

A participatory approach to tracking system transformation in clusters and innovation ecosystems—Evolving practice in Sweden’s Vinnväxt programme

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Abstract

For decades, cluster initiatives and funding programmes have been used as instruments of industrial and innovation policy—addressing system failures by strengthening linkages among actors, fostering innovation, and developing more effective innovation systems. More recently, a growing segment of these initiatives are also focused on driving system-level transformation and contributing to broader societal benefits. This segment is characterized by larger-scale and longer-term strategic efforts involving a variety of stakeholders across different parts of society, aimed at contributing to addressing societal challenges. These characteristics are shared with the emerging frame of transformative innovation policy, which highlights the importance of embedded practices of learning and reflexivity to enable continuous monitoring of progress and inform and adapt the direction of systemic change processes—requiring new approaches to governance and evaluation. Despite deep experience with implementing cluster programmes and other systemic innovation policy instruments, practitioners still struggle with monitoring and evaluation. Current approaches focus on evidencing strengthened innovation (and economic effects) on the level of firms and research actors, and fail to capture contributions on the level of the broader system. This article presents an evolving approach for tracking system transformation in clusters and collaborative innovation initiatives. Through an interactive, co-development process with initiatives in the Swedish Vinnväxt programme, this research proposes a definition and set of system effect categories for cluster initiatives. It tests a participatory approach for tracking their contribution to system-level change over time, providing an initial case on which to build and apply in other transformative innovation programmes.

Key words: tracking system transformation; cluster evaluation; innovation ecosystems; collaborative innovation initiatives; system-level effects; participatory evaluation approach

1. Introduction

The use of cluster initiatives and other collaborative innovation initiatives as instruments of industrial and innovation policy now stretches over several decades. The focus of the cluster policies supporting these initiatives is to address system failures by

strengthening linkages among actors in established clusters. While the hypothesized benefits of strengthened collaboration are typically broader, fostering innovation is at their core, hence a strong link between cluster initiatives and a range of other measures designed to support effective innovation systems. Yet in recent years, we also

observe that cluster initiatives are asked to contribute more than solely providing for stronger economic productivity and competitiveness among firms. On the one hand, the adoption of a strategic regional approach to innovation through smart specialization strategies (S3) (European Commission 2014) has reinforced the dimension of directionality in the discourse around cluster policies. On the other hand, the launch of the United Nations Sustainable Development Goals (SDGs) has helped push industrial and innovation policies to adopt directionality that is focused on addressing complex societal challenges. In turn, this requires the alignment of aims and investments in longer-term systemic efforts.

As a result, we witness a growing segment of cluster initiatives and related policy programmes that are expanding their focus from fostering innovation and firm-level competitiveness, to simultaneously contributing to system-level change processes that will bring broader societal benefits (Wise and Johansson 2012; OECD 2016a, 2016b; Wilson, Konstantynova and Aranguren 2017; European Commission 2019, 2020a, 2020b). This change is reflected in the use of different terminology when describing collaborative initiatives with scope for meeting broader, system-level aims; for example, ‘superclusters’, ‘industrial ecosystems’, and ‘innovation ecosystems’ (ISED Canada 2017; Vinnova 2019; Innovation Norway 2020; European Commission 2020a). Moreover, many policy programmes that support cluster initiatives and/or other types of collaborative action are being adjusted to leverage existing collaborative structures to develop more efficient and attractive system resources (or relations) and to innovate (or transform) the system.

This journey with respect to collaborative initiatives can also be framed in terms of the evolution of innovation policy more generally, which is experiencing a shift in terms of the primary targets of research and innovation investments: from a focus solely on economic growth; towards a focus on tackling societal challenges and generating combined environmental, societal, and economic impacts. This ongoing shift has recently been articulated as the ‘third frame’ for innovation policy, aimed at the transformation of socio-technical systems (Weber and Rohrer 2012; Schot and Steinmueller 2018).

The broader strategic agendas associated with these changes have led to demands for new evaluation approaches to evidence the impacts and values at a system level, leading to the exploration of new practices for evaluating systemic instruments (Arnold 2004; Hummelbrunner 2011; Edler et al. 2012; Magro and Wilson 2013). So-called Transformative Innovation Policies (TIP) are focused on addressing complex societal challenges and come with a number of specific evaluation requirements: the integration of evaluation and learning activities as part of the design and implementation of policies, programmes, and projects; the use of more participatory and inclusive approaches; and the use of a mix of methods and techniques for continually collecting and reflecting on information in order to evidence signs of change and to adapt strategies going forward (Chataway et al. 2017; Boni, Giachi, and Molas-Gallart 2019; Molas-Gallart et al. 2020; Molas-Gallart et al. 2021). As Weber and Rohrer (2012) point out: ‘the long-term character of transformative change, associated with the uncertainty surrounding innovation and change requires a continuous monitoring with respect to progress towards the transformation goals and the development of adaptation strategies. Reflexivity needs to be built into the process of transformative change (Weber and Rohrer 2012: 1044)’.

Recent academic contributions have helped frame the challenges, establishing a framework, principles, and approach for TIP evaluation (Boni, Giachi, and Molas-Gallart 2019; Molas-Gallart et al.

2020, 2021). However, there remains a shortage of research on practical experience with tracking system transformation in innovation programmes. More specifically, while research on the evaluation of cluster initiatives and other collaborative policy programmes has made important recent advances in terms of evidencing the impacts of collaborative and networking dynamics (Aragon et al. 2014; Calignano and Fitjar 2017; Lucena-Piquero and Vicente 2019; Graf and Broekel 2020), there are important gaps in terms of evidencing their contribution to system-level change processes and wider societal outcomes.

This article contributes to addressing these gaps by proposing a definition, key characteristics, and initial set of system effect categories for cluster initiatives and other collaborative innovation initiatives, as well as testing a participatory approach for tracking their contribution to system level change over time. It does this by presenting the results of a 3-year interactive research project with Vinnova’s¹ Vinnväxt programme in Sweden, a transformative innovation programme that is rooted in regional innovation systems and cluster dynamics (activity and place based, and collaborative in nature). By providing insights from practical experience with a participatory approach to tracking system-level effects in Vinnväxt, the research aims to contribute not only to the development of cluster policy evaluation, but also to the broader field of transformative innovation policy evaluation.

Following a review of the conceptual and practical background to the research, Section 3 describes the Vinnväxt case and the research approach. The results are presented and discussed in Section 4, and are followed by conclusions, policy implications, and directions for future research.

2. Conceptual and practical background

2.1 The evolution of innovation policy and its evaluation

Recent academic literature has provided a comprehensive overview of the evolution of innovation policy over the last half-century. Among others, Weber and Rohrer (2012) and Schot and Steinmueller (2018) have discussed how the underlying rationale and assumed model of innovation have influenced policy aims and practices over time. This evolution can be simplified into three frames (Transformative Innovation Policy Consortia 2019; see Figure 1), in each of which there have been parallel changes to innovation policy evaluation in terms of the indicators and methodologies used to measure innovation.

2.1.1 Frame 1: Innovation for growth

In this frame, innovation policy directly addresses a market failure leading to lack of investment in basic scientific research and technological advancement due to the challenges of appropriating the benefits. The underlying understanding of innovation was that it followed a linear path from discovery to commercialization and broader dissemination, and that increased innovation was a motor of economic growth. Policy instruments aimed at stimulating knowledge generation (e.g. through R&D subsidies and tax credits), developing effective regulatory and educational policy, and building awareness of the importance of technological advancement. Evaluation of Frame 1 innovation policies correspondingly focused on statistical measures of R&D inputs (in terms of funding sources, performers, and personnel) and outputs (in terms of articles, patents,

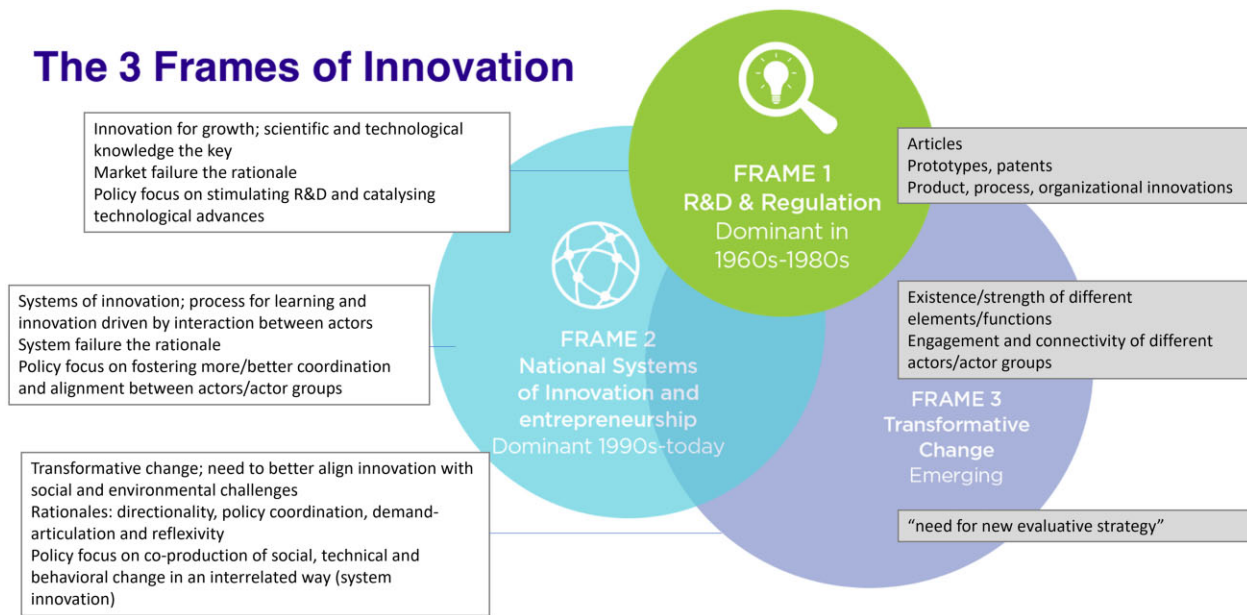


Figure 1. Three frames of innovation: Characteristics and evaluation. Source: TIPC (2019) and authors' own elaboration.

and different kinds of innovation), typically using Frascati Manual approaches for collecting and reporting data (OECD 2015).

2.1.2 Frame 2: Systems of innovation

The underlying rationale for the second frame of innovation policy, prevalent from the 1980s until today, is the need to address system failures reflected in the lack of linkages, mutual learning, and use of knowledge between different actors and actor groups. The underlying understanding of innovation is that it is fostered through regular interaction and feedback loops between actors (government, science, and industry) in a geographically, sectoral, or technologically defined 'system of innovation'. Policy instruments thus aim at developing linkages, interactive learning, and coordination/alignment between actors in order to stimulate knowledge utilization, innovation, and entrepreneurship, which in turn fosters competitiveness and economic growth. In this frame, cluster initiatives can be a key policy instrument, and we begin observing the rise of systemic interventions with policy actions focusing on the level of the innovation system (Smits and Kuhlmann 2004; Wieczorek and Hekkert 2012). This expanded framing of innovation policy is also reflected in evaluation practices. The *Oslo Manual* (first published in 1992) addressed the need to reflect how innovation systems operate, using qualitative approaches (e.g. the Community Innovation Survey) to complement existing statistical approaches. It also introduced new measures to capture innovation capabilities, the role of linkages with other firms and institutions in the innovation process, and external factors influencing innovation in firms, as well as measures for innovation activities and outcomes (OECD/Eurostat 2018).

2.1.3 Frame 3: Transformative change

The underlying rationale for this emerging third frame of innovation policy is the need to address failures in directionality, policy coordination, demand articulation, and reflexivity that are necessary elements for solving complex societal challenges. Policy instruments seek to foster new connections between systems, providing 'spaces

for experimentation' and co-producing solutions that can be expanded to enable broader socio-technical system change (e.g. through missions and challenge competitions or challenge-driven innovation programmes) (Schot et al. 2019). The evaluation of these (emerging) policy instruments is underdeveloped. We witness increasing attention to monitoring transformative outcomes in the form of changes in behaviour, relationships, activities or actions of people, groups, and organizations. We also witness increasing use of continuous monitoring and evaluation to support learning and reflexivity and change the way people think about and act towards future changes (Earl, Carden and Smutylo 2001; Arnold et al. 2018; Schot et al. 2019). In the context of these emerging developments, recent research has highlighted the need for new evaluative strategies and approaches for transformative innovation policy (Boni, Giachi, and Molas-Gallart 2019; Molas-Gallart et al. 2020).

2.2 Evaluating transformative innovation programmes: The challenge of tracking system-level change

The complexity of objectives and the long-term nature of transformative innovation programmes create new requirements for the role of and approach to evaluation (Arnold 2004; Hummelbrunner 2011; Magro and Wilson 2013, 2019; Caffrey and Munro 2017; Boni, Giachi, and Molas-Gallart 2019; Molas-Gallart et al. 2020, 2021). In addition to monitoring efficiency, effectiveness, and relevance, evaluation of transformative innovation programmes also needs to monitor progress and inform the direction of the systemic change process underway (Patton 2016; Arnold et al. 2018; Boni, Giachi, and Molas-Gallart 2019; Molas-Gallart et al. 2020, 2021). In this regard, so-called developmental evaluations use mixed methods, try to understand the context of the initiative, and evidence outcomes and impacts over time. They may require working with stakeholders to co-develop sets of performance metrics that are specific to the initiative and that use new means of gathering, storing, and making sense of data to ensure that the evaluation results support further development (Patton 2016; OECD 2017). These aspects

overlap to a certain extent with TIP evaluation principles (Boni, Giachi, and Molas-Gallart 2019; Molas-Gallart et al. 2020, 2021), which stress mixed methods, participatory approaches, and the integration of evaluation as a formative and strategic dimension of a project, programme, or policy process to support learning, evidence system-level changes, and inform strategic choices over time (see Table 1).

Yet there are key differences between developmental evaluation and the emergent ‘formative approach to TIP evaluation’ developed in the Transformative Innovation Policy Consortia (TIPC). Developmental evaluation is designed to capture system dynamics to provide context-specific understanding that guides ongoing innovation and adaptation in dynamic environments (Patton 2006). TIP evaluation, with its strong roots in sustainability transitions literature and the multi-level perspective on socio-technical transitions (Geels 2002, 2010; Geels and Schot 2007), is designed to monitor signs and progression of systemic change in 12 categories of transformative outcomes (Ghosh et al. 2021), in order to enhance reflexivity and learning and potentially trigger changes to experimental policy engagements (Molas-Gallart et al. 2021). Whereas developmental evaluation has an open position on the direction and progression of system development, TIP evaluation monitors the progression of system transformation through stages of niche building, niche expansion and embedding, and opening up and unlocking regimes.

However, both share the perspective that the primary purpose of evaluation is to track (or constructively monitor) the signs of system-level change in real time, and support learning and reflexivity among participants in order to assess the contribution of the initiative to its aims of longer-term systemic transformation (Jansson 2019; Molas-Gallart et al. 2021). Instead of measurable indicators, the signs of change are indicated by, for example, the development of the constellation of actors and interactions among them, the evolution of strategic aims (in relation to broader system-level transitions), and the outcomes that have been affected by the collective

action. The approach to data gathering and analysis (or sense-making) involves participating actors, seeks to include a variety of perspectives, and is embedded in the process of continual strategy development. The results, in the form of contextualized insights and narratives, are used as ‘food for thought’ to be interpreted by the collaborative group in order to guide the agile adjustment of the transformation trajectory (e.g.: same direction or changed path; more or less resources to different areas/experiments; need for different/more actors’ engagement; etc.).

2.3 Cluster policies as instruments of system innovation

For nearly three decades and corresponding with the development of the second frame of innovation policy, regions and countries around the world have employed cluster-based policy programmes as part of their industrial, innovation, and regional development policies (OECD 2007, 2016a). Cluster-based policies are expected to deliver not only higher firm-level innovation and productivity through strengthened knowledge-sharing and collaboration, but also more efficient and competitive regional innovation systems. While cluster initiatives are often seen as focusing on firm-level innovation and growth, cluster policies have often assumed a broader remit in terms of strengthening the local system through collaborative action. They typically bring industry, science, the public sector, and (more occasionally) civil society actors together in participatory processes geared to increasing competitiveness, encouraging diversification, and ensuring resilience.

In recent years, we have witnessed an evolution of cluster policies (Table 2). This has been centred on the increased use of cluster initiatives as intermediaries that can support actions to address a wider range of specific regional and national policy challenges: skills development, entrepreneurship, digitalization, industrial modernization, internationalization, and sustainable development (Wise and Johansson 2012; OECD 2016a, 2016b; Wilson, Konstantynova and Aranguren 2017). In cluster policy programmes around the world, we see the introduction of concepts such as shared value (Porter and

Table 1. Comparison between traditional, developmental, and TIP evaluation

Traditional evaluations...	Developmental evaluations...	TIP evaluations...
Render definitive judgements of success or failure	Provide feedback, generate learning, support direction, or affirm changes in direction	Help to inform and refine the transformation process (directionality, societal goals, and system impact)
Measure success against predetermined goals	Develop new measures and monitoring mechanisms as goals emerge and evolve	Use a mix of methods and techniques to assess and contextualize transformative outcomes/signs of change
Position the evaluator outside to assure independence and objectivity	Position evaluations as an internal, team function integrated into action, and ongoing interpretive processes	Evaluation process should be inclusive and participatory; external evaluators ensure different perspectives are heard
Design the evaluation based on linear cause-effect logic models	Design the evaluation to capture system dynamics, interdependencies, and emergent interconnections	Use a flexible theory of change (which is revisited and redefined) and a nested approach to assess multiple levels
Aim to produce generalizable findings across time and space	Aim to produce context-specific understandings that inform ongoing innovation	Aim is to help assess if the policy/initiative is contributing to move towards its objectives
Accountability focused on and directed to external authorities and funders	Accountability focused on learning and responding to what is unfolding	Integrate evaluation with policy design and implementation; more active role of funding agencies in monitoring activities and making interventions/initiating new experiments
Evaluator controls the evaluation and determines the design based on their perspective of what is important	Evaluator collaborates in the change efforts to design a process that matches philosophically and organizationally	
Evaluation engenders fear of failure	Evaluation supports hunger for learning	Evaluation supports learning and reflexivity

Source: Based on Patton (2006), Chataway et al. (2017), Boni et al. (2019) and Molas-Gallart et al. (2020).

Table 2. Evolution of cluster policy

From:	To:
Aims focused primarily on participating firms' innovation, economic performance, and industrial competitiveness	Increased focus on renewal, territorial system competitiveness, addressing shared challenges, and delivering value to society
Facilitating collaboration among a local or regional scope of actors within a cluster/cluster initiative	Also acting as a change agent for a broader and more open system of actors across sectors and geographies
Sharing knowledge and strategic intelligence among participating actors to inspire innovation and guide future actions	Serving as the voice of industry and partnering with the public sector to guide long-term strategic action

Source: Own elaboration.

Kramer 2011; Alberti and Belfanti 2019) and system leadership (Nelson and Jenkins 2016; Dreier, Nabarro and Nelson 2019), as well as the introduction of new selection criteria and capacity building activities related to addressing the SDGs. More recently, we see clusters taking on an active role in response to the COVID-19 crisis,² both to address urgent supply chain issues as well as to support longer-term recovery strategies. Indeed, cluster-based policy programmes (and particular cluster initiatives) are increasingly recognized as a policy instrument that can be leveraged to mobilize actors together in a common strategic direction, aimed at achieving broader industrial transformation and system innovation (OECD 2016b; European Commission 2019, 2020a, 2020b).

2.4 Evaluating cluster policies as instruments of system-level change

Despite deep experience with cluster policy implementation over several decades, practitioners still struggle with monitoring and evaluation of these systemic instruments (Smith, Wilson and Wise 2020). Evaluation practice maintains a focus on indicators of innovation and firm-level economic performance and often fails to capture the development of collaborative strength and the contributions it can make to wider system-level impacts. Yet, we witness increasing interest in exploring and tracking the contribution of collaborative initiatives to broader system-level effects. Examples include the analysis of economic ripple effects of clusters in the Norwegian Innovation Clusters programme (Røtnes et al. 2017), attempts to apply Porter and Kramer's (2011) shared value concept to cluster dynamics (Alberti and Belfanti 2019), and the exploration of Strategic Innovation Programmes' contribution to system transitions in Sweden (Åström and Arnold 2020; Åström, Arnold and Olsson 2020).

Exploring these approaches becomes even more important as cluster policies evolve towards a tool being used to serve transformative innovation paradigms and a range of wider policy goals. In this sense, there is a need to experiment with and develop approaches to evaluation that support both the tracking and contextualization of signs of systemic change being stimulated by these collaborative instruments, as well as the use of this information for learning and reflexivity. Building on emerging developments in both cluster and innovation programme evaluations, this article analyses a practical case that has developed and tested new participatory approaches to tracking transformation through embedding a developmental evaluation approach in a specific policy context. Vinnväxt is a long-term policy programme in Sweden with the aim of ensuring transformational change within innovation systems, and with collaboration and a cluster methodology at its core. As such, this was a valuable opportunity to develop a frame for capturing the system level

impacts of such investments that could inform further research and evaluation approaches in both the cluster and the TIP fields.

3. Empirical context and methodology

3.1 The Vinnväxt case: From developing innovation systems to guiding system transformation

The Vinnväxt programme is run by Sweden's Innovation Agency Vinnova and was initially launched in 2001. Since then, it has promoted sustainable growth in Swedish regions by bringing together triple helix actors in long-term, collaborative initiatives designed to contribute to the development of internationally competitive regional innovation environments in specific growth areas. The programme provides funding and other support services over a period of 10 years (or longer).³ This can be used for institutional development and needs-driven R&D to strengthen cutting-edge competences in the various innovation environments.

The programme implementation approach has included active strategic dialogue between Vinnova (the funding agency) and the funded Vinnväxt initiatives. It also develops activities to support 'strategic learning' (i.e. to continuously follow and reflect on developments over time to inform the direction of collective action going forward). Indeed, at least 5% of Vinnova funding should be used for strategic and reflective learning, providing external 'constructively critical' coaching and supporting analysis for the initiative's management (and for the board/steering group), as well as documenting the story of the initiative and the effects it has had on the system. Strategic learning tasks are conducted by action researchers or consultants and serve as a complement to the programme's monitoring and evaluation system.

In addition to the continuous evaluation provided by the action researchers and/or consultants hired by each Vinnväxt initiative, Vinnova implements monitoring and evaluation activities comprised of four main elements:

- Ex-ante evaluation (based on the proposal submitted to the open call), comprised of a 'base report' (including the initiative's theory of change and initial 3-year action plan and budget)
- Regular monitoring through annual reports submitted by initiative leaders, regular dialogues with programme management, and experience exchange workshops
- Interim evaluations conducted by external international evaluators after the 3rd and 6th year of the contract period
- Ex-post evaluations (of system impacts) conducted 2 years after the end of the contract period

Based on an in-depth programme development effort in 2001, Vinnväxt reflects an operationalization of the systems of innovation policy frame, yet also includes elements of the transformative change frame (Schot and Steinmueller 2018, TIPIC 2019):

- Alignment between objectives to foster innovation and to address social and environmental challenges (*Vinnväxt focus on sustainable growth*)
- Engagement of an open, dynamic system of actors to contribute to system-level changes (*Vinnväxt expectation for continuous mobilization of all Triple Helix actors and for coordinated action, e.g., to create infrastructure and societal services*)
- Directionality and long-term perspective (*Vinnväxt funding for a 10-year period—guided by a clear strategic direction for the collaborative action from the start*)
- Interactive approach to programme implementation and governance (*Vinnväxt programme team taking the role as active funders/investors*)
- A focus on formative evaluation (*Vinnväxt processes of continuous and embedded ‘strategic learning’—for development of the individual initiatives and of the programme/policy*)

The inclusive approach to long-term processes aimed at addressing societal challenges and system level development, supported by a unique combination of activities to support strategic learning and reflection make Vinnväxt an ideal case to explore the contribution of collaborative initiatives to system transformation and to begin developing a common language and approach.

Over time, the Vinnväxt programme has developed an increasing focus on the innovation environments’ contribution to restructuring and renewal, with the 2030 Agenda and the SDGs as a guiding framework for transformation (Kontigo 2016). This is reflected in the programme description and call texts, as well as evolving monitoring and evaluation practices (see Table 3). These demonstrate a clear evolution over time in various dimensions, which together move the focus from one of developing innovation systems (Frame 2) to one of realizing transformative change (Frame 3).

Specifically, the *programme objectives and characteristics* shift from ‘sustainable growth and more effective and attractive regional innovation systems’, to ‘renewal and contributing to social and environmental (in addition to economic) objectives’, to ‘having SDGs as the driver for collective action’. The *selection criteria* shift from strategic development and improved international attractiveness for ‘existing areas of strength’ to long-term strategies for ‘renewal and transformation’ and resilience through the capacity for continual system-level change. They also demonstrate progressively increasing expectations on the role of the initiative’s leadership, from ‘providing a strategic direction and facilitating linkages within the initiative’, to ‘mobilising resources and creating increased leverage through connections with other actors and initiatives in the system on regional, national and international levels’, to proactively taking on the role of ‘catalyst’ and ‘system integrator’. This also demonstrates increasing expectations for policy coordination.

In terms of the programme’s *effect logic/expected results*, there is a shift from ‘strengthened research and education, more effective interactive learning and increased collaborative action for company competitiveness’ to ‘effective regional and thematic innovation systems with the ability to interact for change and innovation, and equipped for future challenges’ and to ‘contributing to Agenda 2030 goals’. Finally, the evolution in objectives and expected results is mirrored in an evolution of *strategic learning practices* (including monitoring and evaluation). These have built from a strong base of interactive dialog and action research to integrate more elaborated reporting/monitoring processes and an increased focus on capturing the initiative’s contribution to system-level changes and impacts

(including the research project reported here which was focused on developing a more harmonized understanding and systematic approach to tracking transformation over time).

As mentioned above, annual reports comprise one part of the overall monitoring and evaluation system for Vinnväxt. Starting in 2009, more detailed annual reporting (including a web survey) was introduced to capture information on actor-level engagement and outputs (including firm-level innovation activities), as well as system-level developments (including new companies, investments, etc.). Reporting practices continued to be developed over the following years to gather information on Vinnväxt initiatives’ contribution to system-level investments and dynamics. From 2012, the Vinnväxt programme management began developing the ‘layer model’ (Figure 2), a conceptual model to illustrate the different layers of effects that are catalysed by Vinnväxt initiatives.

The layers build on each other, such that Layer 1 (which represents the core Vinnväxt funding from Vinnova and regional actors) is leveraged to initiate new collaborative activities and mobilize additional project funding, either directly to the Vinnväxt initiative (Layer 2), or to other actors supported by the initiative (Layer 3). Layer 4 is a listing of key events and system-level developments that can be linked to the financial and human resources mobilized in the first three layers. As such, this ‘layer model’ provides a way of documenting the ripple effects to which the collaborative Vinnväxt initiatives contribute and capturing the development of the innovation ecosystem over time.

To document Layer 4, Vinnväxt initiatives are asked to list key events (or developments) in the innovation system (e.g. new establishments or investments, research infrastructures), explaining what role the initiative has had in realizing the event. This element of annual reporting has proven challenging, as Vinnväxt initiatives have different interpretations of what qualifies as a key system-level development and varied approaches to developing their annual lists. It is also difficult to follow and communicate progress over time, to compare and learn from other Vinnväxt initiatives, and to highlight the contributions that Vinnväxt initiatives make to broader system-level transformations.

In recognition of these challenges, Vinnväxt programme management initiated a meta-level action research project focused on developing a common and theoretically-grounded understanding of system-level effects, as well as a more structured and harmonized method for evidencing system-level changes over time. This would, in turn, inform and support Vinnväxt initiatives’ strategic efforts, enable better use of data collected through annual reports, and foster increased visibility of Vinnväxt initiatives’ contributions to broader system-level transformation.

3.2 Research approach: Leveraging the system of actors to track system-Level change

The project has followed an interactive research approach, built on a continuous joint learning process between researcher and participant (Svensson, Ellström and Brulin 2007; Svensson, Brulin and Ellström 2015), and employing qualitative methods for data collection (document analysis, interviews, focus groups). The research has involved 60–70 stakeholders (Vinnväxt initiative leaders and their teams, the network of action researchers working with each Vinnväxt initiative, Vinnova programme management, and a broader international network of researchers, policymakers, and

Table 3. Evolution of the Vinnväxt programme 2001–19^a

Vinnväxt generation start date	2003 (Two-phased call open Jan–April and July–Dec 2002)	2005/08 (Two-phased call open June–Oct 2005 and Dec 2005–March 2006; at end of 2007, a third phase upgraded to ‘full Vinnväxt’)	2013 (Call open Jan–May 2013)	2019 (Call open Oct 2017–July 2018, with thematic seminars and dialogue to support regional mobilization over the period)
Programme objectives (headline)	<ul style="list-style-type: none"> Promote sustainable growth and international competitiveness based on high-quality applied research and education in future growth areas Develop effective regional innovation systems 	<p>Building on the same overall programme objectives (see left). . .</p> <ul style="list-style-type: none"> Identify and support emerging areas of growth (filling out the Vinnväxt portfolio with growth initiatives at different stages of development) 	<p>Build and develop innovation environments in strategic areas of importance for sustainable growth in regions</p>	<ul style="list-style-type: none"> Create sustainable growth in regions by developing internationally attractive innovation environments in specific areas of strength Sustainable Development Goals (SDGs) and gender equality perspectives should be embedded in the vision and working approach, as well as a driving force for renewal and transformation
(New) characteristics	<ul style="list-style-type: none"> Breaking new ground through a new type of call and funding approach; innovation systems in practice Selection based on competition (challenging existing approach to regional policy) Long-term (10-year) investment (regional and national actors together) Triple Helix leadership and collaboration (strong involvement of politicians/civil servants unique) Prioritization and mobilization of resources in functional regions 	<ul style="list-style-type: none"> After two calls focusing on existing regional strongholds, this call focused on ‘embryonic’ or emerging regional areas of growth Initiatives with high growth potential yet viewed as ‘risky investments’ Initiatives with a credible leadership, yet where stakeholder collaboration and development organization are only partially in place (to be supported by expanded programme services) Taking on a portfolio approach (different ‘classes’ of Vinnväxt initiatives) 	<ul style="list-style-type: none"> Focused on growth and renewal of an existing area of strength Investing in mature innovation environments with an ambition for renewal/pursuit of new paths Increased focus on green and social sustainability; challenge driven Introduction of a flexible financing model; Vinnova financing should be used to create leverage Positioning of Vinnväxt relative to other Vinnova programmes; desire for linkages Relating to Smart Specialization Contributing to Sweden being a leading, internationally attractive country for research and innovation Increased focus on expectations for strategic learning and action research 	<ul style="list-style-type: none"> Agenda 2030 and SDGs used as the guiding light to catalyse renewal and transformation of the innovation environments Strengthened focus on: <ul style="list-style-type: none"> Agenda 2030 (holistic framework for sustainable growth) Regional leadership/governance Gender equality/inclusiveness Connections with other innovation environments and programmes Internationalization Investment in the role of ‘system integrators’ who guide and contribute to renewal and transformation Increased focus on system impacts
Selection criteria	<p>Credibility and relevance of:</p> <ul style="list-style-type: none"> Strategic idea Potential for future growth (coupled to sustainable development) Leveraging local/regional knowledge and initiative (geographic proximity and engagement of various actors) Triple Helix governance and plan for implementation Expected results and foreseen system effects 	<p>Selection process in three steps (idea sketches; 2 years funding; ‘upgrade’ to full Vinnväxt)</p> <ul style="list-style-type: none"> How strategic idea leverages sustainable development and gender equality Contribution to sustainable development and societal challenges, and to more effective innovation system 	<p>Potential</p> <ul style="list-style-type: none"> Current position and potential for renewal and growth (including expected results) <p>Actor constellation</p> <ul style="list-style-type: none"> Composition: breadth (TH+), relevance and engagement of key actors 	<p>Potential</p> <ul style="list-style-type: none"> Through renewal and transformation, potential to contribute to Agenda 2030 Contribution to: more effective innovation system, increased gender equality, stronger national and international linkages Maturity of and collaboration between existing research and industry base <p>Actor Constellation</p> <ul style="list-style-type: none"> Relevance of constellation for targeted area; legitimacy to drive initiative

(continued)

Table 3. Continued

Vinnväxt generation start date	2003	2005/08	2013	2019
	(Two-phased call open Jan–April and July–Dec 2002)	(Two-phased call open June–Oct 2005 and Dec 2005–March 2006; at end of 2007, a third phase upgraded to ‘full Vinnväxt’)	(Call open Jan–May 2013)	(Call open Oct 2017–July 2018, with thematic seminars and dialogue to support regional mobilization over the period)
	<ul style="list-style-type: none"> Prerequisites for and ability to create new research-based knowledge and technology Nature and degree of renewal The people who are leading the initiative and the roles they have Description of the geographic core (what assets in the functional region) Development plan and potential barriers <p>In the third step, initiatives were evaluated on the potential to develop into full-scale Vinnväxt (based on existing criteria)</p>	<ul style="list-style-type: none"> Anchoring/mandate, competence and experience to drive initiative Regional leadership; capacity to mobilize resources (regl and natl) 	<ul style="list-style-type: none"> Regional leadership and relation to other actors in innovation support system Composition, competence and experience of initiative’s ‘process leadership’ team Gender balance 	<ul style="list-style-type: none"> Regional leadership and relation to other actors in innovation support system Composition, competence and experience of initiative’s ‘process leadership’ team Gender balance
Effect logic/expected results	<p>(From initial programme document)</p> <ul style="list-style-type: none"> Strengthened research and education within the growth area More effective interactive learning (between different organizations and competence areas) Increased collaboration around a shared vision to realize industrial renewal Attraction of new companies to the region, new RDI actors/activities within the area Building/strengthening of national and international linkages (of the ‘hub’) 	<p>After first 2 years:</p> <ul style="list-style-type: none"> Strategic collaboration between research, industry and public sector actors has been established <p>After 5–10 years:</p> <ul style="list-style-type: none"> Generation of new knowledge and new technology Ability and experience to commercialise new knowledge and new technology Creation of growth in companies and structures for internationalization <p>Longer-term: international competitiveness (for companies and the functional region)</p>	<p>Implementation feasibility</p> <ul style="list-style-type: none"> Description of existing resources/system Strategy for renewal Degree of natl and intl connections Leadership and organization/governance Implementation and financing plan Strategy for learning/development 	<p>Implementation feasibility</p> <ul style="list-style-type: none"> Credibility of vision, strategy, and action plan, as well as budget and financing plan Leadership and organization/governance Plan for further development of system Position relative to other initiatives/actors Strategy for internationalization Integration of gender equality aspects Strategy for learning/development
		<p>Effect logic presented in the call</p> <p>Expected results:</p> <ul style="list-style-type: none"> New/increased R&D Applied knowledge/commercialization New and increased resources attracted to the innovation environment <p>Long-term effects:</p> <ul style="list-style-type: none"> Establishment of internationally attractive innovation environment Development of companies’ international competitiveness Business actors and the public sector must have strengthened their ability to work with innovation processes and innovation 	<p>Effect logic visualized and presented in the call (including Agenda 2030 goals); applying initiatives submitted their own effect logic</p> <ul style="list-style-type: none"> Effective regional and thematic innovation systems where companies, the public sector, academia and civil society have developed a good ability to interact for change and innovation The regional business community in the area of strength has increased its capacity for renewal and long-term growth The regional R&D base within the area of strength has developed and has strong national and international connections The public actors in the region have developed their ability to work with innovation processes Contribution to Agenda 2030 goals 5, 8, 9 (10) and others dependent on thematic area of the initiative 	

(continued)

Table 3. Continued

Vinnväxt generation/ start date	2003	2005/08	2013	2019
	(Two-phased call open Jan–April and July–Dec 2002)	(Two-phased call open June–Oct 2005 and Dec 2005–March 2006; at end of 2007, a third phase upgraded to ‘full Vinnväxt’)	(Call open Jan–May 2013)	(Call open Oct 2017–July 2018, with thematic seminars and dialogue to support regional mobilization over the period)
Strategic learning/ monitoring and evaluation activities	<ul style="list-style-type: none"> Active Vinnväxt programme officers (at Vinnova) Active academic reference group/action researchers attached to each initiative (coaching/intervention, reflection, systematic documentation) Strategy for monitoring (annual reporting and strategic dialogue between initiative/region and Vinnova) and evaluation (external evaluation panel every 3rd year) to support continued strategic development 	<p>From 2008, new processes introduced:</p> <ul style="list-style-type: none"> More detailed annual reporting requirements including: web-survey, annual summary of development, income/expenditure statements, mapping/list of participating actors, and list of initiated projects Increased focus on ‘system level changes in the regional innovation system’ (e.g. changed stakeholder behaviours and priorities that can be traced to Vinnväxt initiative actions)—including a paper on ‘Vinnväxt action research’ (written by Björn Eriksson) <p>In addition, Vinnväxt wrote or commissioned studies to enhance strategic learning (on programme level). ‘Vinnväxt I halvtid’ (Andersson et al. 2010) and ‘Hundra år av erfarenhet’ (Kempinsky et al. 2011) summarize results and learning, and suggest possible areas of development for the future.</p>	<ul style="list-style-type: none"> Secure the renewal and long-term growth prospects of stakeholders Attractive environments to operate in for academia, business and the public sector as well as leading knowledge nodes in selected, strategically important areas From 2012: Development of the ‘skiktmodell’ (a model to capture system impacts—investments and dynamics) From 2015: Vinnova summary of ‘strategic learning’ and expectations for action researchers 	<p>From 2018:</p> <ul style="list-style-type: none"> Based on the programme effect logic, applying initiatives were expected to submit their own effect logic which would guide their own strategic learning activities Initiation of programme level action research project focused on capturing system effects

^aThe Vinnväxt programme has had a total of six calls (with different approaches) since 2002—resulting in six ‘generations’ of Vinnväxt initiatives (by year of initiatives’ start date: 2003, 2004, 2006/08, 2013, 2016, and 2019). The table provides an overview of programme objectives, key characteristics, selection criteria, and expected results/effects from four of the six calls—illustrating the major shifts in the programme’s development over time. Data have been collected from call texts and interviews with (previous and current) members of the Vinnväxt programme team.

Source: Own elaboration.

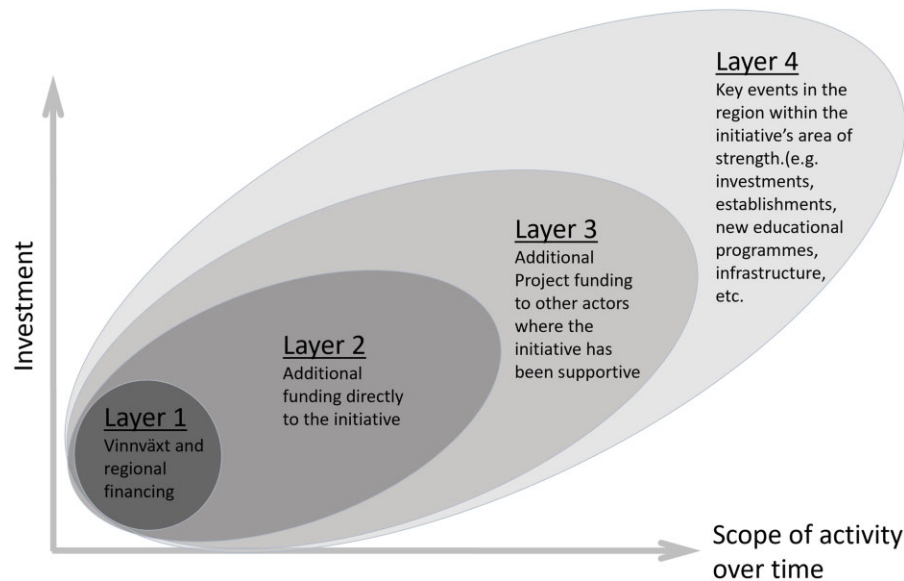


Figure 2. Vinnväxt 'layer model': A model to capture system impact (investments and dynamics). Source: Own elaboration based on Vinnväxt programme illustration.

cluster evaluation practitioners) in an interactive, co-development process structured in three phases.

The first phase of research focused on developing and testing a conceptual framework, combining academic literature review, comparative analysis of impact studies of cluster programmes in several countries, and two parallel series of interactive workshops among two discrete focus groups.⁴ The cluster programme framework of effects distinguishes between three levels of effects (actor, collaborative initiative, and territorial system). Whereas current cluster evaluation practice has focused on indicators of innovation and firm-level economic performance (the actor level of effects), less attention is paid to capturing the development of collaborative strength (the collaborative initiative level) and the contributions the collaborative initiative makes to wider system-level impacts (the territorial system level). While there are emerging evaluation approaches that place more weight on relationships at the centre of clusters (Aragon et al. 2014; Choi, Sang-Hyun, and Cha 2013; Giuliani and Pietrobelli 2016; Etxabe 2018; Felzensztein, Gimmon and Deans 2018; Lucena-Piquero and Vicente 2019; Graf and Broekel 2020), there lack examples of evaluation approaches that capture if and how cluster initiatives contribute to systemic change and transformative outcomes in their (regional) innovation system. Thus, the focus of this research project was on exploring the level of the territorial system—i.e. what contributions Vinnväxt initiatives make to transformation of their respective regional innovation systems.

The second phase was a pilot within the Vinnväxt programme, which sought to develop a common understanding of system effects and define a set of system effect categories for innovation ecosystems, as well as test participatory approaches for tracking system-level changes. Through documentary analysis of previous years' annual reports and reflection on current activities and strategy documents (defining intended future actions), as well as three semi-structured group interviews with (5) Vinnväxt initiative leaders, a set of system effect categories was agreed and integrated into the annual reporting templates for listing of 'key events' ('layer 4' in Figure 2). The results were discussed and elaborated through several

rounds of semi-structured group interviews with Group 1 (the focus group of Vinnväxt stakeholders). Following this process of participatory dialogue, a revised set of system effect categories and suggested methodological approaches (summarized in a guide for Vinnväxt initiatives⁵) was launched in advance of the third research phase: a scaled-up testing of the system effect categories in the annual reporting process of the full Vinnväxt portfolio of 12 initiatives.

4. Results and discussion

4.1 Research results

The research has resulted in an initial definition and list of system effect categories for innovation ecosystems, as well as a structured approach for reporting and tracking system-level change over time. In the context of this research, a *system level effect* is defined as a development step (milestone, event) or outcome that has been influenced by (a set of) actions of the collaborative initiative, and which has a lasting, longer-term impact on several actors in the system (both within and beyond the collaborative initiative). Four aspects of this definition can be highlighted as key characteristics of a system-level effect:

1. *Strategic intent of the collaborative initiative*
One of the key rationales underpinning transformative innovation policy is directionality (i.e. a process for exploring development paths and negotiating collective priorities). The strategic intent and actions of the collaborative initiative should have a contributing influence on the system-level effect.
2. *Evidence of progress over time*
Given the long-term nature of system-level transformation, the focus of monitoring and evaluation is on tracking and evidencing the signs of system-level change and steps along a transformation journey (i.e. qualitative evidence of key milestones that demonstrate progress towards an intended strategic direction, as compared to measurable outputs).

3. *Affecting multiple organizations and actor groups*

In contrast to other measures of innovation activity (e.g. new prototypes, patents, products, and services) that occur at the level of an individual organization, system-level effects affect multiple organizations (and actor groups). This includes both those directly engaged in the collaborative initiative and others that have not been engaged.

4. *Longer-term, sustainable change*

A system-level effect should represent a longer-term, sustainable change in the resources, actors, and institutions (including policies and behaviours) that are mobilized towards the collective aims.

During the final research phase’s scaled-up test with the full portfolio, Vinnväxt initiatives reported a total of 103 system-level events or strategic milestones where the initiative played a contributing role, and marked these within the *seven main categories of system effects* set out in Table 4. An eighth category of ‘other’ was used to capture additional types of system-level effects that did not fit within the proposed categories. However, only 3 of 103 events were categorized as ‘other’, thus confirming that the categories capture the various types of system-level contributions that Vinnväxt initiatives are making.

The system effect categories that were derived from the participatory involvement of the Vinnväxt initiatives mirror many of the functions of technological innovation systems (TIS) (Hekkert et al. 2007; Bergek et al. 2008; Wiczorek and Hekkert 2012), as well as other functions supporting structural change processes (e.g. articulation of expectations or directionality, formation of new or deepening networks, changes in policies or regulations) that are not covered by the TIS functions (Haddad and Bergek 2020). This reinforces the relevance of the set of activities that are performed to contribute to system-level change processes and complements other recent findings on the role and functions of intermediaries in system transformation (Kanda et al. 2019; Kivimaa et al. 2019; Åström and Arnold 2020; Åström, Arnold and Olsson 2020). Rather than adopting the TIS functions or other existing categories of change agency functions, the analysis maintained the categories derived by the participating stakeholders, adopting the TIP principle of inclusive and participatory evaluation processes (Molas-Gallart et al. 2020).

As a result of applying the descriptive categories in annual reporting processes (each reported event is allocated to one category from Table 4), Vinnväxt initiatives are better able to document and track strategic milestones within their respective innovation ecosystems over time. An example from one Vinnväxt initiative (Figure 3)

Table 4. System effect categories for innovation ecosystems

Category abbreviation		Description	Examples
System Resources	KD	<i>Knowledge development and dissemination:</i> affecting how knowledge is developed, spread between actors and combined/ applied in the system	New university courses, new research networks, programmes or institutional establishments/ expansions within the thematic area, attraction of talent
	EE-N or EE-I	<i>Experimentation and entrepreneurship:</i> fostering test of new technologies, applications, or markets; new company establishments	Experimentation within existing companies, new companies or spin-outs, foreign companies establishing in the region
	INV-N or INV-I	<i>Investments:</i> new investment	Expansionary investments in existing companies, FDI/purchase of companies in the region
	INF	<i>Infrastructure:</i> development of physical research and innovation infrastructure and environments	Test/demo facilities, accelerators
System Leadership	POS-N or POS-I	<i>Position:</i> acting as the ‘voice of the ecosystem’; development of national or international reputation, position or visibility	National coordination responsibility, engagement in international RDI projects
	SP/ISS	<i>Strategic partnership or business/ innovation support system:</i> development of collaborative culture, new strategic/longer-term partnerships and more efficient innovation support system	New cross-sectorial connections, improved structures/working practices among innovation support actors
	POL/ST	<i>Policy or strategy:</i> informing and influencing policy or strategy related to thematic area	Public procurement, regulations, company or regional development strategy, resource mobilization, and financial allocations

Source: Own elaboration.

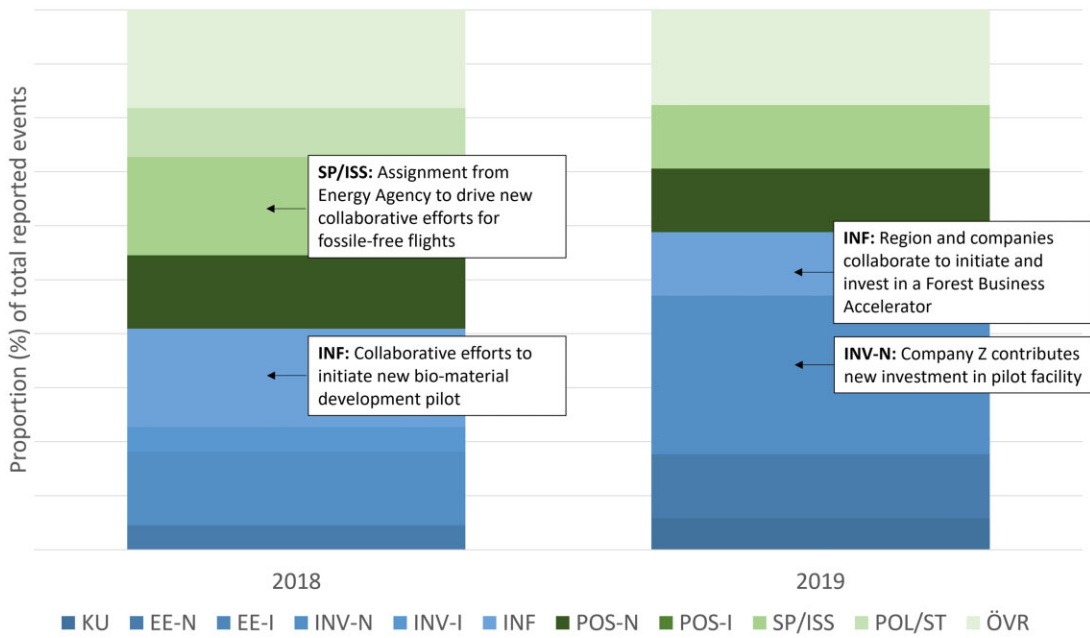


Figure 3. Tracking system effects—Example Vinnväxt Initiative and sample of milestones. Source: Own elaboration.

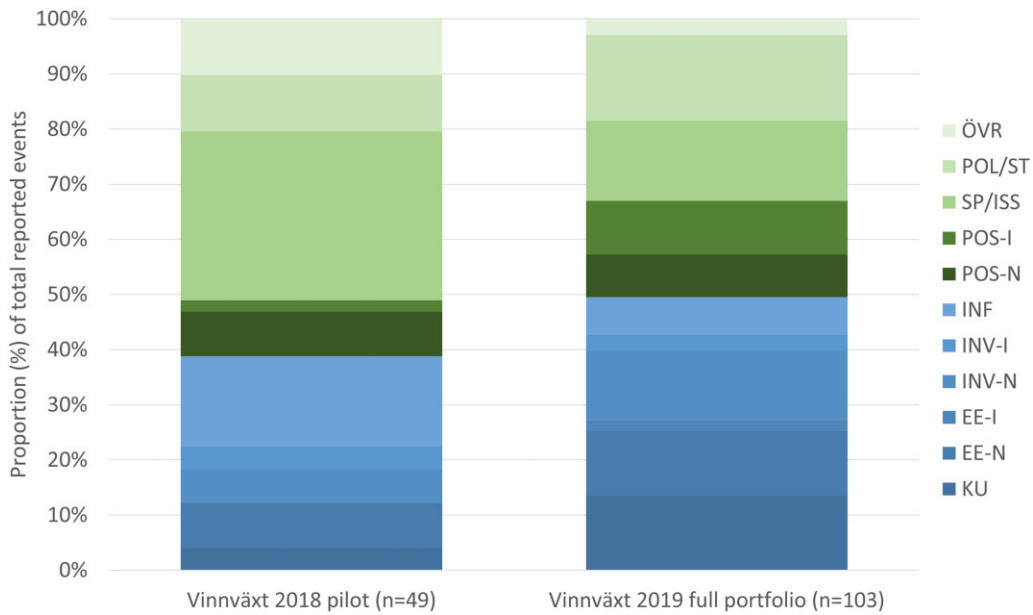


Figure 4. Vinnväxt portfolio contribution to system-level change. Source: Own elaboration.

illustrates the categorization of reported key events in 2 years (2018 and 2019). The visualization of milestones shows that this initiative contributes to many types of system effects, with a relatively higher proportion of highlighted milestones in ‘strategic partnerships’ and ‘infrastructure’ categories in 2018, and a relatively higher proportion of highlighted milestones in facilitating new investments nationally in 2019.

This information provides qualitative evidence of the collaborative initiative’s contributions to various system-level change processes and effects, as well as a way of visualizing their particular ‘system effect profile’ (i.e. their differentiated role and contribution

in relation to other actors in the innovation ecosystem) and how this evolves over time. The information also serves as a basis for reflecting and adjusting the strategic direction and priorities for future investments and collaborative action. However, as each reported event is given the same level of importance, the information does not provide any indication of the relative importance of particular events, nor how they contribute to broader strategic aims or transformation trajectories. Additional narrative is needed to put these pieces of evidence into a context and explain the relative significance of the milestones that have been achieved in terms of progress towards system transformation aims.

Figure 4 provides an overview of the categorization of events across all Vinnväxt initiatives, both in the 2018 pilot study and the 2019 full portfolio study.⁶ This confirms that Vinnväxt initiatives contribute to a variety of system-level change processes and effects, with a notably strong role in bringing together actors in the system and developing longer-term collaborative platforms for strategic action (SP/ISS); informing and influencing policy and strategy (POL/ST); and developing/attracting new research and innovation infrastructure.

In addition to establishing an initial definition, key characteristics, and list of system effect categories, the research has also contributed to enhanced monitoring practices by proposing a structured approach for tracking system-level transformation over time (Figure 5). This approach has built on existing annual reporting practices within the Vinnväxt programme⁷ and the common understanding of important system-level events achieved through the categories. From that base, it highlights how to use the information as an input to strategic governance (e.g. decisions on adjusting courses of action and investments) and communication (e.g. evidencing and describing the initiative’s contribution to system-level change), by

leveraging the role of embedded action researchers. This shared, structured approach is in line with the guiding principles for TIP evaluation (Boni, Giachi, and Molas-Gallart 2019; Molas-Gallart et al. 2020). It enables enhanced capacity at the programme level, providing information on Vinnväxt initiatives’ contribution to system-level transformation that is more easily communicated and ‘traceable’ over time. This, in turn, informs initiative and programme levels, supports dialogue (internally as well as with Vinnova and other funders) and the development of strategic direction over time, provides the opportunity to benchmark and learn across initiatives, and enables broader communication and visibility of Vinnväxt initiatives’ role as ‘system change agents’.

4.2 Discussion of insights

While this interactive research project has realized initial goals,⁸ the results are only first steps towards developing a stronger understanding of and approaches for tracking longer-term system transformation processes and for assessing how they contribute to advancing transformative aims. Nevertheless, the research has provided several

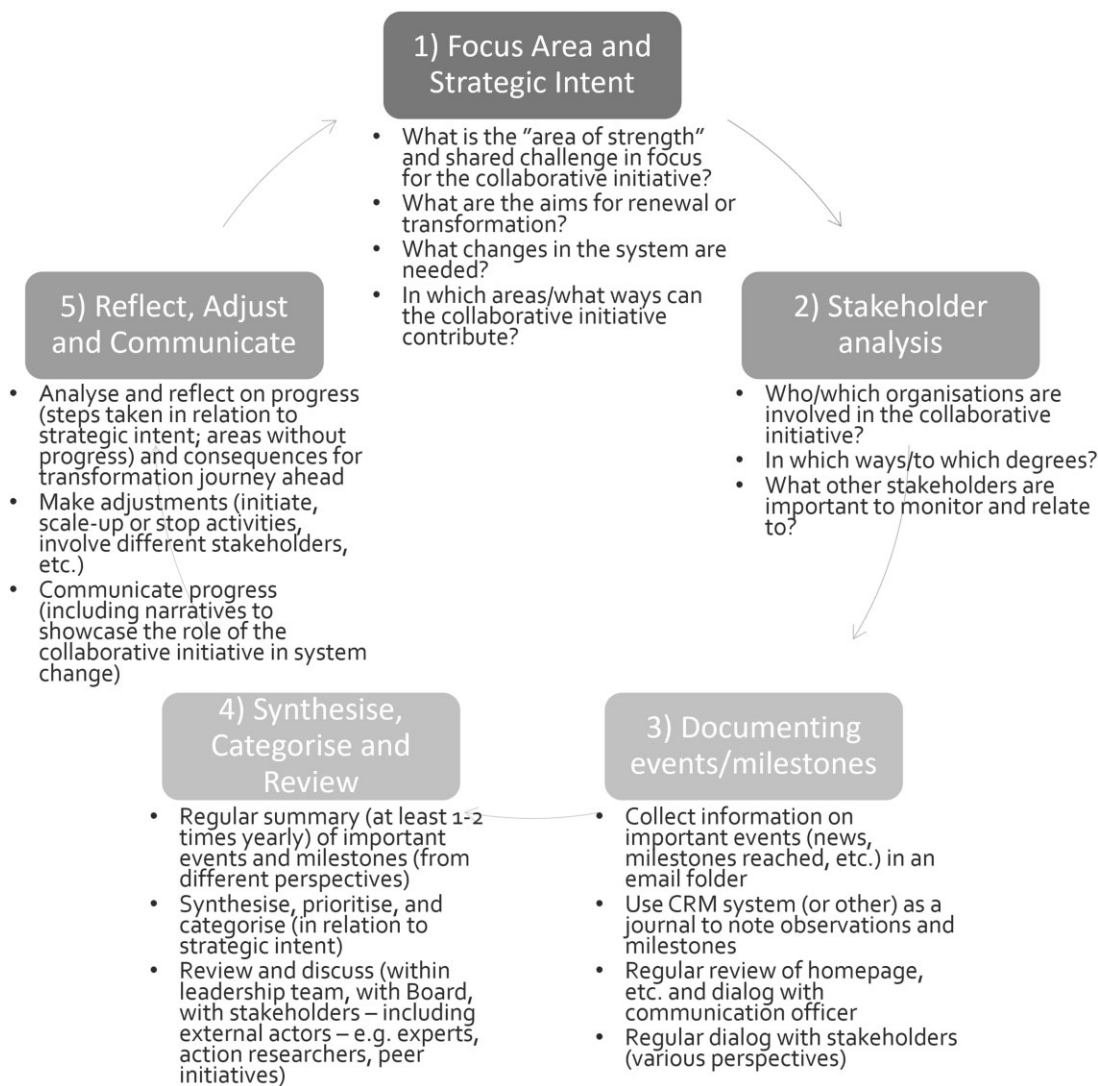


Figure 5. Approach to tracking system transformation in Vinnväxt. Source: Own elaboration

confirming the relevance of the categories, as well as exploring the different system-level contributions that are made by different types of collaborative initiatives at different phases of strategic development.

The model to capture system impact (Figure 2), definition and categories of system-level effects (Table 4), and generalizable approach to tracking system transformation (Figure 5) provide a basic conceptual frame and approach for tracking system transformation on which to build. This first attempt at tracking system-level results in Vinnväxt has demonstrated the benefits of certain programme design elements (e.g. active programme management, embedded action researchers/followers', strategic dialogues, and other activities to facilitate reciprocal learning between policy/programme and funded initiative), and generated a participatory approach to evidencing system-level change. Whereas the stronger directionality towards societal goals and an assessment of progress are still areas where additional evidence is required, the developmental evaluation approach (helping to inform ongoing processes of transformation) outlined in this case has shown how this approach can be used as a base for further development and testing in the context of other transformative innovation programmes.

Notes

1. Sweden's innovation agency
2. See Covid Forum | European Cluster Collaboration Platform
3. Funding from Vinnova is in the range of 2–8 MSEK per year over the 10-year period.
4. Both sets of workshops took place between 2018 and 2020. The first was a series of six workshops among 27–35 individuals representing Vinnväxt initiative leaders (or managers), programme officers, and action researchers (Group 1). This provided a specific applied policy and practitioner context. The second was a series of four workshops among 25–35 researchers, practitioners, and policymakers from 12 countries (Group 2). This provided a broad-based, international triple helix perspective. For more information on the development of the framework, see Wise et al. 2019.
5. The guide (in Swedish only: 'Hur kan vi följa systemresultat? – en guide för Vinnväxt initiativ') explains the 'why, what and how' of tracking system-level results—providing a generalized process and tips for documenting, prioritizing, categorizing, and communicating important system-level results over time (including how to leverage actions researchers).
6. Each initiative selects and categorizes its own strategic milestones/system-level events. There are no requirements on how many events are reported. In 2019, each initiative reported between 4 and 17 events (of the total of 49 events in 2018 and 103 events in 2019).
7. Including comprehensive 'baseline information' on renewal/transformation strategies and actor constellations, as well as documentation of new project financing and important system-level events of relevance to the collaborative initiative.
8. Of a strengthened common understanding of system-level effects, a more structured and harmonized method for evidencing system-level changes over time, a better use of data collected, and increased visibility of Vinnväxt initiatives' contributions to broader system-level transformation.
9. Following context, stakeholder perspectives and progress in real time; documenting and interpreting, as well as questioning and coaching.

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