating these aspects of the system design requires solutions that are in equal parts organizational, technological, political and educational (Figure A3.1).

The existing use-case and development-case scenarios for geographic information systems (GIS)-based and data-based regional observatories and exploration platforms fall into the following taxonomy; however, there is increasing interoperability across these taxonomies, with the result that systems with massive reach, scope and potential utility are now feasible.

Development agencies Several development agencies have instituted systems that are map-based and GIS-based (by GIS-based, we mean systems that are or may be map-based at the level of their interface, but offer the additional ability to download, repurpose and/or analyze the data using geographic-based queries on the database side of the system). They are producing and publishing – often on public-facing websites – much of



Source: Author.

Figure A3.1 Initial considerations and opportunities for designing and positioning knowledge platform

their development data (investments, targets, priorities, impacts and indicators) for public communication. In several instances, these data may be downloaded in a variety of formats for further analysis.

Universities Academic research and development efforts are also underway to produce GIS-based development data portals, either to support (1) open GIS, citizen mapping, or volunteered geographic information, or (2) to *use* the portals in service of substantive investigation into human geography, economics, international affairs, government and politics, disaster relief and so on. Many of these groups have partnered with the other use cases to collaborate (The College of William and Mary, Brigham Young University, and The University of Texas at Austin with United States Agency for International Development (USAID) and Environmental Systems Research Institute (ESRI) on the *AidData* portal, for example).

OPENAID PARTNERSHIP

Citizen advocacy There is a relatively long tradition of map-based portal development for public participation purposes (Elwood, 2010). Recently, this has evolved into dedicated citizen mapping initiatives (Hodson, 2013), based largely around the idea of first crowdsourcing the *task* of data collection (Bonney et al., 2009; Cohn, 2008; Goodchild, 2007; Hand, 2010) and portal development (Coast, 2011; Haklay, 2010; Haklay et al., 2008;

Haklay and Weber, 2008), and second, using the products of that work in an open fashion to foster citizen engagement in development decisions and impacts (Eagle, 2009; Hagen, 2011; Nelson, 2011).

Software companies Providing support platforms (databases, data models, map layers, data access schemes, base data, visualization, virtualization, servers) in support of these activities. These companies are behind (or partnering with) the other use-case scenarios, for example, ESRI, CartoDB, MapBox. In other cases, they have built value-added platforms atop these primary providers (for example, Development Gateway using ESRI services).

Government agencies As part of open government initiatives, many local, regional and national governments have begun to produce data portals, organized around GIS. Development groups within governments have also begun to produce these for their investments and priorities (for example, the United Kingdom's Department for International Development's *Development Aid Tracker*). Recently, similar initiatives have appeared at national and international level. Chief among these is the European Union's portals to their existing datasets, which have evolved from GIS data *infrastructures* developed for client-server interactions (for example, the Infrastructure for Spatial Information in the European Commission), to fully fledged publically oriented portals and platforms for widespread access and reusability (see the latest version of Eurostat, for example, or plans for the second generation of the European Cluster Observatory (http://www.tci-network.org/news/776)). At global level, the United Nations has also developed several exploratories. Some are focused on specific UN missions (global health, for example), but they have recently published a wide-reaching initiative, *UN Global Pulse*, designed as an umbrella portal to a wide-reaching set of data, with many paths to entry to those data across media and datasets, with the aim of scaling to massive datasets across interest domains (United Nations, 2012). Their recent work in docking streaming social media data to Global Pulse has attracted significant attention for its innovation and the potential range of applications to which it can be applied (Lohr, 2013).

Universities There are also a number of university and academic groups that have built, or are building cluster-type observatories as part of their research exploration. In the United States, the recent (October, 2014) *Cluster Mapping* initiative from the Harvard Business School is one such high-profile effort (http://clustermapping.us/).

DATA

Data Sources

While the knowledge platform will provide the scaffolding for information-sharing, use and contextualization, it must be sourced in *raw data* before the information can be produced. These data are likely to come from a variety of sources, some of which may currently be known and for which design goals can be established, but also for other data that are yet to be known, such that the platform should support extensibility in a way that future-proofs its development, use and media.

Legacy data products It is most likely that a large volume of previously developed, previously produced and previously collated datasets are 'floating around' already. These could, if corralled and reconciled into a cohesive system, provide much of the foundation for the knowledge platform. Indeed, the fact that the Asian Development Bank is likely to have these data on hand, or within reach, could establish significant headway in building the platform. These data could be in digital format. Data in paper format can be digitized and, in some cases, geo-referenced, if in map form. At a minimum, data that are in the form of documents or reports can be digitized to portable format and *indexed* in their native format to the GIS side of the platform, simply by assigning them a location and storing them in the spatial database.

Official sources Several datasets will be likely to be sourced from official data collection efforts. These would probably include sources from governmental agencies, such as censuses of population and economic activity; tax and property records; city and regional planning surveys; road network files; building locations; land use, political, and legal boundaries and so on. Other official sources could come from non-governmental agencies (NGOs), and this is a significant point as many NGOs are beginning to get involved in data collection and certification of spatial data records, with specific efforts to foster public participation and transparency in the production of data (Crooks and Wise, 2013; Hagen, 2011; Nelson, 2011). International agencies (or quasi-international, or international-facing agencies) are also a significant source of official data. This is particularly true for remotely sensed data, such as land use and land cover, or environmental characteristics of the Earth's surface. Several other official datasets could come from companies and commercial entities, and this is significant for many aspects of economic development.

Unofficial sources In many cases, unofficial data sources may be a significant product for the platform (or at least could be usefully allied to other datasets on the platform for the purposes of analysis). In particular, *case studies* could provide a significant source of insight. These could come from a variety of sources: students working on projects, local groups with site-specific insight, records of local agricultural or industrial companies and so on. Negotiating access to these data could be challenging, but the platform could be developed to encourage these groups to *volunteer* their data to the platform, in the interest of the public good, perhaps, but more likely as a mechanism to *add value* to those data, by connecting them to the other data sources provided by the platform, and by connecting them to the tools for analysis that the platform might afford.

Machine-sensed data Data from machines, particularly orbiting imaging platforms, can be critical in providing (1) a steady-stream of data that is up to date; (2) an unbiased (or at least objective) view of conditions on the ground; and (3) a 'big picture' view of Earth surface features and human activity. Of course, these assertions must be tempered with the reality that the choice of machine, the view, the time of data capture, and the lens through which things are seen or data are collected may themselves be subject to bias. Moreover, machine-sensed data must often be processed (as imagery, classified variables such as land-use and land cover, interpreted features) and this also introduces the notion of bias and uncertainty. However, there have been significant advances in using remote sensing, in particular, to gather data about a variety of human (Sutton et al., 2001), built (Elvidge et al., 1999; Elvidge et al., 2007; Herold et al., 2002), infrastructural (Elvidge et al., 2011), physical (Akgun et al., 2012; Hodgson and Bresnahan, 2004; Moore et al., 1993; Townsend and Walsh, 1998), environmental (Curran, 1989; Gao, 1996; Schmidt and Karnieli, 2000; Voogt and Oke, 2003), development (Elvidge et al., 2009; Foody, 2003; Xiuwan, 2002), and economic attributes (Field et al., 1995; Jensen and Cowen, 1999; Moran et al., 1997; Sutton et al., 2007). In many instances these data are proprietary to the commercial companies that collected them, but many others are free for use in the public commons. Moreover, there are a variety of national agencies that have collected these data, over long periods, in their own national interest. Similarly, there are cooperative agreements across many agencies to collect such data in the global public good. Sensed data could also come from *sensor grids* that are positioned on or below the Earth's surface, or in and around water bodies. Generally, such systems are proprietary in nature, but in some instances they are available for public use (Wright and Bartlett, 2000; Wright and Goodchild, 1997). Data are also increasingly available from instrumented built and transport infrastructure (smart roads, tool systems, logistics pipelines, environmental sensor web, and so on) and these can similarly be integrated into GIS-based platforms (or streamed dynamically to them) where available (McCullough, 2004).

Social media The rapidly growing volumes of data that are now being produced (passively or actively) by social media platforms and technologies are of great relevance to the development of the platform. Such data represent the most voluminous and rapidly generated sources of data for many social factors and transactional attributes that we have ever encountered. Increasingly, these can be reconciled to common data platforms via GIS, which provides spatial structure across such data (Elwood, 2010; Goodchild, 2007). (However, there is growing realization that these data are often highly biased, and that the quality of their geographical identifiers can be problematic (De Longueville et al., 2010; Elwood, 2008; Flanagin and Metzger, 2008; Haklay, 2010; Haklay et al., 2010).) Nevertheless, a huge variety of data products can be assembled from such data, spanning from human demography (Frias-Martinez et al., 2012b; Frias-Martinez et al., 2010) and activity (Frias-Martinez and Virseda, 2013; Liu et al., 2010), to economics (Frias-Martinez and Virseda, 2012; Frias-Martinez et al., 2012c), culture (Croitoru et al., 2012), politics (Ratti et al., 2010; Sobolevsky et al., 2013), development (Frias-Martinez et al., 2010), sociality (Croitoru et al., 2013; Stefanidis et al., 2013; Vieira et al., 2010), movement and migration (Girardin et al., 2008; Rubio et al., 2010), and land use (Frias-Martinez et al., 2012a). The inclusion of social media data to the *UN Global Pulse* platform, for example, has generated significant coverage for and interest in the system (Lohr, 2013).

Stages in the Data Development Pipeline

At face value, the knowledge platform will be a tool for communicating (visualizing) data to a variety of users. However, within that role, the platform should support a seamless transition from data to information to knowledge to understanding. At each transition point in the chain, different components of the platform should support the transition, and should do this is in different ways.

For spatial data, the primary mechanism for transforming it into information is to place it in its geographical context, by georeferencing it relative to universal spaces (geometry, cartography, topology, networks, time geography, systems diagrams and so on), or to domain-relevant spaces (human geography, urban geography, economic geography, political geography, historical geography, social geography, physical geography, transport geography, biogeography and so on). However, there are, of course, many other domains that can add value to raw data, well beyond geography, and these can be made geographical by mapping them (counting them in particular places and times, looking for clusters or their absence, performing buffering operations, examining heterogeneity and homogeneity, assessing adjacency and boundary effects, exploring space–time distributions, and so on). This can be quite concerning for the design of information systems, as a potentially massive array of data sources might need to be considered, and multiples of that array may need to be treated to accommodate transformations between them. The geographical sciences have long grappled with this issue (Kwan, 2002, 2012; Kwan and Schwanen, 2009), and to some extent geographic information science has emerged as the most universal solution, to a large degree because of the ability of geography to structure otherwise unstructured data (Blumberg and Atre, 2003; Leavitt, 2010; Mansuri and Sarawagi, 2006; Rao, 2003; Sester, 2000). As data and information systems (considered generally) have grown into large and even massive silos, spatial data handling has emerged as a special data scheme for coping (Gieryn, 2000; Goodchild et al., 2000).

It is therefore prudent (perhaps crucial) that a deliberate (and extensible) georeferencing plan and actionable scheme be developed to handle and grow spatial data from the platform's first principles (see later section on Georeferencing).

Data Types and Data Models

A successful platform should support a wide variety of data types of both a spatial and non-spatial nature. There are potentially a wide variety of data types to be accommodated, but a minimal taxonomy of types would include those listed below. (Note that most mapping services, such as Google Maps and Bing Maps, realistically allow users only to manipulate geometry and attribute data at the interface and application programming interface level of the services that they offer.)

Location data At its simplest level, the platform should provide two-way interaction with location data, that is, it should allow for the querying, display and manipulation of data by location, and it should allow for the data to be uploaded to the system and registered to the system via location. This latter point is significant: the data should have unique location identifiers, where possible, of resolution, accuracy and precision (Goodchild and Gopal, 1989) appropriate to the source and to its use. Moreover, they should be extensible enough to accommodate the expression of location in as wide a variety of contexts and formats as possible, so that a broad range of geographies can be employed in adding value to the data. This can be difficult when the data are not naturally or natively spatial in nature (for example, when they are produced non-spatially, and rendered spatial after the fact), and here the roles of metadata and geocoding become significant (as we discuss shortly). Furthermore, the nature of location data is currently shifting dramatically, as data streamed from location-aware technologies and services become part of the spatial data ecosystem, and as such data become quasi-ubiquitous for many usage scenarios (Borriello et al., 2005). Thus, the platform needs to be able to rapidly ingest and reconcile data (Hazas et al., 2004; Muthukrishnan et al., 2005).

Relationship data A central component of supporting robust analysis on the platform, and using the data that it provides, as well as docking the platform with related model-based or statistics-based analyses will be to handle relationship data carefully. Here, we refer to the spatial connections (distance (Sui, 2004; Tobler, 1970), adjacency (Anselin, 2003), flow (Tobler, 1987), barriers (United Nations Development Programme, 2009), within and without (Karanja, 2010; Thurstain-Goodwin and Unwin, 2000), isolation (Anselin, 1995), connectivity (Liben-Nowell et al., 2005; Welch and Mishra, 2013) and so on) between data points. Many of these can be treated with modern georelational models (Dueker, 1985), and can be optimized for large datasets using clustering on spatial data access schemes (using quadtrees (Samet, 1984), for example). Ideally, these should also work with standard relationship schemes for other information systems, including object-oriented hierarchy (Gamma et al., 1995), entity-relationship models (Peckham et al., 1995), topology (Ellul and Haklay, 2006), and newly emerging formats such as the Resource Description Framework (Miller, 1998). A resource description framework can operate on metadata (which we discuss shortly) and is therefore a candidate for suprarelationships. Hypergraphs (Gunopulos et al., 1997) can provide similar functionality for network data.

Network data Network data constitute something of a special case of relationship data for the platform because of their significance in ascribing variables and structure to linkages in the system, between entities, and across space and time. Dedicated spatial network data types are possible in most GIS, although they are generally limited to geometry and topology and therefore constrained in the range of operations that they afford in spatial analysis and spatial data access. New forms of spatial network data model, such as SANET (Okabe et al., 2006a) are beginning to be used, and are beginning to be folded into spatial analysis routines (including spatial statistics) (Shiode and Shiode, 2010), but they are academic in nature.

Similarly, graph-based network data types can be employed (and spatial networking could be considered as one property of the graph). Graph structures are straightforward to implement in database systems, but connections to GIS thus far have been rather experimental (Butts, 2009).

Attributes Attributes of the data types already discussed can be represented in the platform via GIS in a straightforward manner, particularly if a georelational data model is employed: the 'geography' can be held in one file, the attributes in a database, and the glue to fashion spatial data exchange can be developed between them. This facilitates the separation and specialization of all three, without necessarily sacrificing interoperability. Georelational techniques also allow users to create their own databases, and then connect them to the platform in a unified (and structured) fashion by performing spatial joins (Patel and DeWitt, 1996), or similar operations (that is, matching and then merging database records via their attribute data type – text, image, values, documents, video media and so on – to the location data type via common indices). These joining and merging operations are now scalable to huge databases and have been optimized for efficient operation over diverse data input streams (Jacox and Samet, 2007).

Place names Place names (*toponyms*) are a special form of attribute data in GIS (Vögele et al., 2003). They are both attribute data and location data, but they are often not unique, and their meaning is often significant across many (sometimes conflicting) axes of consideration. This is further complicated by language and differences in the expression of place names in different dialects or vernacular (Berg and Vuolteenaho, 2009). That place names are sometimes contested or have diverging cultural or historical meaning (Rose-Redwood et al., 2010) is a significant consideration when developing a platform that crosses cultural and political spaces. These issues are of long-standing concern in geography and in GIS and are not well-reconciled. Recent developments in ontologies (database classes for ascribing meaning to data items held within them, as style sheets or equivalents, for example) provide one possible path for reconciling the diverse treatment of place names within a structured spatial data platform: particular names can be invoked when toponyms are well defined or allied to a particular language class or location container (Agarwal, 2004).

Objects Object data types can be reconciled to the spatial database using standard object-oriented schemes, with the advantages of polymorphism, hierarchy and encapsulation that they afford (Gamma et al., 1995; Microsoft Corporation and Digital Equipment Corporation, 1995).

These can also be registered to other data types, in the GIS, if the objects are indexed with functional location types (using schemes such the Component Object Model (Ungerer and Goodchild, 2002), for example). However, objects often require special treatment in GIS, particularly when they have boundaries that are expressed in the GIS: these boundaries can be indeterminate (Burrough and Frank, 1996; Cohn and Gotts, 1996; Schneider, 1996), fuzzy (Schneider, 1999), and contested (Paasi, 1998). They are also subject to change (Galton, 2004) and can move (Gidófalvi and Pedersen, 2009; Wolfson et al., 1998). Issues of defining what, exactly, an object is and what its bounds might be are also often subjective and will probably depend on the context in which the object is placed, and the use for which it is considered (Guesgen and Albrecht, 2000; Guo et al., 2008; Jacquez et al., 2000).

Surfaces Objects and fields have something of a long-standing conflict in GIS (Couclelis, 1992). While objects (market areas, sovereign boundaries, property bounds) are often distinct in their identities (ownership, land use, address) at particular scales of space and time, fields (temperature, travel time, soil moisture) are continuous and subject to sampling, scale and observation in many ways. Fields are thus difficult to represent in object-based GIS platforms, such as the geometry-focused GIS that are predominately used. This makes it difficult to represent surfaces, with related difficulties for supporting conditions as they appear on the ground, and for supporting many data types that one may wish to reconcile to GIS (particularly data from remotely sensed platforms (Fisher, 1997)). In these cases, it is necessary to use spatial analysis and spatial statistics to sample fields as geometries that can be stored and manipulated in a GIS (Anselin, 1995; Anselin et al., 2006; Clark and Evans, 1954; Cressie, 1991; Getis and Ord, 1992; Moran, 1950), or geostatistics that can interpolate and probably estimate surfaces (Fotheringham et al., 2004; Oliver and Webster, 1990; Shepard, 1968). Once derived, surfaces can be stored using mesh data types or raster data types (Goodchild, 1992), and a suite of operators can be employed to process them in those formats (Lu et al., 2008; Mennis, 2010; Yu et al., 2003).

Three-dimensional A decision to incorporate three-dimensional (3D) data types, such as 3D geometries (which can be reconciled in GIS using common data models such as FBX (Filmbox proprietary file format, .fbx), for example, and handled using open source scene graphs (Sun et al., 2014)) or Triangulated Irregular Networks (TINs) (Peucker et al., 1978) is significant. Including these details would render the platform incredibly valuable as a tool, as the incorporation of 3D facilitates a much richer set of representations of data, and it allows for a wider range of analyses, both on three dimensions of spatial data (aspect analyses, terrain generation, least-cost traversal paths and so on) (Fowler and Little, 1979; Nagy, 1994), but also on multiple dimensions of *any* data (Chen and Guevara, 1987). However, few systems are available to support this. One approach to circumnavigate the issue is to develop extrusion of 2D features into 'two and a half dimensional' data that illustrate variable value. This approach, for example, is common on virtual globe platforms such as *Worldwind* and *Virtual Earth* (Butler, 2006).

Graphs Much of the data to be reconciled in and generated by the platform may usefully be represented by graph data types (Amin and Hakimi, 1973; Dijkstra, 1959; Watts, 2003), that is, as vertices (points, nodes, locations, entities) and edges (links, paths, connections, roads, rails, corridors). In many cases, graphs can be represented natively in a GIS, if we consider them as geographic objects. On the database side, most GIS can handle massive graphs and data structures for big data over graphs (Gupta et al., 2014; Quamar et al., 2014). However, performing graph analyses over them in non-geographical ways (using social network analyses, for example) can be difficult in these cases (Faust et al., 2000; Liben-Nowell et al., 2005; Singleton and Longley, 2009; Ter Wal and Boschma, 2009; Waaserman and Faust, 1994). It should be noted that graph data structures are often significant for data that will be shared, accessed, hosted and reconciled on the Web (including cloud resources that store data in several locations and must treat reconciliation across these databases and locations concurrently or reasonably in synchrony) (Broder et al., 2000).

Time GIS have long grappled with how to represent time, and particularly how to build data models for time that can 'play well' with data models for space (Miller and Wu, 2000). Several schemes for achieving this exist in the field of time geography (Peuquet, 2002; Timmermans et al., 2002). These include transforming time to a third dimension, and docking it with planar geographies to produce space–time paths, space–time prisms, space–time aquariums, and so on. The benefit of this approach is that it opens up time to a rather full range of GIS and database operators and facilitates accessibility (Miller, 1999), sufficiency (Brimicombe and Li, 2006; Miller, 2005) and event-based queries (Chen and Kwan, 2012), such as 'where do these two things intersect in space and time, and for how long?'; 'given this much space and time, how far can this object span?'; 'what is the potential roll-out range for this particular diffusion event?' and so on. Dedicated data-access (Rey and Janikas, 2006) and visualization systems have also been developed to handle time in this way, such as space–time cubes (Kraak, 2008; Kristensson et al., 2009), and these have been polished for a wide variety of substantive applications (Huisman et al., 2009). Recently, there has been considerable effort to build space–time GIS schemes to handle big data and streaming data (Shaw et al., 2008). This has led to the development of a next generation of space–time data models that should be considered for the platform, including space–time cluster models (Diggle et al., 1995; Wayant et al., 2012; Yamada et al., 2009), space–time network models (Shiode and Shiode 2009), trajectory models (Buchin et al., 2008; Demšar and Virrantaus, 2010), space–time shape models (Gorelick et al., 2007), space–time interest points (Laptev, 2005), and dedicated space–time event and action models (Gatalsky et al., 2004). In many of these cases, the models have been developed to analyze and structure space–time data in dynamic feeds (Wang et al., 2011).

Change It is likely to be critical that the platform treat change in a variety of fashions and dedicated data models to handle change can be introduced. Several schemes have been employed in database theory (Cho and Garcia-Molina, 2000, 2003), and dedicated methods have been developed for change detection and change reconciliation in GIS (Ahlqvist, 2008; Fisher et al., 2006; Goldsberry and Battersby, 2009; Hornsby and Egenhofer, 2000; Lambin, 1996; Moreno et al., 2008; Yi et al., 2014), although many of these are experimental. The current standard for handling change in most GIS platforms is via attributes, metadata, updates and animation (Koussoulakou and Kraak, 1992), which in turn are based on the space–time data models discussed above.

Mark-up The inclusion of a dedicated mark-up scheme (or a set of interoperable schemes) is critical for developing a unified platform, across several axes of consideration: (1) in enabling communication between datasets (particularly those with different knowledge domains); (2) in allowing for data parity between different systems (within the platform or federated to the platform); (3) enabling Web functionality for the platform; and (4) semantically enabling the platform. Various domain-specific mark-up schemes and languages are available, for example, for transport (Cambridge Systematics Inc. et al., 2006), urban environments (Kolbe, 2009), for planning (Hopkins et al., 2003), public policy (Schill et al., 2007), and traffic (Gu et al., 2004). Similarly, mark-up schemes are available for data collection methods and representation, independent of domain, for example, for sensors (Botts et al., 2008), computer animated design and drafting (CAD) (Döllner and Hagedorn, 2007), and virtual reality (Wu et al., 2010) in GIS settings. These are potentially commensurate with similar developments in other information systems and other domains, for example, with event mark-up for logistics (Mendling and Nüttgens, 2006), decision-making (Tang and Meersman, 2009), banking (Barnes and Corbitt, 2003), and government services (Kavadias and Tambouris 2003). Given the diversity of these mark-up schemes, recent efforts have focused on developing interoperable and extensible mark-ups (that is, the mark-up encodes its own semantics as part of its scheme), with some progress in doing so in a dedicated fashion for GIS (Badard and Richard, 2001). Much of this is targeted toward moving GIS and their functionality to the Web and cloud (Shanzhen et al., 2001). An emerging standard – Geographic Markup Language (GML) – is coalescing around these efforts, and is gaining support from international standards agencies (Kolbe, 2009; Lake, 2005; Peng and Zhang, 2004). Moreover, dedicated data operators are beginning to be developed specifically for and with GML (Boucelma and Colonna, 2004).

Metadata Metadata, that is, data about data is critical for managing a seamless platform across a variety of users, uses, media and datasets (Tsou, 2002). This includes general metadata, such as access rights, ownership, dates, edit history and provenance, source, and so on (Edwards et al., 2011). However, specific treatment of geographic metadata is critical. Indeed, there is growing agreement that robust geographic metadata are essential to providing a public commons for both spatial data and spatial data infrastructure (Onsrud et al., 2004). Key here are issues of transparency (the metadata should allow users to fully understand the limitations and opportunities that the data provide) and interoperability (the metadata should allow users to transfer data between systems, or could allow systems to do this automatically) (Lacasta et al., 2003). This includes cartographic metadata: projection used, units used, place name style sheets, data models, mark-up languages, timing, change, directionality and so on. It may also extend to the data collection scheme (whether this is from a sensor Web with particulars of its engineering and precision, or from survey instruments and the sampling and biases involved) (Nogueras-Iso et al., 2005). These may also be domain-specific (Petras et al., 2006). Recent developments are focused on automated extraction of metadata from spatial data (which is of relevance to the legacy data sources and international sourcing of data for the platform that we discussed earlier) (Manso et al., 2004), on developing national and international metadata standards (Zarazaga-Soria et al., 2003), and on building knowledge domains (again, automatically) from metadata (Ahlqvist et al., 2000; Albertoni et al., 2005; Schuurman and Leszczynski, 2006).

Ontology One of the end stages in the pipeline of use for a successful platform should be the generation of knowledge (Gantner et al., 2013). Ontologies codify this, for data, for users, for uses and for systems into formal 'way of knowing' about things. These include classifications, algorithms, semantics, ground truth, typologies, hierarchies, heuristics, best practices and so on. There has been a long-standing interest in ontologies for GIS (Frank, 1997; Schatzki, 1991; Winter, 2001) and the topic has recently advanced with some rapid progression, thanks in large part to the move of spatial data and GIS to the Web, where those data and systems have come into contact with other ontologies. This is a huge topic for consideration, but a successful knowledge platform should treat metrics of success and ways of knowing in some formal, structured fashion (Bateman and Farrar, 2004). Moreover, it should be extensible enough to support the development of new ontologies. Several operational ontological schemes are available to achieve this, with the Web Ontology Language (OWL) (Bechhofer, 2009) and Protocol and Resource Description Framework Query Language (SPARQL) (Pérez et al., 2009) being among the most widely used. Schemes for developing these ontologies *with* metadata (and bundling the two) are also being developed (Schuurman and Leszczynski, 2006).

Social media Social media, as a potentially valuable data source, have already been discussed above. However, it is worth mentioning that specific data types *for* social media could and should be considered as part of the platform. This would include types for docking social media data to the system (and GIS is one possible universally structuring container for those types, particularly for social media data that have been produced using location-aware technologies). However, social media should also be considered as an output for the platform, that is, as one of many potential media and interaction schemes that the platform could consider.

Databases

Once the data types and data model have been settled upon (which is no small undertaking, as the discussion above probably conveys), these need to be implemented and instantiated as physical models as databases. Here, the discussion grows further. Database methods for GIS or hybridized information systems that dock or 'talk' with GIS are well developed (ArcGIS offers many formats, as do open source GIS, and big data systems usually have spatial database structures – Oracle Spatial is an example (Kothuri et al., 2007)). However, if data and databases span several systems and organizations, this can become a thorny issue far beyond the spatial nature of the physical database used. That said, most physical spatial databases should be able to function at the 'enterprise' level (Qi et al., 2003), and many more can scale over big data and multisite schemes via conventional high-performance computing (Behzad et al., 2011; Wang, 2010; Wang et al., 2013; Wang and Armstrong, 2003), Web services (Zhang et al., 2007; Zhang and Tsou, 2009), and virtualization schemes (Bhat et al., 2011; Degen and Qin'ou, 2012; Jinnan and Sheng, 2010; Shekhar et al., 2012).

GEOREFERENCING

Georeferencing (Cramer and Stallmann, 2002; Hill, 2009) is essential to the development of a usable and scalable platform, as we discussed throughout the previous section. In essence, it provides the foundation and scaffolding for (1) the data that make up the system's resources; (2) the interfaces that are capable between users and the data; (3) the operators and queries that are possible on the data and within the databases; and (4) the interoperability of the platform with other related and dependent systems. Because of the diverse nature of the data that are likely to be included in the platform, and the diversity of uses and interpretations that the platform should support atop those data, the georeferencing scheme should be both well grounded and flexible.

Base Maps

There are many diverse pathways for achieving grounding and flexibility. The most common would be to establish a series of base maps (Frank, 1992) as ground truth, and a series of projections or transformations from that base to flexible further forms (Griffin, 1980). These may be sourced in common geometry (Buttenfield, 1991), and then specialized to be domain-specific and several possible basemaps may need to coexist in the platform to accommodate this, for example, demography (Bhaduri et al., 2002), digital elevation (Adkins, 2002), physical features (Dikau, 1992), roads (Khan et al., 2010), land parcels (Bishop et al., 2000), utility networks (Knecht et al., 2001), address files (Drummond, 1995) and so on. Coexistence can be negotiated by several further schemes, such as layering (MacDougall, 1975) and map algebra (Mennis, 2010; Takeyama and Couclelis, 1997; Tomlin, 1990). While the notion of 'layer-caking' basemaps is rather well developed across a diverse set of GIS suites, schemes for transforming between basemaps are less mature and often require commercial solutions (Griffin, 1980). Many cities, regions, states and nations have settled upon basemaps that need to be reconciled when geography and data crosses their boundaries, and so this issue of transformation between them is a significant component of interoperability for the platform (Mennis, 2010; Takeyama and Couclelis, 1997; Tomlin, 1990). Similarly, the rate of refresh and update of the basemaps and ground truth need to be considered. Many organizations may update their maps on a regular cycle, while others may take decades. Recent developments in geosocial media and remote sensing have been targeted at addressing the problem of updating basemaps for this reason (Arai and Shikada, 2001).

Accuracy and Uncertainty

Issues of accuracy and uncertainty almost always need to be addressed when basemaps are developed, or when they are reconciled. Again, this is a topic of long-standing concern in the geographic information sciences (Ahlqvist, 2004; Ahlqvist et al., 2000; Guo et al., 2008; Hunter and Goodchild, 1993; Jones et al., 2008; Liu et al., 2009b; Prager, 2007; Spielman et al., 2014; Voudouris, 2010; Wieczorek et al., 2004). Recent developments have focused on map-matching as a technique for (automatically) performing this (Drummond, 1995; Greenfeld, 2002; McKenzie et al., 2013; Power et al., 2000; Pyo et al., 2001; Quddus et al., 2007; Sobolevsky et al., 2013; Yin and Wolfson, 2004). Other techniques are focused on crowdsourcing the problem (Elwood et al., 2013; Fritz et al., 2009; Gao et al., 2011).

Geocoding

Geocoding is a special case for georeferencing. It involves the conversion of place name data (or sometimes other address-based attribute data) into location data types (points, polygons, lines, objects). For some countries, address systems have been developed to perform this on a quasi-automatic basis (the United States' zone improvement plan (ZIP) code +4 system, or the United Kingdom's Ordnance Survey's postal code system are examples). However, in many places in the world, such systems are not in place and many replicated geocodes or variable vernaculars must be negotiated. This becomes even more problematic when such data present in multiple languages and alphabets. Moreover, geocoders developed to machine-learn resolution schemes are often proprietary. As in other cases, this can also be semantically specific and domain specific (Larsson, 2014). Recently, schemes have been developed to produce universal geocoding (geonames, for example), although this is still in relative infancy (Goldberg, 2011).

VISUALIZATION

Visualization is a critical component of most information systems, and of GIS, in particular, as it serves as the *interface* to the data, as the main *interactive modality* for interacting with the system, and as a central *communication medium* for the system (Card et al., 1983). Most users of the system are unlikely to interact directly with the underlying data and in many cases the visual interface and the user experience (UX) (Garrett, 2010) that it provides *is* the system.

Cartography

The mainstay of both the visual interface to the observatory system and the interaction scheme for making extensible use of its functionality as a planning support system or decision support system will be cartography. Details of what could, should or ought to be included in the cartographic design of the system are perhaps voluminous in their axes of consideration. At a minimum, and given the immediately known needs of the observatory, they should include: (1) boundaries (Pundt and Brinkkötter-Runde, 2000); (2) networks and relationships (Okabe et al., 1992; Okabe et al., 2006b); (3) surfaces and/or fields (whether as dynamically generated surfaces sourced from a strong GIS, or sampled surfaces in raster or image form) (MacEachren and Davidson, 1987); (4) attribute display (Leitner and Buttenfield, 2000; Volta and Egenhofer, 1993); and (5) layering by data, feature class and particularly by theme (population, trade, economy, finance, environment, transport, sociology and so on) (Foody, 1999). As with most conventional Web-based cartography, the system should also accommodate (6) linking and brushing between datasets, data types, and view windows directly through the interface (Cook et al., 1997).

Visualization for Change and Process

Time Much of the data to be displayed and exchanged via the observatory may have historical components, future components, or may be tied or allied to particular processes and policies with change attributes. It is therefore critical that the visualization design accommodate this. However, as noted above, most GIS are not well equipped to handle temporal components of data beyond their attribute cases, and even less well equipped to treat *spatiotemporal* data (Andrienko et al., 2000; MacEachren, 1992). Strategies for tackling this at the data model scheme are discussed above. There are, also, several strategies for visualizing change on Web-based GIS, including animation schemes (Harrower, 2003; Ogao and Kraak, 2002), using dithering and change vectors (Acevedo and Masuoka, 1997; Ehlschlaeger et al., 1997), transition probabilities (Logsdon et al., 1996); rhythms and motifs in timing (Edsall et al., 2000); interactive timeline scrubbing and data entry schemes (Shepherd, 1995), space–time transformation of GIS geometries (Ahmed and Miller, 2007), and space–time paths for trajectory data (Aigner et al., 2007; Chen et al., 2011; Kwan and Lee, 2004).

Scaling Given the multiscale focus of ADB's interests (world, nation, region, city, town, locality, neighborhood), it is also critical that the visualization scheme be sensitive to, responsive to, and flexible relative to scale. This can be accommodated at a simple level using zooming and zoom-dependent data abstraction (that is, features only relevant at a particular scale appear only at that zoom level), which is easily accomplished using conventional tiling schemes (Liu et al., 2007), *Leaflet* being the most commonly used (Crickard III, 2014; Derrough, 2013). Tiling of this nature, while (and sometimes because, particularly when datasets are complicated and large in volume) visually oriented, can have significant impacts on load balancing on the computational side of the system (Fox and Pierce, 2009), and so the choice of fetching schemes and caching (Kang et al., 2001; Talbot and Talbot, 2013), topology between tiles and patches (Li et al., 2009), *and* rendering options (Liu et al., 2013; Sorokine, 2007; Zhang and You, 2010) for the tiler need to be carefully considered (Lee et al., 2002; Li et al., 2009).

Processes Because of ADB's initiatives on cross-border factors, it is critical that the observatory develop visual schemes for handling flow, diffusion and movement. Traditionally, flow has been accommodated with cartographic techniques for representing line–link relationships, for generalizing lines, for adding detail and enhancing lines, for expanding and shrinking boundary polygons and so on (see Tobler, 1987; 2005 for an overview). More recent work (Andrienko and Andrienko, 2012) is focused on visualizing dynamic processes implied in flows, spillovers, trade, traffic, diffusion and movement either using animation or through creative revising of traditional line–link static relationship representations. These include ringmaps (Battersby et al., 2011; Zhao et al., 2008), velocity and diffusion fields (Blaise and Dudek, 2013), trajectories (Demšar and Virrantaus, 2010), sequencing and events (Vrotsou et al., 2009), routing (Liu et al., 2011), and dynamic bounding (Murray et al., 2012).

COMPUTING

Several computing considerations also present with unique, or at least special, relevance for GIS-based observatories.

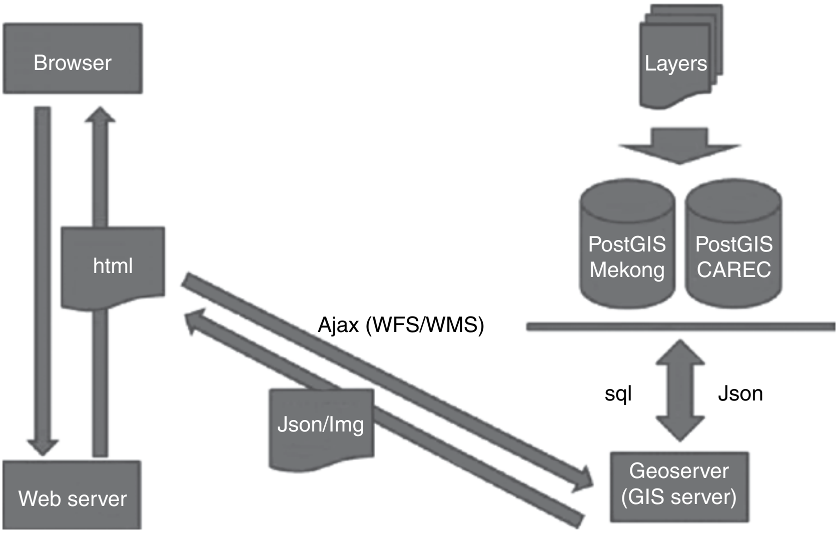
Application Programming Interfaces Much of this is already discussed above in the section relating to visualization schemes for development. However, there should be careful consideration of application programming interface (API) standards, particularly for the computing components of the observatory. In particular, should the observatory be based on existing commercial and off-the-shelf software, or on mashups via widely available Web mapping APIs from major search companies (Lee, 2009; Miller, 2006), the peculiarities of those APIs will need to be considered in the *systematic* design of the observatory, as all other users and uses will have to negotiate them. Another option may be to base the observatory on free and open-source APIs. Several such APIs are available for mapping (Ames et al., 2007; Chow, 2008), or can be adapted from remote-sensing data handling. However, increasingly there are robust API suites available as free and open-source for either GIS specifically (Warmerdam, 2008), or based around existing spatial database APIs. Increasingly, such APIs are being developed for 'big data' and 'big data access' computing (Anselin et al., 2006). In particular, much of the activity in this area is focused on (1) service-oriented architectures (Coetzee and Bishop, 1998; Kim and Kim, 2002; Paul and Ghosh, 2006; Sha and Xie, 2010) (and Web services especially (Anselin et al., 2006; Sayar et al., 2006)), and (2) high-performance computing on distributed networks.

Virtualization, mirroring and distribution Much of the functionality of the system becomes critically dependent on computing when it is published and used in real time (Zhang and Li, 2005). This presents several computational challenges that are sometimes intertwined with the system software but at other times a function of the base computing and networking on which the system functions. In particular, a dedicated strategy must be considered when implementing the observatory, to consider virtualization, mirroring and distribution. Virtualization refers to the need to provide a duplicate experience for each access and each user of the system, regardless of the load that the system is enduring. For this reason, the system may be served from multiple sites. This can be complex when dealing with GIS-based systems; however, as data exchanges are often large in size and rapid in transactional update, data may be hosted in different physical locations and databases, and the system is likely to be under continual update with requirements for reconciling those dynamics. Mirroring refers to the need to host (or serve) data from multiple sites, so that many users can access them, or because particular data owners may need or prefer to have them located in particular physical locations or configurations. Distribution refers to both the distributed nature of users (and their media for access, particularly if they are accessing the system via *mobile devices*), data, but also of the data processing required by such systems. Recent developments in this area have seen much of the commercial and off-the-shelf architecture migrating to commercial distributed computing and virtualization services (Blower, 2010). Much of ArcGIS functionality is now available within Amazon Web Services and its Elastic Compute (EC2) resources (Shao et al., 2011), for example, and among academic GIS there is a movement to replicate this functionality in free and open-source form via cyberinfrastructure (Wang, 2010; Wang et al., 2013), with some tie-in to commercial resources (Microsoft's Azure platform, for example (Behzad et al., 2011)). This is not as easy as copying systems to cloud computing platforms, however, as it often requires specific treatment of spatial data organization (Papadopoulos and Katsaros, 2011) and access atop those resources (Cary et al., 2010; Wang et al., 2009). Increasingly, there is a recognition that fundamental operators for GIS and related spatial data query may also need to be treated specially in cloud contexts (Agarwal et al., 2012), and there is a need to rethink spatial analysis (particularly on big data and distributed big data) in a cloud environment (Rezgui et al., 2013). Other developments have seen the separation of geoprocessing functionality (basic operators, spatial analyses (Kerry and Hawick, 1998), database processing (Frye and McKenney, 2015) (via MapReduce and Hadoop for GIS, in particular (Aji et al., 2013; Dittrich and Quiané-Ruiz, 2012; Liu et al., 2009a; Wang and Wang, 2010; Weng and Liu, 2013)), and update functions (Müller et al., 2013) and so on) to high-performance computing schemes (Stojanovic and Stojanovic, 2013). This, in turn, then creates the necessity for high-performance networking considerations that can keep pace with the data exchange requirements from a distributed system. Networking becomes critical, in particular, when the system needs to offload geoprocessing (Wolf and Howe, 2009) while also handling asynchronous update (Rodrigues and Rodrigues, 2009), by human users as well as Web services (Yang et al., 2010) and sensor networks that might stream data to the system (Gadea et al., 2010).

Appendix 4 Details and data related to Asian Regional Integration Observatory with Greater Mekong Subregion/Association of Southeast Asian Nations Economic Community Cluster Demonstration (also Central Asian Regional Economic Cooperation Demonstration)

1 SYSTEM DESIGN

The platform is built on a general Web-GIS structure. Thematic socioeconomic datasets are organized as GIS layers and stored in a PostgreSQL database. The database has a GIS application layer, and PostGIS, as extension of the standard database to process spatial queries. GeoServer is used as GIS server to receive hypertext transfer protocol (HTTP) queries from the browser. It decodes the queries for vector or image layers, requests the data from the database, and passes the result back to the browser. The Web server is the component that deals with the HTTP query on the interface of the website. It returns the webpage in HTML format as well as the style file in cascading style sheets (CSS) format and browser-side code in JavaScript. The JavaScript code helps to implement the interactions and to compose a correct query for the thematic maps (see Figure A4.1).



Notes: CAREC = Central Asian Regional Economic Cooperation; GIS = geographic information systems; html = hypertext markup language; Img = image; Json = Java Script Object Notation; sql = structure query language; WFS = Web Feature Service; WMS = Web Map Service.

Source: Fu (2015).

Figure A4.1 System structure of observatory

2 INDICATORS

Due to the expected data availability issue, the project confines itself to 14 critical indicators: population, GDP, employment, wage levels, consumption, productivity, poverty level, transportation accessibility, transportation cost, land use, product space, trade and value-added flows, sector cluster location, and R&D expenditure.

3 DATA SOURCE

The main data sources of socioeconomic data are government statistics agencies (see Table A4.1).

As socioeconomic data is not detailed enough to identify cluster locations, information on industrial zones in GMS and CAREC was also collected as a complementation source. Survey reports from Japan

Table A4.1 Government statistics agencies

Country	Agency
Cambodia	National Institute of Statistics
PRC	National Bureau of Statistics
Lao PDR	Statistics Bureau
Myanmar	Central Statistical Organization
Myanmar	Myanmar Industries Association
Thailand	National Statistical Office
Viet Nam	General Statistics Office

Notes: PRC = People's Republic of China; Lao PDR = Lao People's Democratic Republic.

Source: Author.

External Trade Organization and Vietnam Investment Network are major sources.

Detailed trade flows in specific sectors and products can also help to narrow down the searching scope on industrial clusters. The UN Commodity Trade Statistics Database (COMTRADE) and Corridor Performance Measurement and Monitoring database are used. Corridor Performance Measurement and Monitoring is hosted by ADB. The project samples cargo flows among CAREC countries every month to record the type of commodity, origin, destination and intermediate cities, total weight of commodity, reported value to customs and so on. By identifying the origin cities of one commodity, we can assume that the commodity is produced in the city or its nearby area to narrow down searching scope.

4 DATA AVAILABILITY

For the data intensive knowledge platform as an observatory, data availability is affected in three dimensions: indicator, geographic unit, and time.

Data accessibility is critical in both GMS and CAREC countries. In practice, there are several data gaps:

1. No indicator data at a certain administrative level. Usually countries have a value at country level but no more detailed values for its provinces. For instance, Myanmar is still in the process of conducting the

2014 census, which is the first census in the past 30 years. Thus no reliable fundamental demographic indicators are available.

2. Different countries have different statistics definitions and/or standards on an indicator. For instance, the Bureau of Statistics in PRC only counts firms with RMB 5 million ($807 000) annual turnover, above which firms are surveyed and sampled.
3. Monetary indicators in different countries are usually presented in own currency. The value is also not adjusted to constant price.
4. Language is a challenge as GMS and CAREC countries do not use English as the official language. Although yearbooks usually have an English version, some surveys and reports are written in the local language.

The administrative unit is also a critical issue. Usually, socioeconomic indicators are aggregated by administrative boundaries. A small geographic unit is better to gain finer spatial knowledge. However, data is also more difficult to access for smaller geographic units. At present, the target administrative and/or geographic unit for presenting data is set at provincial level for balancing data accessibility and spatial detail. Table A4.2 shows detailed information about the geographic unit selected for each GMS country.

Time is the third critical dimension. To collect evidence on the process of clustering, time series data is required. As most socioeconomic indicators are reported annually, a year is the basic time unit in the observatory. The time span that this observatory tries to cover is between 2007 and 2012. The observatory also adds the most recent

Table A4.2 Geographic unit in Greater Mekong Subregion countries

Country	Unit	Administrative level
Cambodia	Province	Province
PRC	Prefecture	Between province and county
Lao PDR	Province	Province
Myanmar	State/Division	Province
Thailand	Changwat	Province
Viet Nam	Province	Province

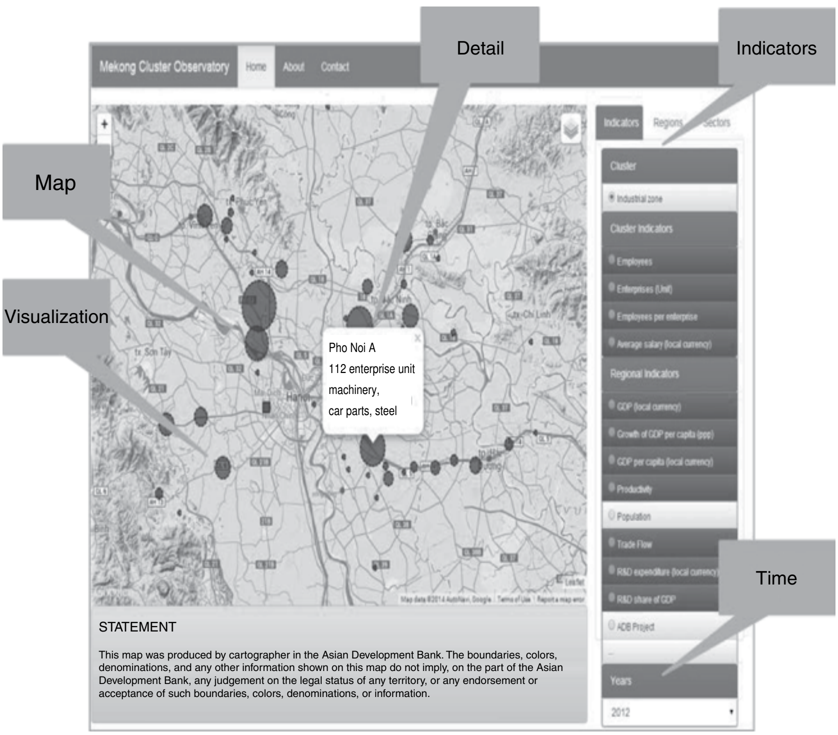
Notes: PRC = People's Republic of China; Lao PDR = Lao People's Democratic Republic.

Source: Author.

survey on GMS and CAREC key industrial zones conducted by ADB in 2014/15.

5 INTERFACE

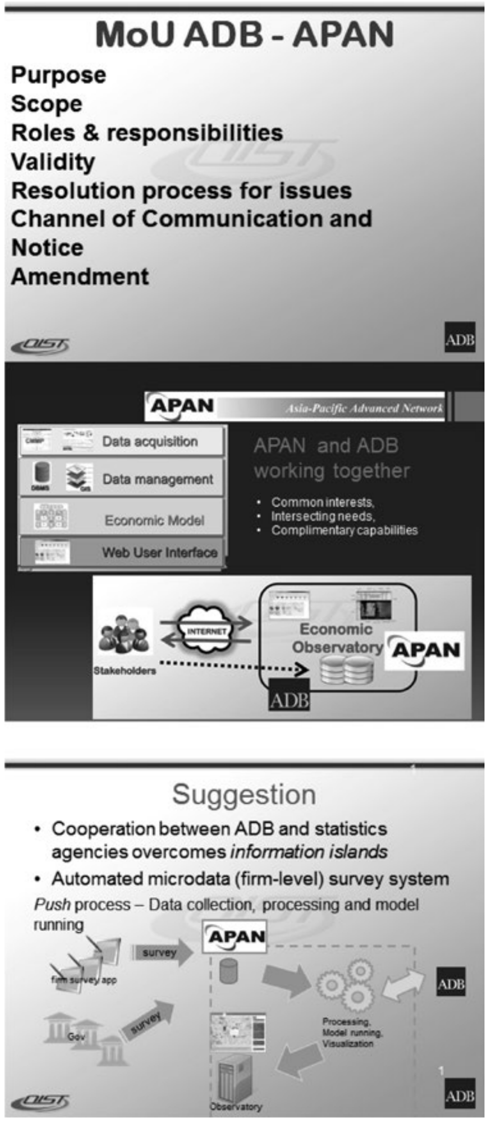
The user interface, as the Web page, is composed of the digital map on the left and the indicator selection column on the right (see Figure A4.2). The map has basic GIS functions, including zoom in and out, pan, and interaction with markers. Data of the selected indicator will be visualized as circle markers in the map. The size of the circle represents the value. Once data is



Notes: ADB = Asian Development Bank; GDP = gross domestic product; R&D = research and development.

Source: Fu (2015).

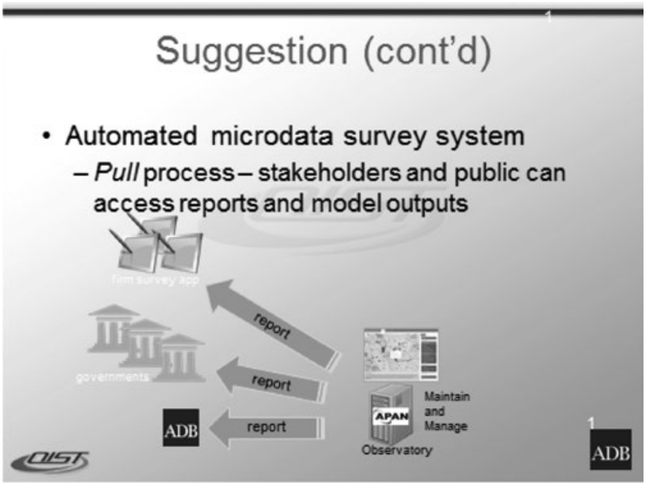
Figure A4.2 User interface of Mekong Cluster Observatory



Notes: ADB = Asian Development Bank; APAN = Asian Pacific Advanced Network; cont'd = continued; MoU = memorandum of understanding.

Source: Author.

Figure A4.3 Asian Development Bank–Asia Pacific Advanced Network Memorandum of Understanding outline



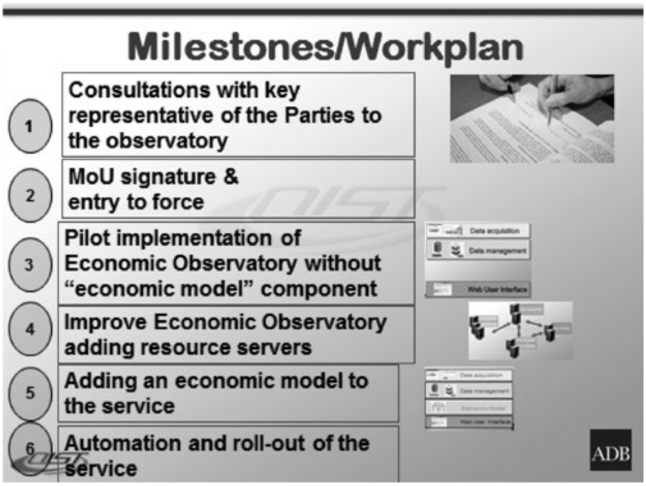


Figure A4.3 (continued)

loaded and visualized, users can click the markers to access the exact value and other relative information in the pop-up window.

For the indicator column, the visualization design helps to identify data availability: a dark-shaded bar (for example 'Employees') means that data for the selected indicator at the current year is not available for all countries. A light-shaded bar (for example 'Population') means that data for the selected indicator is available for at least one country.

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