Chapter 4
Expanding Entrepreneurial, Innovative and Sustainable (EIS) Ecosystems: A Cultural-Historical Activity Theory Perspective

Romano Audhoe, Neil Thompson, and Karen Verduijn

Abstract The value of Entrepreneurial, Innovative and Sustainable (EIS) ecosystems has seen increasing recognition from policymakers and researchers alike. Policymakers employing New Public Management (NPM) have come to understand that the intricate links between diverse EIS stakeholders play a vital role in advancing sources of local transformation – entrepreneurship and innovation – to enhance citizen wellbeing (e.g. happiness, trust, safety and satisfaction). A persistent challenge to both academic and policy research, however, is uncovering how and why EIS ecosystem stakeholders do or do not interact to produce positive outcomes. In this chapter, we propose and explain a novel framework for analysing and assessing EIS ecosystems: activity system analysis (ASA). This methodological framework, rooted in cultural-historical activity theory (CHAT), assists researchers by guiding analyses towards specific tensions and contradictions between stakeholders that prevent EIS ecosystems from developing. ASA does this by moving the analysis from ambiguous framework and systemic conditions (e.g. cultural, social and material attributes) towards the activities and objectives by stakeholders in specific locales. Additionally, it allows researchers to gain insights in the developmental trajectory of EIS ecosystems and to understand the learning actions that transform them. Ultimately, this chapter provides guidelines for performing activity-oriented research on EIS ecosystems so as to uncover the intricacies of an EIS ecosystem's functioning. Adopting the ASA approach will enable policymakers to better understand how to improve EIS ecosystems and the quality of life for their citizens.

Keywords Activity systems • EIS ecosystems • Entrepreneurship • Community • Expansive learning cycle

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4.1 Introduction

The bureaucratic processes that were once firmly rooted in governmental practice have transitioned to a new management philosophy called New Public Management (Hood 1995). Under this philosophy, policymakers aim to embrace sustainable and inclusive businesses to improve the quality of life for citizens (Osborne 2010; Thomas 2013). It is no surprise then that entrepreneurship, known for its vital role in urban renewal, job creation and innovation (Decker et al. 2014; Stam 2014), has been a central focus of NPM. Entrepreneurs working with a sustainable orientation are actively modifying markets and institutions towards a more pro-environmental and social condition, thus introducing and diffusing new sustainable products and services (Thompson et al. 2011, 2015). It is widely accepted that entrepreneurship does not happen in a vacuum, but rather as the result of coordinated actions among many stakeholders (Mason and Brown 2013; Stam and Spigel 2016). Such notions have dovetailed into a keen interest in the development and successes of Entrepreneurial, Innovative and Sustainable (EIS) ecosystems consisting of private and public stakeholders that support sustainable and innovative action of entrepreneurs (Feld 2012; Suresh and Ramraj 2012). Recent research in this area has succeeded in identifying the different components or elements that are manifest in successful cases of entrepreneurial ecosystems (Isenberg 2010; Spigel 2015). For instance, Spigel (2015) details the material attributes (policies, universities, infrastructure, open markets, supportive systems), social attributes (networks, worker talent, investment capital, mentors and role models) and cultural attributes (supportive and history of entrepreneurship) needed for productive entrepreneurship. In alignment with the goals of NPM, the notion of EIS ecosystems informs potential policy actions that will encourage a flourishing environment for innovative and sustainable entrepreneurship.

However, there remains two major opportunities to further our understanding of EIS ecosystems that will enhance quality of life for citizens. First, existing research has systematically overlooked the existence and importance of the diversity of entrepreneurship communities within them. Entrepreneurship communities are groups of individuals and organizations, such as nascent and serial entrepreneurs interacting (physically, digitally or in markets) who interact based on a common interest in a particular domain (Cohen 2006). Examples of entrepreneurship communities are information technology (software/Internet), biotech, cleantech, natural foods, Lifestyles of Health and Sustainability (LOHAS) and so on. Studies by Horst (2008) and Horwitch and Mulloth (2010) among others have shown that it is through the grassroots process of sharing information and experiences with the community that entrepreneurs learn from each other, have an opportunity to develop personally and professionally (Wenger 1999) and expand opportunities for participation (Feld 2012) which influences entrepreneurial emergence and success (Popoviciu and Popoviciu 2011). Meanwhile, researchers, policymakers and practitioners acknowledge that actors and factors of the ecosystem are interdependent (Stam and Spigel 2016) and that successful outcomes often result from the identification of both comparative and competitive advantages (Mason and Brown 2013). But to date, the fact that EIS ecosystems consist of several entrepreneurship communities, each having a different repertoire of actions, styles, artefacts, concepts, discourses and histories, remains under-acknowledged. The result is that policymakers develop plans and policies to promote and increase sustainable and innovative entrepreneurship in general, without acknowledging that each entrepreneurship community has different needs or systemic constraints.

Second, there is still a lack of understanding of how and why (ongoing) interactions between different parties within EIS ecosystems take place, how these interactions develop over time, and why they may prevent EIS ecosystems from developing (Mack and Mayer 2016). The dynamics of EIS ecosystems are important because they reveal how historical ties between companies, people and entrepreneurial communities have developed (Zahra and Nambisan 2012), which lead to transformation in EIS ecosystems. For instance, entrepreneurial activity in Finland once centred solely around Nokia, yet nowadays it revolves around a vibrant start-up community (Mason and Brown 2013). Following Feld (2012), we recognize in this chapter that EIS ecosystems not only include multiple entrepreneurship communities, but that their dynamic development is linked to their interaction and systemic conflicts with investment, government, research and education communities. In order for policymakers to improve the quality of life for their citizens, a deep understanding of entrepreneurship communities and their interactions with other communities involved in EIS ecosystems is indispensable.

Considering these two oversights, the purpose of this chapter is twofold. First, we aim to develop a new conceptual framework of EIS ecosystems that explains the dynamics and interactions within entrepreneurship communities as well as between investment, government, research, education and other communities. Second, we develop and discuss methods for understanding, developing and intervening in EIS ecosystems for policymakers and researchers. To achieve these objectives, we employ the framework of activity systems from cultural-historical activity theory (CHAT). Originally developed by Vygotsky (1978) and Leont'ev (1978, 1981) and later extended by Engeström (1993, 1987, 2001), CHAT provides a framework for conceptualizing and studying EIS ecosystems as multiple interactive activity systems (Kuutti 1996). Next, we explain the contradictions within and between activity systems that explain the development and expansion of an EIS ecosystem through collective learning. Finally, we discuss activity system analysis (ASA) as a way for policymakers and researchers to understand, develop, resolve contradictions and support the dynamic activities of EIS ecosystems. In particular, we outline how the ASA method can help investigators make sense of complex real-world data sets in a manageable and meaningful manner. It provides a valid framework to use as a guide while building reliable interpretations of data about EIS ecosystems. Thus, ASA provides opportunities for investigators to (a) work with a manageable unit of analysis, (b) find systemic implications, (c) understand systemic contradictions and tensions, (d) communicate findings from the analyses and (e) implement informed actions to support EIS ecosystems (Yamagata-Lynch 2010). Accordingly, this chapter serves as a guide for policymakers, scholars, practitioners or other investigators to assist in better visualizing EIS ecosystems, thus enabling them to make better informed choices in deciding on how to improve the quality of lives for citizens.

4.2 Literature Review and Motivation

This section briefly reviews the existing literature on Entrepreneurial, Innovative and Sustainable (EIS) ecosystems with reference to the improved quality of life that EIS ecosystems bring about from the perspective of New Public Management (NPM). Following this review, we discuss two opportunities for conceptual development that motivates this chapter.

4.2.1 Entrepreneurial, Innovative and Sustainable Ecosystems

The mission of NPM is to not only effectuate renewal and growth to cities but also to enhance the quality of life for its citizens (Osborne 2010; Thomas 2013). A key mechanism for achieving this mission is the support of innovative and sustainable entrepreneurship (Stam 2014). Research on sustainable entrepreneurship suggests that it can be an 'innovative, market-oriented and personality driven form of creating economic and societal value by means of break-through environmentally or socially beneficial market or institutional innovations' (Schaltegger and Wagner 2011, p. 226). Dean and McMullen (2007) and Cohen and Winn (2007) argue that various market failures represent opportunities for sustainable entrepreneurs to reduce socially and environmentally degrading economic behaviours. Since sustainable entrepreneurs find bottom-up solutions to these problems, they help redirect the path of socio-economic development towards sustainable development (see Hekkert and Negro 2009).

The limited but growing literature on entrepreneurial ecosystems begins with the observation that entrepreneurs do not perform activities in a social vacuum (Drakopoulou Dodd and Anderson 2007; Steyaert and Katz 2004; Suresh and Ramraj 2012). Rather a growing body of evidence suggests that external support is essential to increasing the number of and survival rates of entrepreneurs in a particular region or city (Mason and Brown 2013; Yasuyuki and Watkins 2014). In fact, the coordinated action among a variety of stakeholders is necessary in order to pave the way for (aspiring) entrepreneurs to set up and grow their own businesses. Stam and Spigel (2016) define an entrepreneurial ecosystem as a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship within a particular territory. The academic study of entrepreneurial ecosystems examines how ecosystems can be arranged to generate competitive advantages for cities, regions and nation-states (Boyd Cohen 2006; Feld 2012; Pitelis 2012; Suresh and Ramraj 2012). The value of an EIS ecosystems construct is evident not only as a means to help stable economies grow but also as an approach to realize cocreated value that has implications for quality of life of its citizens and declining economies (Suresh and Ramraj 2012). As such, EIS ecosystems serve the needs of New Public Management (NPM) in its goal of moving public policy away from bureaucratic administration and towards creating sustainable, flourishing communities through renewal, entrepreneurship and growth (Osborne 2010).

The research on entrepreneurial ecosystems connects with ongoing theoretical discussions regarding the role of context in entrepreneurship (Welter 2011) as well as recognizing entrepreneurship as an inherently socially embedded process (Steyaert and Katz 2004). The entrepreneurial ecosystem concept is important in this literature as it recognizes the complexity and diversity of interactions between components such that outcomes of one organizational process may be used as raw material in another process. Among the components being discussed, Isenberg (2010) suggests entrepreneurial ecosystems consist of elements that can be grouped into six domains: (1) a conducive culture (e.g. tolerance of risk and mistakes, positive social status of entrepreneur), (2) facilitating policies and leadership (e.g. regulatory framework incentives, existence of public research institutes), (3) availability of dedicated finance (e.g. business angels, venture capital, microloans, crowdfunding, crowdsourcing, equity funding), (4) relevant human capital (e.g. skilled and unskilled labour, serial entrepreneurs, entrepreneurship training, coaching and mentoring programmes), (5) venture-friendly markets for products (e.g. early adopters for prototypes, reference customers) and (6) a wide set of institutional and infrastructural supports (e.g. legal and accounting advisers, telecommunications and transportation infrastructure, entrepreneurship promoting associations). Recently, Stam and Spigel (2016) build from these ideas to create a conceptual framework based on framework conditions (formal institutions, culture, physical infrastructure, demand) and systemic conditions ('a broad, deep talent pool', financial capital, leadership, 'mentors and advisors giving back across all stages', supportive large established organizations and supportive policies). In their conceptual model, systemic and framework conditions of entrepreneurial ecosystems encourage entrepreneurial activity that results in aggregate value creation for a particular region or city.

4.2.2 Limitations of Current Models

We argue that there remain two opportunities to greatly increase our understanding of EIS ecosystems. The first is the empirical acknowledgement that EIS ecosystems are very often made up of multiple communities (Wenger 1999), each with their own shared repertoire of actions, styles, artefacts, concepts, discourses and histories. The notion of community suggests that entrepreneurship includes an element of situated learning (Pitelis 2012) – the handed-down ways of doing and being that persist through time. For example, successful and impactful start-ups in cleantech require the acquisition of human, social, technological and financial capital through engagement with individuals and organizations within a community who are themselves knowledgeable about cleantech. Thus, the structural and changing dynamics of these communities have differential but measurable impacts on entrepreneurial emergence and success (Horwitch and Mulloth 2010). As Feld (2012) notes, the thriving entrepreneurial ecosystem in Boulder, Colorado, includes multiple communities related to information technology (software/Internet), biotech, cleantech, natural foods and Lifestyles of Health and Sustainability (LOHAS). Knowing how to succeed in these communities is a matter of displaying the socially defined competence sustained by the community (Haugh 2007); thus the knowledge and competence necessary for successful entrepreneurship in one community are historically and socially defined (Wenger 1999). Despite its intuitive appeal, existing conceptual models, such as those previously reviewed, emphasize acquiring or supporting the necessary components for a flourishing EIS ecosystem (resources, policies, etc.) without recognizing the crucial role of communities.

Second, the conceptual frameworks that focus on listing the distinct elements or components are certainly valuable, yet they tend to overlook the inherently dynamic and developmental nature of EIS ecosystems (Mack and Mayer 2016). This is problematic since EIS ecosystems are born and grown out of ongoing processes that serve the needs of both public and private stakeholders (Spigel 2016). Therefore, it is essential for policymakers, entrepreneurs and governments to understand how EIS ecosystems evolve and develop over time in order to design interventions or promotional policies to encourage them. Understanding what propels the formation and expansion of EIS ecosystems thus enables one to engage more deeply in the ongoing activities within these ecosystems and to adjust actions and policies accordingly, to benefit the entrepreneurs within these communities. This can only be achieved by taking note of the history and context that help shape the EIS ecosystems (Zahra and Nambisan 2012). To illustrate this point, we can turn to the entrepreneurial ecosystem of Switzerland, whose medical technology community emerged as a result of growth and development in engineering advancements within the Swiss watch industry (Vogel 2013). Accordingly, what is needed is a framework that enables policymakers, academics and practitioners to identify and analyse those important activities over time, while also accounting for the cultural and historical background of communities which have shaped these activities.

Finally, existing conceptual frameworks lack connection to a specific methodological procedure to understand and support EIS ecosystems. The main challenges to proponents of EIS ecosystems are not only conceptualizing real-world EIS ecosystems but also extracting meaningful information from massive and complex data. Conceptual frameworks that list elements or factors that are necessary for flourishing EIS ecosystems downplay the systemic relations between different communities that comprise them. In particular, it is hard to visualize systemic contradictions and tensions that influence a series of related activities, as well as how communities modify and create new activities while adapting to environments. Systemic contradictions do not happen accidentally or arbitrarily but reflect the incompatible incentives or interests between communities. Understanding real-world ecosystems involves complicated data collection, analysis and presentation that make communicating findings with others difficult. It can also be challenging for investigators to coordinate at multiple levels to arrive a meaningful conclusion about the development or barriers to EIS ecosystems. Finally, these challenges ultimately mean it remains difficult to stimulate EIS ecosystems to enhance citizen wellbeing (e.g. happiness, trust, safety and satisfaction). In the next section, we develop a new conceptual model of EIS ecosystems that seeks to solve these issues.

4.3 EIS Ecosystems as Multi-interactive Activity Systems: A New Conceptual Framework

In response to the critiques above, we draw on cultural-historical activity theory (CHAT), to develop a new conceptual model of EIS ecosystems that acknowledges evolving, interacting communities. In particular, we employ CHAT's notion of an activity system to conceptualize a community. After explaining the elements of an activity system and the outcomes of interacting activity systems, we move on to describe the formation and expansion of EIS ecosystems. In doing so, we employ a model of expansive and collective learning developed by CHAT scholar Engeström (1987, 1990, 1999, 2001). Throughout this section, we draw on empirical research to provide examples of our conceptual model as well as indicate spillover benefits for citizen wellbeing.

4.3.1 Activity Systems

Rooted in a tradition of adopting practice-based theory in the social sciences (Foot and Fi 2001; Nicolini 2012; Roth 2007; Yamagata-Lynch 2007), CHAT is a cross-disciplinary theoretical framework that argues researchers, policymakers and practitioners should seek to understand and analyse object-oriented activity in order to study how humans intentionally and unintentionally transform natural and social reality. At the centre of CHAT is the notion that an activity is not something a person or organization does, but is a collective effort of communities. Thus activities are not viewed as units of discrete individual behaviour. Consequently, activity systems are conceptualized as an indivisible, molar unit of analysis, that cannot be disaggregated into its substantive parts (Leont'ev 1978), as shown in Fig. 4.1. Importantly, activities are longer-term formations – their objects are transformed into outcomes not at once but through an iterative process that typically consists of several steps or phases. Actions are shorter-term processes that are conscious, goal-oriented and facilitated by tools. Therefore, activities consist of actions or chains of actions that are subject to concrete conditions (Kuutti 1996). In the following section, we describe and give empirical examples of each element of an activity system, before moving on to discuss its implications for the formation and expansion of EIS ecosystems.

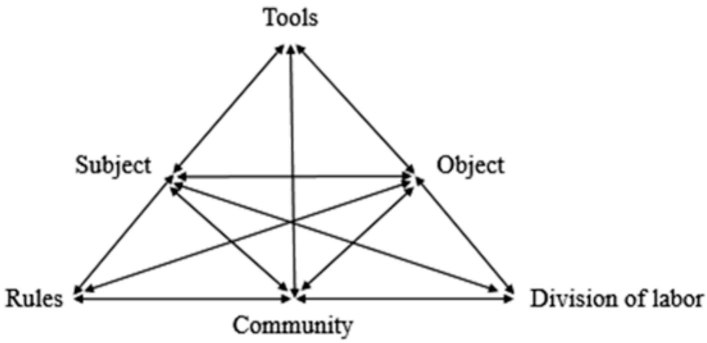

Fig. 4.1 An activity system (Engeström 1987, p. 78)

4.3.2 Object of the Activity System

The object element distinguishes one activity system from another (Leont'ev 1978), which means understanding an activity system requires understanding its object. For example, the shared object of a community of entrepreneurs might be to improve environmental conditions and citizen wellbeing by establishing cleantech ventures (e.g. wind, solar, bio, etc.). Objects can be thought of as consisting of three dimensions – a thing to be acted upon, an objectified motive and a desired outcome. In CHAT, each object has all three of these facets, and any of these facets may be constructed or perceived differently by various members of the community. For example, entrepreneurs may interpret cleantech (thing to be acted upon), business models (motive) and flourishing ventures (desired outcome) differently than other entrepreneurs in the community. The process of shared object formation within an activity system arises from a state of need on the part of one or more actors, such as the need for an alternative to fossil fuels, cleaner air in cities or more equitable supply chains. Accordingly, it is the shared object that gives an activity system a determined direction, a horizon towards which it orients – but just as a horizon is never reached, an object is never fully accomplished (Engeström and Miettinen 1999). In other words, the object of flourishing cleantech ventures is necessarily open to further expansion and redefinition as conditions change.

4.3.3 Subject of the Activity System

The subject(s) (or actors) of an activity system are individuals and organizations taking part in actions towards some object. Going back to our example, entrepreneurs and their immediate colleagues are the subjects that take action towards the shared object of flourishing cleantech ventures. The actions of subjects towards any object involve interaction between aspects of the subjects' personal experience, his or her relationship to the community of significant others with whom the object is pursued and cultural-historical properties of the object. As such, an individual subject (or even a collective subject) cannot arbitrarily define or construct the object of an activity. Rather, a subject's perception of an object is both facilitated and constrained by historically accumulated constructions of the object (Foot 2002), as well as by the community of significant others oriented towards the same object. For example, the various ways that generations of people involved in energy and cleantech – whether as providers or receivers – construct what cleantech is (and is not), which influences how individual entrepreneurs (subject) at a particular point in time constructs the object of flourishing cleantech ventures. Accordingly, the historical layers of object constructions both enable and constrain the entrepreneurs' perception of and engagement with the object, in both ideational and material ways (Engeström 1990). At any point in time, participants in an activity may be at different stages in the reciprocal processes of need and object formation, thus differing in their abilities to perceive and articulate the object of the activity in which they are engaged. In other words, an entrepreneur's past professional experience, position in the power structure, role within the team and idiosyncratic characteristics of each particular case influence each entrepreneur's construction of the object of the activity.

4.3.4 Tools of the Activity System

CHAT scholars argue that a subject's actions towards an object in activity systems are never 'direct', but always mediated by means of the use of tools and signs, sometimes called 'mediational means' (Wertsch 1994). Tools can be either material or conceptual, e.g. physical technologies or mental/textual plans or schemas. For example, cleantech entrepreneurship involves multiple types of environmental technologies (e.g. solar panels, bioenergy, wind turbines, etc.). In every activity system, participants draw upon pre-existing tools as well as use cultural-historical resources to create new tools with which to engage, enact and pursue the object of their activity. Tools are important because they provide a historical record of the relationship between subjects and the object of their activity. That is, each tool employed in an activity system reveals something about the relationship between actors and their object concept at the point in time in which the tool was appropriated or created. For example, modern solar panels for creation of clean energy are situated in ongoing discussions of climate change, which were neither occurring nor available by tools earlier in human history.

It is important to point out that tools can simultaneously enable certain forms of action and constrain others. For example, cleantech involves multiple types of environmental technologies (e.g. solar panels, bioenergy, wind turbines, etc.) that provide an entrepreneur (the subject) with a particular way of formulating and testing business models (the object). Each technology consists of properties that both enable and constrain the uses to which it can be put. On the other hand, any single environmental technology orients problems and solutions in one way – rendering other potential technologies less important or even invisible. For instance, consider a cleantech entrepreneur (subject) that develops and sells solar-powered products to achieve an objective of viable business and promote a greener world. While this entrepreneur is bound by the limits of current solar technology (tool), it also allows him to utilize solar panels in working towards the objective. As such, many kinds of tools are employed in a complex activity system. However, since tools are subject to innovation, their purpose may change over time. For instance, the way in which people use computers (tool) has changed enormously over the past few decades – and may continue to do so in the future. The point is that there is no inherent characteristic of any tool (i.e. a human-constructed instrument, in either material or conceptual form) that will permanently determine its role and function in an activity system.

4.3.5 Community, Rules and Division of Labour of the Activity System

In addition to tools, core to the undertaking of activities are communities, rules and division of labour. The community within an activity system consists of the individuals and organizations who share with the subject an interest in and involvement with the same object. The interactions between the subject and the community that engages a shared object can be thought of as the 'communicative relations' of the activity (Engeström 1999, p. 32). As explained previously, communities are implicated in the process of making and interpreting meaning – and thus fundamental to all forms of learning, communicating and acting. Keeping with our illustration, cleantech ventures' ability to meet their objectives depends on its members knowing how to successfully implement and commercialize their technology. Because achieving this objective requires the acquisition of human, social, technological and financial capital through engagement with individuals and organizations who are themselves knowledgeable about cleantech, knowledge is not bound to the individual members or to an organization but a matter of displaying the socially defined competence sustained by the community (Haugh 2007). Within the cleantech community of Boston, for example, serial entrepreneurs play a key role in the knowledge creation and facilitation, as they develop and identify talent, invest in educating prospective entrepreneurs, start incubators and host start-up competitions (Van Stijn and Van Rijnsoever 2014).

Relations between the subject and the community are mediated by the last two components: (1) the rules that regulate the subject's actions towards an object and relations with other participants in the activity and (2) the division of labour, understood as what is being done by whom towards the object, including both the relatively horizontal division of tasks and the vertical division of power, positions, access to resources and rewards (Engeström 1987). First, rules in an activity system primarily mediate what the subject does vis-à-vis the object of the activity (i.e. how the subject acts in relation to the object, including the tools employed and the ways they are used). For instance, cleantech ventures' selling of a sustainable product is subject to many formal laws (e.g. business tax, labour, product safety, intellectual property, nondisclosure, etc.) as well as norms in the community about behaving entrepreneurially and the importance of sustainable development. Second, activities are constrained and enabled by rules that govern relations between subjects and the community. Such rules and norms stem not only from the community of this particular activity but also from the broader cultural, economic and political context. In the case of cleantech entrepreneurship community, rules and norms may dictate that subjects profess pro-environmental and pro-entrepreneurial values.

Finally, the division of labour refers to how the tasks are shared among the community. For example, cleantech entrepreneurs' actions towards an object are both supported and constrained by the corresponding actions of supportive staff (e.g. those who manage working capital, apply for property rights, assist in hiring, etc.) as well as outside the subject's organization (e.g. other entrepreneurs who develop and identify talent, invest in educating prospective entrepreneurs, start incubators and host start-up competitions). For example, many cleantech entrepreneurs divide their tasks and projects with co-founders or employees in order to achieve efficiency and overcome knowledge constraints. Furthermore, members of the entrepreneurship community that have an interest in cleantech play different roles, such as building relations with local governments, hosting developmental workshops or encouraging the next generation of entrepreneurs. Historical explanation of who does what in relation to the object (i.e. which members of the community engage with subjects) is typically mediated by sociohistorical power structures and patterns of relations both within the community and between a community and the larger culture/society of which it is part. For instance, serial entrepreneurs tend to come into contact with local governments when considering how to develop EIS ecosystems.

4.3.6 EIS Ecosystems as Multi-interactive Activity Systems

In this section, we develop a novel view of EIS ecosystems as multi-interactive activity systems that provide unparalleled citizen wellbeing. To do so, we review two ways in which activity systems interact – shared objects and supportive activities – and discuss their relevance for flourishing EIS ecosystems. Since the interactions between multiple activity systems in EIS ecosystems are complex, we will delve more into their tensions and contradictions in Sect. 3.7.

First, when two activity systems interact, it is possible that their objects obtain collective meanings, which may lead to a third object – a collective object for both activity systems, as seen in Fig. 4.2. For example, an activity system that revolves around the object of increasing sustainable entrepreneurship may require that its government (subject) takes certain actions. Now suppose that another activity system aims to develop sustainable business models (object) for that particular region. In this second activity system, entrepreneurs (subject) may seek to utilize the

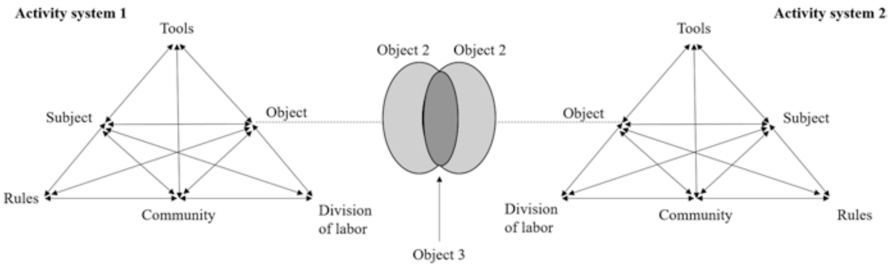

Fig. 4.2 Two interacting activity systems with shared object (Engeström 2001)

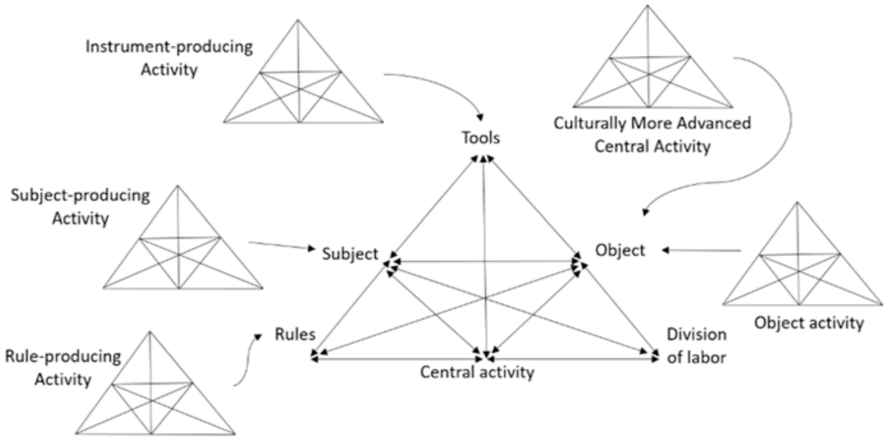

Fig. 4.3 EIS ecosystems as multiple, interconnected activity systems (Based on Engeström 2001)

resources in the community. Together, the government and the entrepreneurs may form a third shared object of developing greater access to resources that promote entrepreneurship within the city (object 3). Yet, while the government and the entrepreneurs in this case have formed a common goal, they may draw on different tools to pursue them. For instance, the government may set up a programme to support entrepreneurial activity (e.g. the StartupAmsterdam initiative explained by the Amsterdam government (StartupAmsterdam 2015) and the StartupDelta project (2015)), while the entrepreneurs may decide to organize some entrepreneurial events to attract more human capital, entrepreneurs and investors to the city. Our overall premise is that all of the different communities involved in any functioning EIS ecosystem have both individual and collective objects. As we will discuss later, developing an EIS ecosystem therefore requires the effort and commitment to forge shared objects that benefit all parties involved.

The second way in which EIS ecosystems are constituted by multi-interactive activity systems is acknowledging the interrelation of activities that influence each other's systems (Engeström 2001; Foot 2001). Figure 4.3 reveals the complexity and multivoicedness of EIS ecosystems as being composed of interdependent activity systems. In this model, a central activity system may be influenced by other instrument-, subject-, rule- and object-producing activity systems. For example, the activities of the community of science and engineering institutions (instrument-producing activity system) may influence the capabilities of environmental technologies that entrepreneurs active in the cleantech community (central activity system) use to achieve their objective of developing sustainable business models. Similarly, subject-producing activity systems (such as education communities) may influence the personal and professional development of future entrepreneurs. On the other hand, rule-producing activity systems (such as local, provincial and national governments) may produce formal and informal rules and norms that enable or constrain cleantech entrepreneurs who are active in the central activity system. In the region of Öresund, for example, the objectives of cleantech entrepreneurs (central activity system) were enabled by the rules of the government (rule-producing activity system) to achieve their 'low-carbon goals' (Kiryushin et al. 2013). Lastly, other communities, such as NGOs, researchers, writers and public intellectuals, may influence the ongoing development of the object of a central activity system (object activity systems). For example, the scientific realization and public discussions that fossil fuels have a negative influence on the global climate spurred the notion of sustainable development that continues to influence the objectives of entrepreneurs in the cleantech community (central activity system). In the next section, we will delve more into the different layers that comprise tensions and contradictions in the next section.

4.3.7 Contradictions, Learning and Expansion of EIS Ecosystems

We argued above that EIS ecosystems consist of multiple, interacting activity systems. In this section, we propose that the contradictions inherent in and between activity systems that make up an EIS ecosystem are complex in nature. We build from Engeström's (2001) four layers of contradictions – primary, secondary, tertiary and quaternary – to explain common contradictions among and between activity systems that hinder the development of EIS ecosystems, as shown in Fig. 4.4. However, rather than be seen as a negative development, contradictions reveal opportunities for creative innovations, for new ways of structuring and enacting activities and EIS ecosystems. Therefore, contradictions should be seen as the 'places' from which innovations in EIS ecosystems emerge (Foot 2014). Foot and Groleau (2011) elaborated the ways in which contradictions provoke collective epistemic actions, which lead to the ascent from abstract ideas to concrete knowledge, as shown in Table 4.1.

Primary contradictions (numbered 1 in Fig. 4.4) challenge the most fundamental aspects of the elements of an activity system (i.e. object, subject, tools, rules,

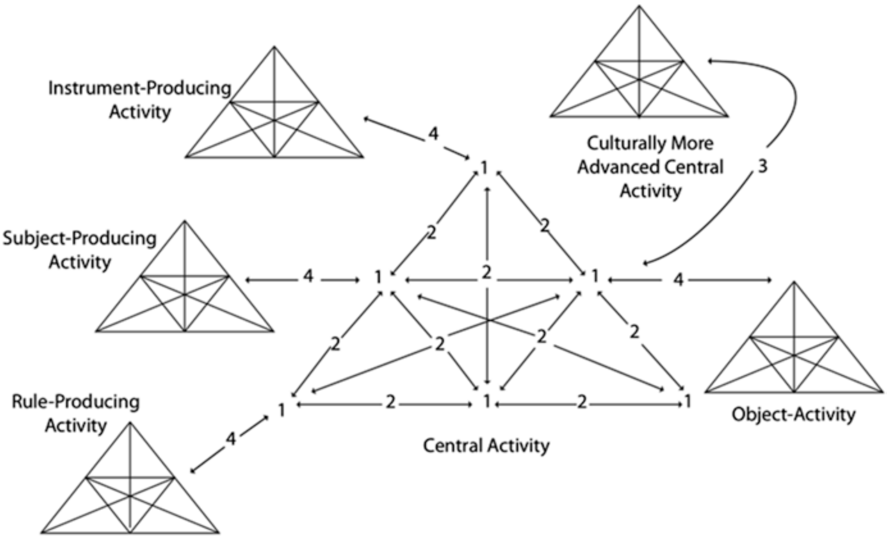

Fig. 4.4 Four layers of contradictions within and between activity systems (Engeström 2001)

Table 4.1 Four layers of contradictions and corresponding learning actions (Foot and Groleau 2011)

Levels of contradictions and corresponding learning actions		
Levels of contradiction	Characteristics of contradiction levels	Corresponding learning actions
Primary	Occurs between the use value and exchange value of any corner of an activity system	Questioning
Secondary	Develops between two corners of an activity system	Analysing
		Modelling
Tertiary	Arises when the object of a more developed activity is introduced in the central activity system	Examining model
		Implementing model
		Evaluating progress
Quaternary	Occurs between central activity and neighbouring activities triggered by tertiary contradictions	Consolidating new practice
		Questioning

community, division of labour). A primary contradiction is due to the dual construction of everything and everyone as both having inherent use value and being an exchangeable commodity within market-based socio-economic relations (Foot and Groleau 2011). In this sense, they lead people, entrepreneurs and organizations to question, critique and even reject some aspects of an accepted practice or existing wisdom. Keeping with our example, cleantech entrepreneurs (subjects) facing tensions in its object caused by the duality of both wanting to reduce environmental degradation (use value) and wanting to generate a profit (exchange value) lead these entrepreneurs to question their own practice or business model and even reject those typically accepted in their industry. Subjects try to overcome primary contradictions when they surface by vocalizing or questioning the legitimacy of some element of the activity system. For example, some entrepreneurs may question the motives of others for prioritizing a certain environmental technology over another, even questioning the efficacy of the technology and/or the profit motivation. The object of a typical sustainable entrepreneur in an EIS ecosystem is inextricably dual – in this case, fostering sustainable development and increasing private revenue (see Haigh and Hoffman 2012, 2014; Schaltegger and Wagner 2011).

Secondary contradictions (numbered 2 in Fig. 4.4) occur between different nodes of an activity system and provoke analysing and modelling actions among participants (e.g. tools and rules, community and subject or object and division of labour). For example, a secondary contradiction can be seen between the nondisclosure laws (i.e. rules) signed upon demands by investors that constrain a cleantech entrepreneur from sharing details of a new solar panel technology and the scientific advancement of solar panel technology (i.e. a tool) that requires openly sharing information about the details of that technology. To resolve this secondary contradiction, cleantech entrepreneurs may engage in analyses to find out why nondisclosure causes a conflict for scientific development. Upon analysis, cleantech entrepreneurs may move on by modelling the newly found explanatory relationship in some publicly observable and transmittable medium.

Tertiary contradictions (numbered 3 in Fig. 4.4) emerge with the implementation of a new model in the central activity system, which spurs actions to analyse the sources of these contradictions. The motive for introducing a new object to an activity system is typically to find relief from one or more secondary contradictions and the tensions stemming from them. As an example of a tertiary-level contradiction, imagine that academic scientists believe that the sharing of information freely with international colleagues advances the purposes of sustainable development. If these scientists talked positively about freely accessible information for the benefit of technological development to the cleantech entrepreneurs (subjects), the possibility of open knowledge transfer as an alternative to the current object of a profitable business model supported by secrecy could precipitate a tertiary contradiction between the existing object (flourishing cleantech ventures) and the new one (open innovation), resulting in rifts among entrepreneurs who wanted to retain the status quo and those interested in open innovation.

Finally, quaternary contradictions (numbered 4 in Fig. 4.4) occur between activity systems and result in the process of consolidating a new practice aimed at solving a tertiary contradiction (Foot and Groleau 2011). Consolidating a new practice or model, in our example, translates into setting up processes and procedures for cleantech entrepreneurs to implement and support the movement from prioritizing profitability to prioritizing equitable access to information. This transformation of the activity systems, nevertheless, leads to substantive changes in the venture's relations with the venture capitalists. In the instance of resource acquisition contradiction, cleantech entrepreneurs may seek to acquire financial resources by implementing a new model but inadvertently cause disturbances with their relations to the rule-producing activity system of the government. In this case, cleantech entrepreneurs take action to realign their activities with neighbouring activity systems, holding meetings and negotiations about the role of private and public value in their community. These discussions may precipitate a new round of questioning actions with and between activity systems, restarting the expansive cycle.

The four layers of contradictions capture the idea of an expanding cycle of development of EIS ecosystems. The evolution and expansion of an EIS ecosystem are thus a collective learning process that necessarily includes contradictions within and between activity systems. In other words, we explain the evolution and expansion of EIS ecosystems as the result of actions aimed at resolving the four layers of contradictions within and between activity systems. New participants are stimulated to enter the EIS ecosystem when they perceive solutions to problems within or between activity systems and believe that their proposed solutions will result in sustainable and independent sources of financial and other resources. This notion attends to the multivoicedness related to the plurality of and in an EIS ecosystem, acknowledging that within each activity system, there are multiple points of view, traditions and interests, each with their own (diverse) histories and contradictions. In the next section, we explain activity system analysis as a method for analysing contradictions, innovation and expansion of EIS ecosystems. This method helps to gain a better understanding of its developmental path (Foot 2014) enabling policymakers to intervene and take action to support EIS ecosystems, thus improving citizen quality of life.

4.4 Activity System Analysis for Analysing and Supporting EIS Ecosystems

In this section, we discuss activity system analysis as a method to understand, analyse, intervene and support EIS ecosystems. We provide a roadmap for ASA applied to the context of EIS ecosystems, thus serving as a guide for investigators to assist in better visualizing and supporting EIS ecosystems. Flourishing EIS ecosystems improve the quality of life of its citizens by providing better access to health, education and natural environment opportunities. While activity system analysis (ASA) is new to the EIS ecosystem literature, scholars in a variety of fields are already applying this method in analysing (professional) activities (Foot 2014; Foot and Fi 2001; Yamagata-Lynch 2010). For instance, it has been used to capture the processes involved in organizational change (Barab et al. 2004; Yamagata-Lynch and Smaldino 2007), identify guidelines for designing constructivist learning environments (Jonassen 1999; Jonassen and Rohrer-Murphy 1999), identify systemic contradictions and tensions that shape developments in educational settings (Barab et al. 2002; Roth and Tobin 2002), and demonstrate historical developments in organizational learning (Yamagata-Lynch 2003).

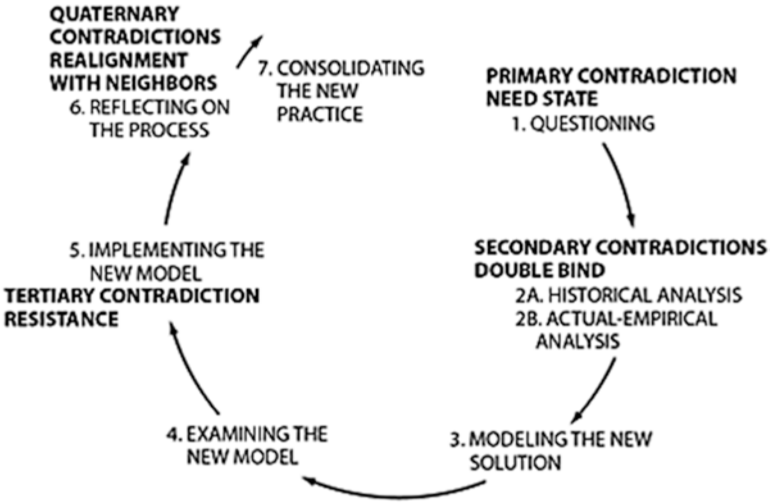

Fig. 4.5 Sequence of epistemic actions in an expansive learning cycle (Engeström 1999)

4.4.1 Analysing and Supporting EIS Ecosystems Through the Learning Cycle

ASA starts with identifying and mapping existing activity systems in a particular spatial area and questioning the absence of desired entrepreneurship communities in an EIS ecosystem (shown in Fig. 4.5). The identification of desired communities requires researchers and policymakers to consider the distinct object of the central activity system. Having identified activity systems, investigators should spend time understanding the elements of each activity system, mapping the people involved as subjects and community, the rules and division of labour that govern their interactions and the tools subjects use to accomplish their objectives. The empirical methods for accomplishing this are interviews and ethnographic work. Having the voices of all relevant communities represented is important, since it allows investigators to understand the multiple interrelated perspectives and distinguish between the different needs and wants of the activity systems within the EIS ecosystem. Next, researchers and policymakers need to identify the secondary contradictions within a particular activity system. This can be achieved by performing a historical and empirical analysis in which they examine the contradictions between the different components of a particular central activity system. One approach to finding secondary contradictions is to look for ongoing conflicts in between the nodes of a central activity system using interviews with subjects and members of the community.

The third step in the learning process occurs when investigators take an active role in (a) cocreating new joint objects between different activity systems and (b) co-developing new models in a collaborative effort to resolve secondary contradictions of a particular activity system. Here, it is important to outline the shared objects that emerge when policymakers' activity system meets a central activity system. Once again, this requires close collaboration with relevant stakeholders in the target activity system to ensure that all viewpoints are accounted for. The new model should serve as a plan of action, outlining the future developmental trajectory of the activity system. Step four of the process entails implementing and examining the new model (i.e. looking for tensions/contradictions that could emerge). Not surprisingly, implementing the model requires the participation of the members of the activity system. Policymakers should bear in mind that change – in any form – is usually met with some resistance. Therefore, it is helpful for researchers and policymakers to investigate the sources and possible solutions to the resistance of the new model for the central activity system.

Once the model has been implemented, policymakers should reflect on the process and seek to identify quaternary contradictions. Identifying these contradictions is a matter of recognizing disturbances that previous interventions and support policies have had in the network of relations between a central activity system and its neighbours. This includes investigating the influences of other activity systems on the central activity system, as well as the disturbances that the central activity system may create for relations with other activity systems (i.e. that receive the output of the central activity system or are otherwise affected by its outcomes). For instance, in Denmark a collective effort of national ministries and regional communities helped to support its cleantech industry. However, one decision to withdraw the subsidy on the wind turbine industry backfired, as it almost put an end to the industry itself. Fortunately, the industry was able to survive by entering new export markets (Potter et al. 2012).

4.5 Discussion

Under the philosophy of New Public Management, policymakers no longer seek to pursue economic growth alone, but aim to enhance the quality of life for citizens as well (Thomas 2013). The recognition that entrepreneurship plays a vital role in innovativeness, economic growth and attracting international talent has captured the attention of policymakers, researchers and practitioners (Decker et al. 2014; Wennekers and Thurik 1999). Interest in the role, and functioning of EIS ecosystems, has consequently grown substantially (Mack and Mayer 2016; Mason and Brown 2013; Motoyama et al. 2014). In this chapter, we have briefly discussed the current state of the literature of EIS ecosystems. We have argued that while the present literature has greatly enhanced our understanding of EIS ecosystems and its distinct elements, it also has clear shortcomings. Our first argument is that the current literature has overlooked the notion that EIS ecosystems are comprised of multiple communities (cf. cleantech, LOHAS, biotech, ICT, etc.). This is problematic, since policies designed to promote entrepreneurship tend to neglect the specific needs of different communities within EIS ecosystems. Our second argument is that the literature falls short of capturing the dynamics that transform EIS ecosystems over time. We have emphasized that building EIS ecosystems requires more than just its distinct elements (e.g.). This understanding has led us to ask the question of how to deal with its dynamic and systemic nature.

In this chapter, we have drawn on CHAT to propose and explain ASA as a novel framework to analysing EIS ecosystems. We have argued that ASA will help academics and NPM-minded policymakers to better conceptualize, understand, analyse, intervene and support EIS ecosystems in their development. Ultimately, ASA will help them improve the quality of life for citizens. Our argument is twofold. First of all, we contend that existing measures to the development of EIS ecosystems generalize across communities without recognizing that different communities within EIS ecosystems (e.g. cleantech, LOHAS) exist and therefore have different needs. The current emphasis in the literature on the distinct elements of EIS ecosystems is limited in that these conceptual models do not capture the role that contradictions and tensions within and between communities have for the development of EIS ecosystems. Secondly, we have reasoned that existing conceptual frameworks that list elements or factors downplay the systemic relations between different communities that comprise it. As a result, it is hard to visualize how systemic contradictions and tensions influence a series of related activities and how communities modify and create new activities while adapting to their environment.

Understanding EIS ecosystems can be a challenging endeavour, since it requires the collection and analysis of large and complicated data sets. The difficulty of figuring out how to present the findings to others in an insightful manner adds to the complexity. Additionally, it can also be demanding for investigators to coordinate at multiple levels to arrive at meaningful conclusions about the development or barriers to EIS ecosystems. Faced with these challenges, our new conceptual framework contributes to NPM by conceptualizing EIS ecosystems as multi-interactive activity systems. While our framework represents a leap forward in furthering our understanding of EIS ecosystems, it also reveals the complexity and interrelatedness of activities. Through ASA, researchers and policymakers can come to understand the systemic contradictions and the resulting learning actions that transform and develop EIS ecosystems. ASA enables researchers and policymakers to coordinate action for collective learning by relying on its detailed methodology. Using ASA may seem daunting at first due to the web of multiple interrelated activities and layers of contradictions. Once the different levels of contradiction have been identified, however, researchers and policymakers can draw on Engeström's expansive learning cycle to track development and/or take intervening action in EIS ecosystems. There is a growing recognition that ASA can help researchers and policymakers to understand complex human activities in an insightful and understandable manner (Yamagata-Lynch 2007). In particular, it can help them to understand how, when and why people interact and take certain actions based on the cultural and historical trajectories of activities. This enables researchers and policymakers to understand how current activities have been influenced, transformed and developed over time. Following the developmental trajectory of EIS ecosystems helps researchers and policymakers to both understand why changes in activity systems occur and when to take intervening action to relieve some of the contradictions. This allows them to implement policies that can help to improve the quality of life of citizens within the EIS ecosystems.

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