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Developing an Object Oriented Model of Critical Success Factors for Clusters: The Link[^]ping Information and Communication Technologies Cluster Test-Case

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**Developing an Object Oriented Model of Critical Success Factors for Clusters:
The Linköping Information and Communication Technologies Cluster Test-Case**

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Abstract

An object oriented model of critical success factors (CSFs) is developed on the basis of a critical review and meta-analysis of the cluster literature. The model is existentially tested, as a proof of concept, against the successful Linköping information and communication technologies (ICT) cluster, Sweden. The model is robust, yet flexible, applying equally to particular clusters as well as to clusters in general. The model aims to act as a diagnostic tool for CSFs in particular clusters as well as a framework for both policy and research (e.g. hypothesis testing, prediction, intervention). The model encompasses some 21 CSFs (e.g. trust, vision, knowledge) that implicate (i.e. belong or depend upon) one or more objects (e.g. firms, institutions, entrepreneurs). A Venn diagram is developed (as a conceptual framework) on the basis of the reviewed literature to help delineate the implicated objects and is subsequently translated into the aforementioned model. The existential testing of the model follows a cluster life-cycle approach in an effort to identify the presence/absence of the 21 CSFs throughout the different life-cycle stages of the Linköping ICT cluster. It is argued that the presence/absence of different CSFs varies throughout a cluster's life-cycle and that not all CSFs need to be present during all stages for cluster success. The paper concludes with some relevant policy implications and areas of further research.

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1. Introduction

There is a long-spanning and ongoing debate concerning the factors that underpin the success of clusters¹, hereafter critical success factors (CSFs). This debate is yet to reach any solid conclusions about the range of relevant CSFs; neither about particular clusters nor about clusters in general. This is not due to lack of wanting or trying. That is, in spite of the fact that several of these clusters are well publicised in the literature (e.g. Silicon Valley), their success seems undisputed, and several research efforts to delineate their CSFs seemed to have been expanded (Saxenian, 1994; Adams, 2005; Weil, 2009).

Although such efforts have produced a number of valuable insights, the general conclusion seems to be that there is a combination of CSFs some of which become important during different stages of the life cycle² of a particular cluster given its geographical, cultural, etc. predicaments. Such a conclusion, although opening up several possibilities for researchers and policy makers alike (e.g. for further studies, experimentation with novel instruments), does not seem to offer a robust framework for systematic learning.

This paper aims to remedy the above by developing an alternative approach to the study of CSFs for clusters. This is pursued in the following manner. In the next section (§2) the methodology involved is introduced, followed by a critical review of the cluster literature that aims to unearth the implicated objects, culminating with the development of a conceptual framework utilising a Venn diagram (in section §3). The model is subsequently developed and existentially tested against the allegedly successful Linköping information and communication technologies (ICT) cluster in Sweden and the results are discussed (in section §4). The paper concludes with some policy implications and areas for further research (in section §5).

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2. Methodology

Success or critical success factors (CSFs), as the terms often appear nowadays, have a long lineage (e.g. Spencer, 1955; Lebreton, 1957; Daniel, 1961; Anthony et al. 1972; Rockart and John, 1979; Rochart 1986; Friesen and Johnson 1995; Gadenne, 1998) spanning several areas of business and management such as information systems, strategy, total quality management, and marketing. However in terms of clusters, CSFs were popularised by the Sainsbury (1999) report. The report identified no less than ten such CSFs for the development of biotech-clusters in the UK (see CSF7-16 in Table 1). Obviously a number of prior and subsequent studies of alternative cluster specialisations in different countries highlighted other CSFs. The focus thus in this paper is to attempt a synthesis of the range of CSF reported in the cluster literature into a robust yet flexible model, that could be used both for policy (e.g. diagnosis, intervention) and research (e.g. hypothesis testing, prediction) purposes (discussed further in

¹ “The cluster notion is multi-discursive. That is, it means different things in different discourses” (Borrás and Tsagdis, 2008:8). This study, wishing to maintain an open-minded perspective so not to impose any ethnocentric or otherwise artificial limitations on the collection of firms and institutions that could pass as a cluster, adopts the Borrás and Tsagdis (2008:9ff) minimal-set of three criteria: “1) geographical concentration of firms, in particular industrial specialisations; 2) number of SMEs has to be larger than the number of large size enterprises; and 3) presence of inter-firm and institutional networks”.

² A number of studies (e.g. Porter, 1998; Etzkowitz and Klofsten, 2005; Sölvell, 2008; John and Pouder, 2006; Borrás and Tsagdis, 2008; Aziz and Norhashim, 2008; Bergman, 2008) have suggested that clusters follow a life cycle as part of which they go through a series of stages, e.g. birth, growth, decline, and finally death (Sölvell, 2008). Alternately, clusters may jump into a new cycle and experience a “renaissance” based on new technologies and/or new firms (ibid, p.17).

section §4). To undertake this effort a suitable hybrid and primarily exploratory research design (Tashakkori and Teddlie, 2003), combining multiple methods and methodologies (Brewer and Hunter, 1989; Jackson, 1991; Mingers and Gill, 1997), was required to be developed which is detailed in the remaining paragraphs of this section

A population of relevant cluster literature was identified (using extensive web-searches in library, journal, and other databases) and preliminary reviewed using content (Weber, 1998) and scientometric (Leydesdorff, 1995) analysis methods (see Table 1 and Appendix 2).

This helped distil the sample of studies (N=32) to be focused upon. Further content and manual discourse (Renkema, 2004; Gee, 2005; Wodak and Krzyzanowski, 2008) analysis using quantitative and qualitative techniques in combination with object oriented analysis and design (OOAD) techniques from the information systems (IS) discipline (Coad and Yourdon, 1991; Graham, 1991) were applied to this sample of 32 studies to delineate the 21 CSFs of interest and the 10 classes of implicated objects.

Still within the IS tradition OOAD techniques were further employed to devise the object-cases (summarised in Table 2), and by adopting a set-theory logic the Venn diagram of Figure 1 (i.e. conceptual framework) was devised. It was on the above basis that the conceptual (object-oriented) model of Figure 2 was developed.

The existential testing of the model adopted a “critical” case study approach (Bryman and Bell, 2003, pp. 53-6; Yin, 2003). A purposeful sample of a single case study was selected, viz. the Linköping information and communication technologies (ICT) cluster, in the east-middle (NUTS2) region of Sweden. Besides pragmatic reasons of access, this cluster and region were selected as they are rather successful. The successful performance of the cluster was established in a series of studies by Klofsten et al. (1999); Etzkowitz and Klofsten, (2005); Hommen et al. (2005); Feldman (2007); whereas the successful performance of the region was established across a series of indicators, viz. industry and service labour productivity (Tsagdis and Alexiadis, 2009), GDP per capita, economic activity diversity, qualified labour, and labour employed in advanced sectors (Tsagdis, 2010).

Primary and secondary data were collected about the Linköping ICT cluster so to construct its test case. The former were collected by Tavassoli in 2009 during semi-structured face-to-face interviews with key cluster actors (e.g. the SMIL board); for a more detailed discussion see Tavassoli (2009). The cluster’s life-cycle was subsequently divided in three stages, viz. birth (1984-1989), growth (1990-1999), and maturity (2000-present) and the presence of the 21 CSFs was sought in each stage. The results are reported in Table 3.

Having described the adopted methodology, in the following section a critical review of the literature relating to ‘cluster-success’ and in particular of the 32 cluster studies forming the aforementioned sample is undertaken in an effort to delineate the implicated objects.

3. Literature review

As Sölvell (2008, p. 17) aptly summarised some clusters ultimately take off and grow; whereas others remain small or disappear over time. He further suggested (in. p. 20) that “cluster success is a result of a combination of evolutionary and constructive forces”. The contribution of such “forces” on cluster success has been documented in a number of studies. For example Lundequist and Power (2002, p. 692), and Sölvell (2008, p. 48) detailed the attraction of external venture capital; whereas Porter (1998) reported on the attraction of outsiders with ideas and/or relevant skills as well as the endogenous emergence/development of specialized suppliers, institutions (e.g. offering specialized training), the local accumulation of information and knowledge, the development of infrastructure, and increases in the cluster's visibility. In actual fact a number of indicators have been put forward all claiming to

be able to capture cluster success, each one underpinned by a range of different forces and factors:

- 1) *Going through a complete cluster life cycle*. That is, birth, growth, maturity, and decline³ while experiencing a renaissance phase at the end and entering a second loop (Sölvell, 2008, p. 16-17) implying for example forces and factors relating to innovation, adaptability, etc.
- 2) *Continued (economic) growth* of the cluster firms (Porter, 1998; Ecotec, 2001; Sölvell, 2008) and its host region (Markusen, 1996, p. 296) highlighting forces and factors relating to competitiveness and productivity.
- 3) *Continued improvement of social interaction* and in general of the linkages between the range of relevant actors (Klofsten et al., 1999; Morosini, 2004) raising to the front forces and factors relating to social capital, trust, collective formation, etc.
- 4) *Continued attraction* for companies and individuals to join the cluster and in a more general sense for the relevant actors to *contribute more* to the cluster (Markusen, 1996; Porter, 1998; Austrian, 2000, p. 98; Lundequist and Power, 2002; Sölvell, 2008; Maggioni, 2005, p. 13; Athiyaman and Parkan, 2008; Menzel and Fornahl, 2009).

Although the above list does not pretend to be exhaustive it nonetheless suffices to raise most issues that form the core of this paper. Namely, that one cannot be sure of when such a list may be complete, or of its organising principles, and thus of any overlaps between the suggested indicators, forces/factors and actors involved. Most importantly however, such a list, even if complete, would only be of rather limited help; i.e. as a check-list, to public and private actors wishing to improve a cluster's CSFs. As introduced in the previous sections, this paper aims to remedy the above by developing a CSF model in which the above are clarified, overlaps removed, become amenable to rigorous testing, can be easily modified and so on. To accomplish the above a more rigorous approach is required, starting with the way the literature is organised. This is attempted in Table 1 that aims to summarise the range of CSFs reported in the cluster literature during the last 13 years.

³ As Sölvell (2008, pp. 16-17) described: some 'seeds' (e.g. natural resources, specific demand/skills, entrepreneur) lead to the emergence of a cluster in a location (birth stage), the cluster can then grow further by attracting other firms and institutions (growth stage). Such growth will eventually saturate, e.g. due to technological lock-in and the cluster will enter its maturity stage; which can be perused to death (i.e. decline) or rebirth (renaissance) of the cluster in the same/different specialization.

Table 1: The 21 CSFs identified during the literature review (1996-2009)

#	CSFs	Year												
		96	98	99	00	01	02	03	04	05	06	07	08	09
1	<i>Right vision</i>	KJ				Ec	LP			EK			AP; Sö	
2	<i>Trust</i>	KJ			GM				Ot		IM			
3	<i>Proximity</i>		Po		Po					EK	JP		Sö	We
4	<i>Pre-existing knowledge</i>		Po			Ec	HB; LP; Ex	HL		Ad			JF	We
5	<i>Addressing lock-ins</i>		Po				Ex						Be	
6	<i>Brand-name</i>			Pe	Ra		LP						AP; Sö	
7	<i>Political setting</i>			LC; Sa		Oe	HB; Ex					Le	AN; BT; Sö	
8	<i>Strong actor(s)</i>			Ke; Sa	Ra	Ec		HL		Ad				
9	<i>Communication networks</i>			Ce; Sa		Ec	Ex		Mo					We
10	<i>Physical infrastructure</i>			Sa		Ec	Ex			Ad			Sö	
11	<i>Finance</i>			Sa		Ec				Ad			Sö	We
12	<i>Skill base</i>			Sa		Ec	LP							
13	<i>Innovation capacity</i>			Sa		Ec		Se						
14	<i>Entrepreneurial spirit</i>			Sa		Ec				Ad				We
15	<i>Growing base</i>			Sa						Ad				
16	<i>Staff attraction</i>			Sa										We
17	<i>Consensus</i>				Ra			HL						
18	<i>External links</i>					KL; Oe	Ex	Se	TS				Sö	
19	<i>Balance</i>						Ex; LP							
20	<i>Support</i>						LP	HL					AP	
21	<i>Solidarity</i>													We
Total no of CSFs pa		2	3	11	5	11	11	6	3	8	2	1	10	7
Total no of studies pa		1	1	5	3	3	3	2	3	2	2	1	5	1
Average no of CSFs/study pa		2	3	2	2	4	4	3	1	4	1	1	2	7

Source: Authors creation based on the reviewed literature.

Notes: 1) CSFs are listed in chronological order according to the year of their first appearance in the reviewed literature. The abbreviations refer respectively to; KJ: Klofsten and Jones-Evans (1996), Po: Porter (1998), Pe: Peneder (1999), LC: Legendijk and Charles (1999), Sa: Sainsbury (1999), Ce: Ceglie et al. (1999), GM: Gordon and McCann (2000), Po: Porter (2000), Ra: Rains (2000), Ec: Ecotec (2001), Oe: OECD (2001), KL: Klink and Langen (2001), LP: Lundequist and Power (2002), HB: Hospers and Beugelsdijk (2002), Ex: Expert group (2002), HL: Hallencreutz and Lundequist (2003), Se: Sölvell et al. (2003), Ot: Ottati (2004), Mo: Morosini (2004), TS: Tambunan and Suptarinko (2004), EK: Etzkowitz and Klofsten (2005), Ad: Adams (2005), IM: Iammarino and McCann (2006), JP: John and Pouder (2006), Le: Lerch et al. (2007), AP: Athiyaman and Parkan (2008), Sö: Sölvell (2008), JF: Johansson and Forslund (2008), Be: Bergman (2008), AN: Aziz and Norhashim (2008), BT: Borrás and Tsagdis (2008), We: Weil (2009). 2) A fuller description of each CSF along with its implicated objects can be found in Appendix 1.

Although the cluster literature on CSFs could be traced back to Marshall's (1890) original writings, it is mainly in recent years that their study has intensified; highlighted by a growing trend for recent studies to address (on average) a larger number of CSFs (see Appendix 2). As it may also be noted the studies listed in Table 1 come from a variety of disciplines and perspectives undertaken for very different purposes. The list does not pretend to capture all cluster literature mentioning CSFs (which can only be an exercise in futility as after all it is a growing literature), although it seems to capture most CSFs reported in the cluster literature. Moreover, most of the studies listed in Table 1 tend to be empirical using sufficiently differentiated samples, methods, and instruments that render comparative analysis across contexts an impossibility; especially in the absence of a comprehensive and robust framework. Hence the need for this study that aims to remedy the above through a chronological review of the literature delineated in Table 1 in order to capture its history, genealogy, and evolution in an effort to delineate the range of 'objects' and their relations that appear to be implicated by these 21 CSFs.

Perhaps the first study in recent years to make explicit reference to CSFs was that by Klofsten and Jones-Evans (1996) which highlighted the importance of having both the *right* (e.g. clear, focused, flexible) *vision* and *trust* (i.e. CSF1 and 2 respectively of Table 1). Starting with the former, they broached the importance of 'clear vision' in a network development context, i.e. by focusing on the business development of SMIL's⁴ member firms. Although Klofsten and Jones-Evans (1996, p. 192) described such vision as being mainly a property of the SMIL board (i.e. of institutional representatives), subsequent studies (e.g. Ecotec, 2001, p. 50) noted that vision in clusters can also originate from firms, e.g. industry leaders who having developed such a vision act as champions for the future strategy of a cluster. Moreover, Lundequist and Power's (2002, p. 698) empirical study of the 13 regional clusters forming the Klustergruppen⁵ in Sweden elaborated further on the vision notion by 'anchoring' it to the context of successful cluster development. Although they did not make explicit if this is a property of firms, institutions, or both; they added that it should be flexible as well as focused. That is, it should be open enough to change along the circumstances inside and outside the cluster. Not long thereafter, Etzkowitz and Klofsten (2005, p. 247) re-emphasised the importance of government in relation to this CSF; whereas in more recent years this CSF has been revisited by a number of theoretical studies (Athiyaman and Parkan, 2008, p. 205; Sölvell, 2008⁶).

In terms of the latter, viz. the importance of *trust* between cluster actors, it was initially reported by Klofsten and Jones-Evans (1996, p. 192) as part of their empirical study of SMIL, receiving a subsequently theoretical treatment by Gordon and McCann (2000, p. 520). However, the two studies highlighted the existence of trust among actors in the context of a business network and of an economic system respectively, rather than in an explicit cluster context. The latter had to await Ottati's (2004) empirical study of the Prato textile industrial district in central Italy, which identified informal (e.g. business customs) and formal (e.g. trade associations) institutions as creators of trust among cluster firms. Not long thereafter, Iammarino and McCann (2006, p. 1023) explicitly acknowledged, albeit in a theoretical manner, the importance of trust in an explicit cluster context. In the same year Gaggio (2006) reported on the important role of trust among economic agents in the Valenza Po and Arezzo

⁴ SMIL (Stiftelsen för Småföretagsutveckling i Linköping) is a network for business development of small and knowledge-intensive firms (mostly of an ICT specialisation) in the city of Linköping, in the middle-east (NUTS2) region of Sweden.

⁵ The Swedish Cluster Focus Group.

⁶ Sölvell (2008, p. 20) also reported on the role of policy makers in elaborating the cluster's vision by 'constructive force' (also known as the 'visible hand'), which he defined as regional, science, industry, and cluster micro policies and initiatives. Such constructive forces combine with evolutionary ones (e.g. entrepreneurship and new firm entry) to form and grow a cluster.

jewellery districts of northwest and central Italy⁷. The above five studies relating to trust however are not always explicit about the kind of objects involved in this CSF; that is trust is portrayed both as existing among a particular set of cluster actors, e.g. firms, governments, higher education institutes (HEIs), as well as in a general sense i.e. without specifying the particular set of actors. This suggests that CSF2, unlike CSF1, is of a slightly different nature in that it is not just a property of a single object but of two (or more) objects; i.e. an object relation.

Porter (1998) has been the next study in chronological terms to introduce three further CSFs; viz. *proximity* of actors to each other (CSF3), *pre-existing knowledge* within the cluster's host region (CSF4), and *addressing lock-ins* (CSF5). Starting with *proximity*, which he observed for example in the California wine and Italian footwear clusters, he found that both inter-firm proximity and proximity to other actors (e.g. HEIs and policy makers) are critical for cluster success. The latter was further supported by a series of subsequent empirical studies; e.g. by Etzkowitz and Klofsten (2005) of the proximity of cluster firms to HEIs in the case of Mjärdevi Science Park in Linköping, Sweden, and in the case of the Silicon Valley by Sölvell (2008) and Weil, 2009. The former, concerning inter-firm proximity had to wait a bit longer for additional empirical support which was provided by the John and Poudier (2006) study of the Akron tyre manufacturers cluster in Ohio, US. It could thus be argued that this CSF manifests both as a property of a single object (e.g. when a firm chooses to locate in the vicinity of some other firm) as well as a relation between several objects (e.g. when a number of public and private sector organisations collocate).

Moving to the *pre-existing knowledge* within the region hosting a cluster (CSF4) but staying with Porter (1998) who hinted at the importance of this factor in a number of clusters (e.g. Californian wine, Italian leather fashion) and stimulated a series of subsequent studies (discussed below) dealing with this CSF as a regional property. Ecotec (2001) for example picked upon this CSF in a 'policy intervention' context, whereas the Expert group (2002) observed it empirically through the Observatory of European SMEs. In the same year, the Hospers and Beugelsdijk (2002) empirical study of the automotive and software industry in Baden-Württemberg in Germany and of machine tools, ceramic tiles, knitting, and footwear in Emilia Romagna in Italy added further support as to the importance of this CSF for the success of the respective clusters in these regions; whereas Lundequist's and Power's (2002) study of the 13 regional clusters (forming the Klustergruppen) in Sweden demonstrated empirically that it is hard to start from a zero base and that it is more conducive to success when a cluster emerges in a region with pre-existing relevant knowledge. Subsequent studies by Hallencreutz and Lundequist (2003) detailed this CSF in three clusters of the Klustergruppen (viz. Telecom City, the IDEA Plant, and Rock City) with similar findings. Outside Europe, Adams (2005) reported on the importance of this CSF for Silicon Valley; while Weil (2009) highlighted its importance in subsequent stages of a cluster's life-cycle by suggesting that the technology (as a kind of knowledge) to be found in a region like Silicon Valley can attract investments from outside the region, which are crucial to the cluster's continued success. Such observations have also been part of more recent theoretical discussions e.g. in Johansson and Forslund (2008, p. 52) that suggested that a region's knowledge can attract R&D activities from outside. It should thus be pointless to argue, as all of the above studies seem to converge on the ideas that this CSF is a regional property.

⁷ In particular he argued that "social and political ties led to the creation of institutions of collective governance, which in turn produced a workable level of trust between economic actors" (p. 19).

Porter's (1998) paper was also one of the first to hint at the importance of CSF5, i.e. the *ability to address lock-ins*⁸. He noted for example the role of technological discontinuities, which could cause technological lock-ins for cluster firms leading to a cluster's decline as in the case of the golf equipment cluster in New England, US (p. 85). He further suggested, albeit not explicitly, that the government has a role to play in addressing and confronting such technological lock-ins. It could thus be argued that, according to Porter, this CSF is a property shared by the cluster and the government. Subsequent studies, e.g. by the Expert group (2001) extended the lock-in concept beyond the technological confines to lock-ins in supplier/buyer relations, while Martin and Sunley (2006) raised the idea of "place"-related lock-ins; such studies suggest additional (i.e. non-technological) threats for a cluster and the development of a region rendering thus this CSF into a regional property. More recently, Bergman (2008) highlighted the importance of addressing technological lock-in, while discussing the exhaustion phase of a cluster life cycle in a theoretical manner.

The importance of a cluster's *brand-name* is the next CSF to emerge in this chronological review of the literature (in the same year as CSF7-16). It was first mentioned by Pender (1999) as part of the Austrian cluster experiences, where he noted that brands could strengthen the attraction of the cluster as a destination for investment, venture capital, skilled workers and new entrants (i.e. CSF6 as cluster property). Not long thereafter, Raines (2000) indicated that branding helped the food/drink and tourism clusters in Scotland to unite their actors, especially firms, in a shared (right) *vision*; implying a dependency relation of vision (CSF1) on branding. The following year Lundequist and Power (2002) in their empirical study of the Klustergruppen went beyond citing the two aforementioned studies by adding that cluster branding often complements a firm's marketing and collaborative-marketing activities, which eventually leads to cluster growth⁹. CSF6 also received a theoretical treatment by Athiyaman and Parkan (2008) as a cluster property. More recent empirical evidence by Sölvell (2008), from the Silicon Valley in the US and the winter car-testing cluster in Sweden, pointed out that mass media (e.g. by creating 'stories') and government (e.g. by creating initiatives), also contribute to the enhancement of a cluster's brand. These later studies thus, render this cluster property as also dependent on mass media and the government.

The importance of an appropriate *political setting* (CSF7), was articulated explicitly for the first time by Sainsbury (1999) as part of his study on the CSFs of the UK Biotech clusters¹⁰. In this report the government was identified as being responsible for creating a stable political environment and cluster policy for the region, suggesting that this CSF is more of a government property. Lagendijk and Charles (1999), writing at the same time as Lord Sainsbury, also pointed out the importance of an appropriate regional political context for efficient networking processes within the UK cluster; implying that CSF7 is also a regional property. This treatment of CSF7 as a regional property was supported by the OECD (2001, p. 407) findings concerning the 'appropriate history and country specificities', in which a region is located. A year later the Expert group (2002) through the Observatory of European SMEs added support to both of the above CSF7 views by suggesting a dependency relation between regional and national government. In the same year Hospers and Beugelsdijk (2002)

⁸ Lock-ins ceases the evolutionary mechanisms and eventually the economic development of a cluster (Belussi et al., 2008, p. 4). Prior to Porter (1998), Grabher (1993) analysing the Rhur districts reported a case of "cognitive lock-in". The 'cognition' in question is subsumed by the objects discussed above.

⁹ According to Lundequist and Power (2002, p. 699) developing a cluster's brand name can be considered as a CSF when the process of cluster-building is a pre-planned top-down public sector-initiative, rather than a spontaneous bottom-up emergence. They further added that in such top-down initiatives the brand-building-efforts often take precedence over competence and network development.

¹⁰ To that effect Lord Sainsbury's (1999) report explicitly introduced CSFs 8-16 discussed in the subsequent paragraphs of this section.

theoretical treatment of CSF7 made explicit that appropriate political factors (i.e. setting) are essential for the cultural uniqueness of a region and consequently for the success of the cluster(s) it hosts. In more recent years CSF7 has been picked up by Lerch et al. (2007) who noted that cluster actors in a region face similar political conditions; implying CSF7 to be a regional property. Aziz and Norhashim (2008) re-affirmed the dependency of this regional property CSF on the government, as initially suggested by Sainsbury (1999) and the Expert group (2002), by arguing that it is the government that creates a stable political environment for the region. Such dependency was extended by Borrás and Tsagdis (2008), under a schema of multi level governance to public and private actors alike at four different levels (viz. local, regional, national, and European). Finally, Sölvell (2008) also elaborated explicitly that a successful cluster requires an appropriate political setting in its region, since it can basically increase the region's attractiveness¹¹.

The presence of at least one *strong actor* as a CSF, was introduced simultaneously by Klofsten et al. (1999) and Sainsbury (1999). The former, implicitly as part of discussing the Triple Helix of the Linköping technopole in Sweden highlighted the important role of Linköping University as a strong actor, whereas the latter highlighted the importance of mature (cum large/strong) firms in three UK biotech clusters. Subsequent studies added support to either or both firms and HEIs as strong actors and CSFs. For example Raines (2000) reported that the presence of both strong universities and large firms as CSFs of the ICT cluster in East Sweden and of the semiconductor and biotechnology clusters in Scotland. Subsequently, Ecotec (2001) not only pointed out the important role played by large firms in the success of Japanese clusters, but went further to detail the range of benefits of such presence, e.g. supplying incubation space for their employees and providing technical expertise. Hallencreutz and Lundequist (2003) emphasised the function of cooperative universities in acceleration of the Hultsfred Rock City cluster and Eskilstuna IDEA Plant cluster in Sweden. Adams (2005) also highlighted the importance of the presence of strong universities and large firms in three well known US clusters, viz. Silicon Valley, Route 128, and the Research Triangle. Overall, the reviewed literature seems to emphasise universities and firms as being the strong actors rendering CSF8 as their property, rather than a property of some other actors such as the government for example.

The importance of *communication network* as a CSF, was also introduced simultaneously by Ceglie et al. (1999) and Sainsbury (1999). The former reporting on the experiences from UNIDO in developing countries noted that *trust* among actors, which can be facilitated by network brokers¹². The latter highlighted the role of biotech associations in three UK biotech clusters as network facilitators. A couple of years later Ecotec (2001) reported that in order to increase knowledge integration and maximize information flow, which are essential for cluster growth¹³, it is important to create an appropriate inter-firm network for example through network associations such as the Scottish Food and Drink Enterprise. The importance of such networks, albeit between HEIs and firms were also highlighted by the Expert Group (2002). Subsequently, Morosini (2004) explicitly noted the importance of communication networks and knowledge integration, however in a broad context of clusters as a whole,

¹¹ According to Sölvell (2008, p. 43) such a political and regulation setting encompasses antitrust, regional, industry, science and innovation policies including patents and IPR (e.g. rules for how to share license fees between researchers and university). Policy frameworks can affect the overall attractiveness of a region for people (housing, transportation, recreation and culture) and companies (land, investment attraction packages, and skilled people).

¹² In the conceptual model of Figure 2 a 'network broker' does not appear as a separate object; instead it is subsumed within the class of 'competence supporting organizations' to which it belongs. This is due to the fact that a number of organisations could act as such brokers and provide the sought support.

¹³ The necessity of knowledge flow and integration for cluster growth is further elaborated by Morosini (2004) discussed next.

implying that CSF9 may be a cluster property. He also listed some further ways such networks can be developed, i.e. through regular communication events and labour-mobility. More recently Weil (2009) reported on the importance of networking between firms as well as between firms and HEIs in the success of Silicon Valley. The reviewed literature thus seem to suggest that CSF9 is a property of the cluster firms as well as being dependant on supporting organisations (such as trade associations) and HEIs.

Sainsbury (1999) also raised the importance of an appropriate *physical infrastructure* within the cluster's hosting region as a CSF for the three UK biotech clusters. However in the case of the clusters he studied the appropriate physical infrastructure referred to laboratory spaces, and the government was considered as the key actor responsible for providing it. Ecotec's (2001) report also highlighted the role of modern physical infrastructure, although in their case, besides facilities for companies, it encompassed facilities for employees as well as good transport and communication links¹⁴. In the following year the Expert group (2002) recommended the availability of appropriate regional infrastructure, and in particular real state, communication, and transport, as key for cluster development. Adams (2005) highlighted the key role of the appropriate infrastructure in Silicon Valley. More recent studies e.g. by Sölvell (2008) affirmed that the performance of a region's economy cannot be explained by sole recourse to the strength of its clusters, but that in addition other aspects of the broader business environment, such as advanced infrastructure, i.e. the microeconomic framework conditions need to be considered. The above studies seem to suggest that CSF10 is a regional property with a dependency on the government.

Sainsbury's (1999) study of the UK biotech clusters also identified explicitly *finance* as a CSF. In particular he noted the need for access to finance for firms and HEIs alike and he delineated financial institutions as the main providers rendering CSF11 as their property. Although Ecotec (2001) re-affirmed Sainsbury (1999), subsequent studies; e.g. by Adams (2005) argued for a shifting of the focus away from financial institutions and towards the government as providers for finance especially for HEIs, on the basis of evidence from the Silicon Valley. Sölvell (2008) further emphasized the need for start-ups' financial support as a CSF but without delineating the range of likely providers. Weil's (2009) more recent and comprehensive study on this matter (using Silicon Valley as the case par excellence) provided support for both earlier positions suggesting CSF11 to be both a property of financial institutions (relating to firms) and the government (relating to both firms and HEIs).

Sainsbury (1999) also reported explicitly on the presence of a strong skill base within firms as a CSF (making clear that CSF12 is a firm property) although highlighting the important role of local training institutions for filling any gaps in the firm skill base (ibid, p. 26). Ecotec (2001) reporting on CSF12 in the New York multimedia cluster, provided further support to the Sainsbury (1999) position, whereas Lundquist and Power (2002) using the 'Aluminiumriket area' in the Blekinge province of Sweden as empirical evidence, argued for HEIs as creators of this CSF for firms. All three studies can be taken to suggest that although CSF12 is a firm property, it is dependent upon HEIs and training and education providers in general.

Sainsbury (1999) also reported explicitly on *innovation/R&D capacity* (potential) within firms and HEIs as a CSF (making clear that CSF13 is a firm and HEI property). Ecotec (2001) added further support on the importance of HEI innovation capacity while studying the New York multimedia cluster, making explicit that HEIs can also function as catalysts for stimulating the growth of innovation/R&D capacity within firms (i.e. adding thus a dependency of this firm property on HEIs). The latest study dealing with this CSF by Sölvell

¹⁴ In addition, Ecotec (2001, p. 43) suggested rather explicitly that the appropriate physical infrastructure has the potential to reduce transportation costs, improve access to raw materials and skilled labour.

et al. (2003) broadened the theoretical discussion on the importance of innovation capacity at the cluster level, suggesting that CSF13 may be better treated as a cluster property.

Sainsbury (1999) also reported explicitly on the presence of entrepreneurial spirit both within the entrepreneurs themselves as well as within the cluster's hosting region as a CSF, (making clear that CSF14 should be construed as a property of both entrepreneurs and the region). He also stated rather explicitly that HEIs can lead to the creation of this CSF within entrepreneurs (suggesting a dependency of this entrepreneurial property on HEIs). Ecotec (2001) iterated Sainsbury in terms of the necessity of this CSF in both individual entrepreneurs and the region, albeit without an empirical referent. More recent studies, e.g. by Adams (2005) and Weil (2009) of the Silicon Valley have tended to emphasise the importance of the entrepreneurial spirit within the region.

Sainsbury (1999) also reported on start ups as well as more mature companies that can act as role models forming a cluster's *growing base* as a CSF (making clear that CSF15 should be construed as a cluster property). Adams (2005) also observed this CSF in Silicon Valley, praising Prof. Terman of Stanford University as its father and facilitator of such company creation through the cluster's formative stages (e.g. birth); which implies that CSF15 as a cluster property may also be dependent on HEIs.

The last CSF raised in Sainsbury (1999) referred to *staff attraction* from outside the cluster, which was portrayed as the responsibility of a cluster's successful firms while acknowledging the importance of the attractiveness of the cluster's hosting region (e.g. in terms of quality of life, natural beauty); suggesting thus that CSF16 is a shared property of the cluster firms and the region hosting the cluster. More recent studies; e.g. by Sölvell (2008) emphasised the attractiveness of the region and the cluster itself as in the case of the Värmland pulp and paper cluster in Sweden, while adding that the government (e.g. through cluster initiatives) can also create staff attraction for a region. Extending thus this property to clusters and raising a dependency on the government. Finally Weil (2009) confirmed the previously reported regional property dimensions of CSF16 in the case of the Silicon Valley.

Capacity for *consensus* was first introduced as a CSF by Raines (2000) study of seven European regions (viz. Arve Valley, France; East Sweden; Limburg, NL; North-Rhine Westphalia, Germany; the País Vasco, Spain; Scotland, UK; and Tampere, Finland) who argued that consensus must be attained among policy makers for a cluster to prosper; suggesting CSF17 to be a property of policy makers. Later studies by Hallencreutz and Lundequist (2003) of the Telecom City in Karlskrona, Sweden broadened the range of the policy making actors involved from the government, to other stakeholders, viz. large firms and universities; rendering thus CSF17 into a firm and HEI property. The latter study also suggested that such consensus could lead to shared *vision* (CSF1) among policymakers/stakeholders which in turn could further enhance cluster development.

The next CSF was simultaneously introduced by Klink and Langen (2001) and the OECD (2001). Both studies made similar remarks concerning the necessity of a cluster's *links* to *external* markets/environments although the OECD report made a more explicit case for the necessity of links to international markets. All subsequent studies e.g. by the Expert group (2002), Sölvell et al. (2003) simply added further support to the above claims. It may be worthy to report that the Tambunan and Suptarinko (2004) study of a number of SME clusters (e.g. handicraft, textile, furniture) in Indonesia reported on the lack of external linkages as a reason for the failed development of these clusters, while more recent studies; e.g. by Sölvell (2008) clarified that such linkages to international markets are crucial both in terms of factors and goods¹⁵. All the studies thus can be taken to suggest that CSF18 is a relation between the

¹⁵ According to Sölvell (2008, p. 43) 'goods markets' are import or export destinations of product-related-goods such as raw materials, components, and final products; whereas 'factor markets' are import or export destinations of production factors such as skilled labour and inward investment.

cluster, its firms and the external markets (be them national or international for goods or factors).

The *balance* between public and private involvement in cluster development was the next CSF to be chronologically introduced simultaneously by the Expert group (2002) and the Lundequist and Power (2002) studies. The former suggested that public sector organisations should limit themselves to playing a ‘catalytic role’, enabling firms to feel freedom to grow, whereas the latter emphasised the importance of such a balance especially for clusters that emerge in a bottom-up fashion; as the founding firms recognize themselves as the ‘true cluster owners’, resenting the tendencies of public sector intervention once the cluster starts to prosper. Both studies seem to converge on the idea that CSF19 is a property of the relation between governments and firms.

Lundequist and Power (2002) were also the first to introduce the competence *support* for cluster firms as a CSF after observing the key role played by the Telecom City Association¹⁶ (as a competence supporting organization) at the Karlskrona Telecom City in Sweden. In the following year the Hallencreutz and Lundequist (2003) study reported similar findings concerning the key role¹⁷ of the Industrial Development Centre in the Hultsfred Rock City in Sweden. More recent studies, e.g. by Athiyaman and Parkan (2008) of the tourism cluster in Queensland, Australia added further support to CSF20 by reporting further examples of such crucial competence supports, e.g. to individual firms in customer management and marketing as well as more general training and educational programmes targeting all cluster firms. All studies concerned with CSF20 thus seem to converge at this CSF being a property of the relation between competence supporting organisations and firms.

Last but not least CSF21 refers to the importance of *solidarity* among cluster and regional actors that was only recently introduced by Weil (2009). He reported that the solidarity among the actors in the Silicon Valley (a peripheral region during the early stages of the cluster), who were suffering from a lack of legitimacy, has been a key driving force for its growth. Although he was not as explicit about the particular actors involved it should be unnecessary to argue that this CSF is also the property of a relation, and that given the Silicon Valley context of his study, that this relation would minimally include firms and HEIs.

Having completed the review of the literature relating to the 21 CSFs listed in Table 1 and having unearthed the implicated objects, Table 2 summarise their relation.

Table 2: The objects implicated in the 21 CSFs

Objects	CSFs																					T
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
Firms	■	■	■			■			■		■	■	■			■	■	■	■	■	■	14
(multi-level) Government	■				■	■	■		■		■					■						11
HEIs		■	■						■			■	■	■	■						■	10
Cluster					■	■	■		■				■	■	■	■						9
Region				■	■	■	■		■						■	■						6
Competence supporting organisations									■											■		2
Entrepreneurs														■								1
Media						■																1
Financial institutions											■											1
(international) Markets																		■				1

¹⁶ For example coordinating an increase in R&D, inter-firm and firm-HEI cooperation, fostering spin-offs, attracting new entrants, and marketing the ‘TelecomCity’ brand (ibid., p. 694).

¹⁷ For example supporting firms and other actors by providing a physical forum for entrepreneurs with new ideas, SMEs, LSEs, researchers, industry and public sector organisations (ibid., p. 541).

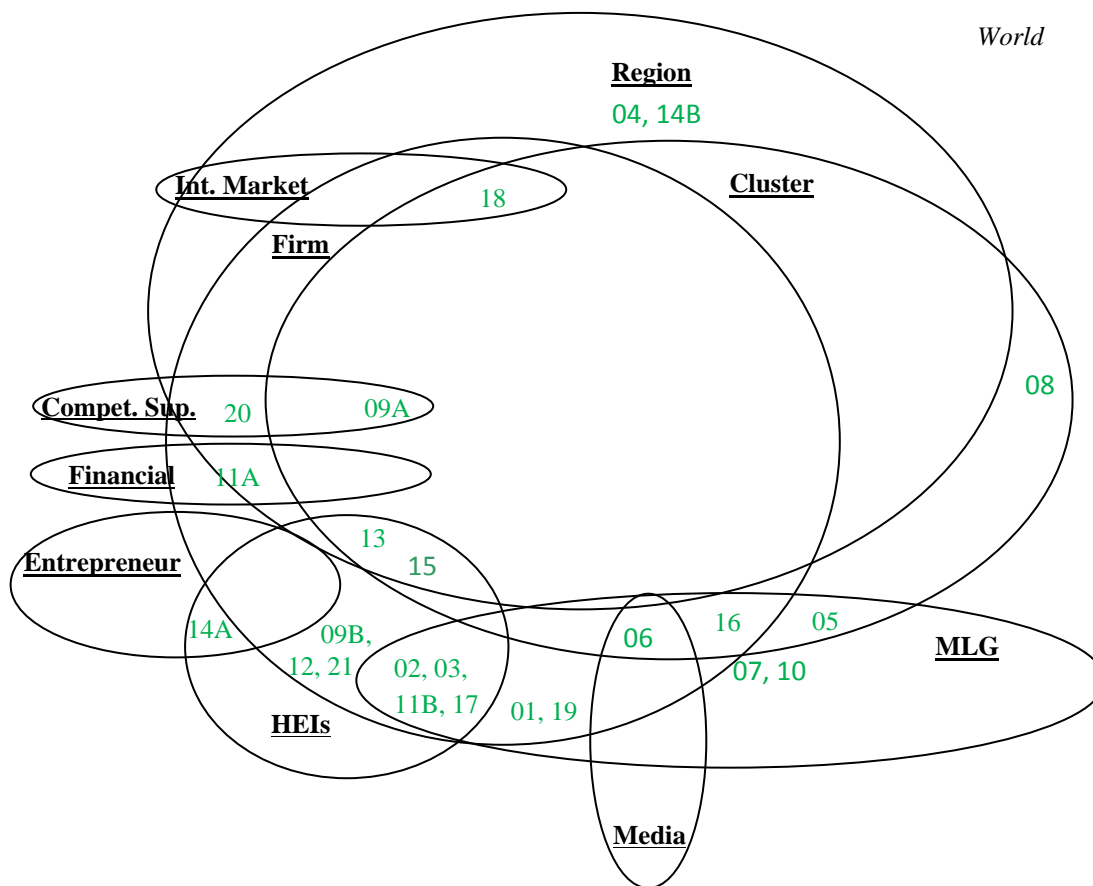
Source: Authors creation based on the reviewed literature.

Notes: Black cells refer to a CSF, grey ones to a dependency relation.

As summarised in Table 2 the object that is implicated in the vast majority of CSFs (15 out of the 21) are firms. This should not come as a surprise given that firms are one of the constitutive elements of a cluster as introduced in section one of this paper; especially as without them there would be no cluster, let alone a successful one. It is though impressive that HEIs and MLG are implicated an equal number of times (in 11 out of the 21 CSFs; which is the second highest). The cluster and the region score almost equally by being implicated in 8 and 7 CSFs respectively. However, following the latter, all other objects, viz. competence supporting organizations, entrepreneurs, media, financial institutions, and (international) markets are being implicated in one or two CSFs at most.

Having discussed the extent to which the ten objects are implicated in the 21 CSFs we can now proceed to develop an appropriate conceptual framework that is able to capture these overlaps. That is using a Venn diagram as made visible in the following figure.

Figure 1: Conceptual framework in a Venn-diagram form



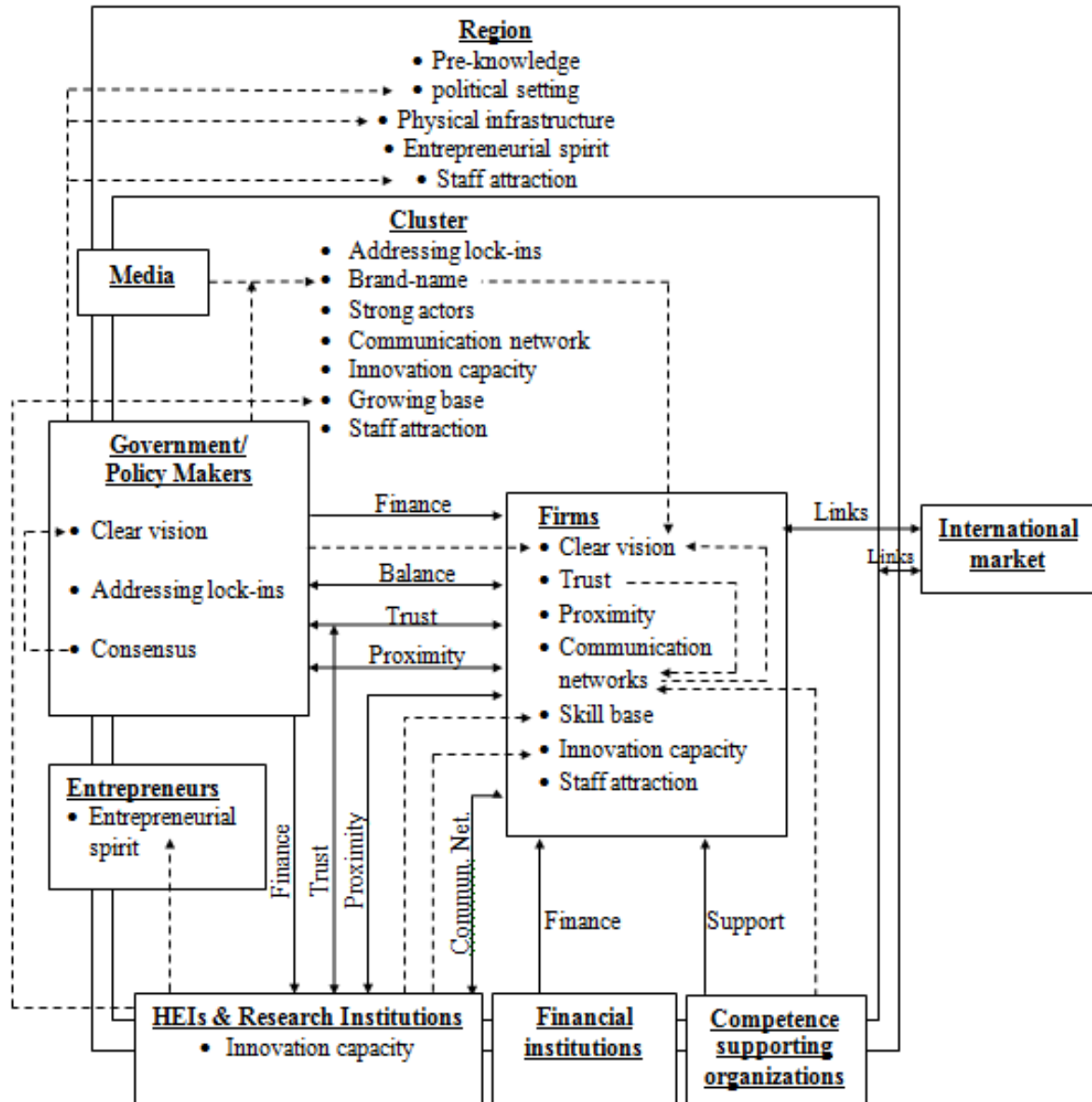
Source: Based on the reviewed literature summarised in Table 1 and the relations reported in Table 2.

Notes: Numbers refer to respective CSFs (as in Table 1). The CSFs are positioned as belonging to one or more sets defined by their respective objects. The set overlaps follow the review of the literature. Due to depiction limitations, three CSFs (viz. 9, 11, 14) appear twice indicated with A and B.

4. Model development, testing, and discussion

In the previous section the review of the literature concluded with a conceptual framework developed using a Venn diagram in which the 21 CSFs were positioned as elements of ten sets; each set representing an implicated object with some CSFs belonging to (i.e. being properties of) more than one sets. In this section the objective is to convert this conceptual framework into a testable model. The result of this transformation is depicted in Figure 2 and discussed below.

Figure 2: Conceptual model of CSFs



Source: Authors' creation based on the conceptual framework.

Notes: A box refers to an object (object names appear in bold and underlined) which may contain one or more CSFs if they are 'proper' properties (in a subset theory sense; i.e. not belonging to another object as well). A solid line refers to a CSF that is a property of the relation between two or more objects. Solid lines can be uni- or bi-directional depending on the directionality of the depicted relation. A dotted line refers to a dependency relation between objects and CSFs or among CSFs. The direction of the dotted line indicates the ordering of the depicted dependency.

The model in Figure 2 depicts the reviewed set of relations between CSFs and their implicated objects along with any dependency relations. It is a scalable and open ended model that can be easily and rigorously revised at the face of new evidence. Such a model could be used to:

- i) identify *gaps* in the existing literature, such as the lack of relations between objects, or the lack of CSFs for some objects
- ii) develop testable *hypotheses*, e.g. concerning the CSFs of clusters in different regions, countries, industrial specialisations, and stages of development
- iii) *diagnose* the extent of presence/absence of CSFs and objects in clusters that are allegedly un/successful
- iv) *measure* the impact of actual CSF-constellations on cluster success
- v) *predict* cluster success in subsequent stages of its life-cycle on the basis of the presence/absence of the particular constellation of CSFs in its earlier stages
- vi) develop *computer simulations* of CSFs
- vii) inform, support, redirect, etc. *intervention* efforts, e.g. when only one of the implicated objects are addressed or when resources are wasted on irrelevant CSFs.

As this paper also aims to act as a proof of concept for the developed model, the third option from the above list is to be pursued in the remaining paragraphs of this section. To that effect, a successful cluster, according to Klofsten et al. (1999); Etzkowitz and Klofsten, (2005); Hommen et al. (2005); Feldman (2007), viz. the Linköping ICT in east-middle Sweden is to be used as a test case. This region also happens to be among the EU27 leading regions in terms manufacturing and services labour productivity (Tsagdis and Alexiadis, 2009), although below the EU27 average in terms of: localisation (that is the size of its dominant economic activity), GDP per capita growth rate, but above the EU27 average in terms of: income per capita, economic diversity (that is the variety in the remaining economic activities), highly qualified labour, and labour employed in advanced sectors (Tsagdis, 2010).

It could thus be argued that this is a rather successful cluster in a pretty successful region (at least during the 1995-2006 period to which the above indicators refer). Moreover, as this cluster has gone through a complete life-cycle and has experienced rebirth, one could be justified in expecting that the vast majority of the 21 CSFs would be present.

As the model's testing is meant to be a proof of concept, and not an exercise in evaluation precision, a three stage periodisation of the cluster's life cycle is adopted, viz. birth, growth, and maturity. The presence or absence of the 21 CSFs is then sought for each stage. The results are summarised in Table 3 below; whereas a more detailed discussion can be found in Tavassoli (2009).

The first thing that is noticeable in Table 3 is that although the majority of CSFs are present in all stages, five (i.e. about a quarter of all) CSFs are absent from all stages, viz. *Addressing lock-ins*, *Political setting*, *Consensus*, *Balance*, *Solidarity*. It is also interesting to note that there are four additional CSFs viz. *Brand-name*, *Communication networks*, *Physical infrastructure*, *Staff attraction* that were absent during the birth stage of the cluster's life-cycle. Taken together (i.e. the absence of these 9 CSFs) it could be argued that although about half of all CSFs in the model were absent during the birth of the cluster, this is nonetheless a successful cluster. This is obviously encouraging to other emerging clusters as it suggests that growth and ultimately cluster success can take place from less than perfect initial conditions, or that at least not all CSFs need to be present at birth. It can also be taken to suggest that not all CSFs are equally good predictors of cluster success (as in v above) as well as that some CSFs may not be relevant to particular specialisations; ICT in this case (as in ii above).

Table 3: Testing for CSFs presence in the Linköping ICT cluster life-cycle stages

#	CSFs	Birth (1984-1989)	Growth (1990-1999)	Maturity (2000-present)
1	<i>Right vision</i>	+	+	+
2	<i>Trust</i>	+	+	+
3	<i>Proximity</i>	+	+	+
4	<i>Pre-existing knowledge</i>	+	+	+
5	<i>Addressing lock-ins</i>	-	-	-
6	<i>Brand-name</i>	-	+	+
7	<i>Political setting</i>	-	-	-
8	<i>Strong actor(s)</i>	+	+	+
9	<i>Communication networks</i>	-	+	+
10	<i>Physical infrastructure</i>	-	+	+
11	<i>Finance</i>	+	+	+
12	<i>Skill base</i>	+	+	+
13	<i>Innovation capacity</i>	+	+	+
14	<i>Entrepreneurial spirit</i>	+	+	+
15	<i>Growing base</i>	+	+	+
16	<i>Staff attraction</i>	-	+	+
17	<i>Consensus</i>	-	-	-
18	<i>External links</i>	-	-	+
19	<i>Balance</i>	-	-	-
20	<i>Support</i>	+	+	+
21	<i>Solidarity</i>	-	-	-

Source: Primary and secondary data have been used in the above table. Primary data have been collected by Tavassoli in 2009 during semi-structured face-to-face interviews with key cluster actors (e.g. the SMIL board). For a more detailed discussion see Tavassoli (2009).

Notes: A positive (negative) sign refers to the presence (absence) of the respective CSF.

Having completed the testing of the model and the discussion of its results the following section concludes this paper by summarizing its findings, discussing their policy implications and delineating some areas of further research.

5. Conclusions, policy implications, and areas of further research

#

This paper started from the premise that the cluster literature on CSFs and success in general appears contradictory or at least ambiguous in several respects. By undertaking a systematic, rigorous, and critical review of this literature it was possible to develop a robust yet flexible model of CSFs and unearth their implicated objects.

It also proved possible to identify several gaps in this literature, as in (i) in the previous section. For example, the fact that most studies are not explicit on the level of regional geographical resolution involved (e.g. NUTS2 or 3) which is particularly pertinent for CSFs that are regional-properties. Similarly, the literature is far from clear as to the objects implicated in CSFs that are cluster-properties or the particular level(s) of (multi-level) governance involved. Furthermore most studies only highlight the presence of some CSF and hardly ever make any effort to report on its intensity or describe the time period(s) involved. Finally, most of the reviewed literature tends to treat a cluster's hosting region as a CSF input provider and rarely attempts to explore how cluster-success or other (non-regional) CSFs feedback to the region.

Moving to the testing of the model against the Linköping ICT cluster, the results afforded some equally interesting findings. For example, concerning the temporal manifestation of CSF-constellations or the possibility that some CSF-constellation may be specialisation- or life-cycle-stage specific. It is also particularly encouraging that although a successful cluster and region, about half of the CSFs were absent during its birth stage and about a quarter from its two subsequent stages. This should be instructive to policy makers and other stakeholders involved in developing successful clusters and regions.

Obviously the value of the developed tool is in its use and it is expected that its continued use will also improve its value, as novel encounters with other clusters will further refine the CSFs, delineate stage or sector-specific constellations thereof, etc.

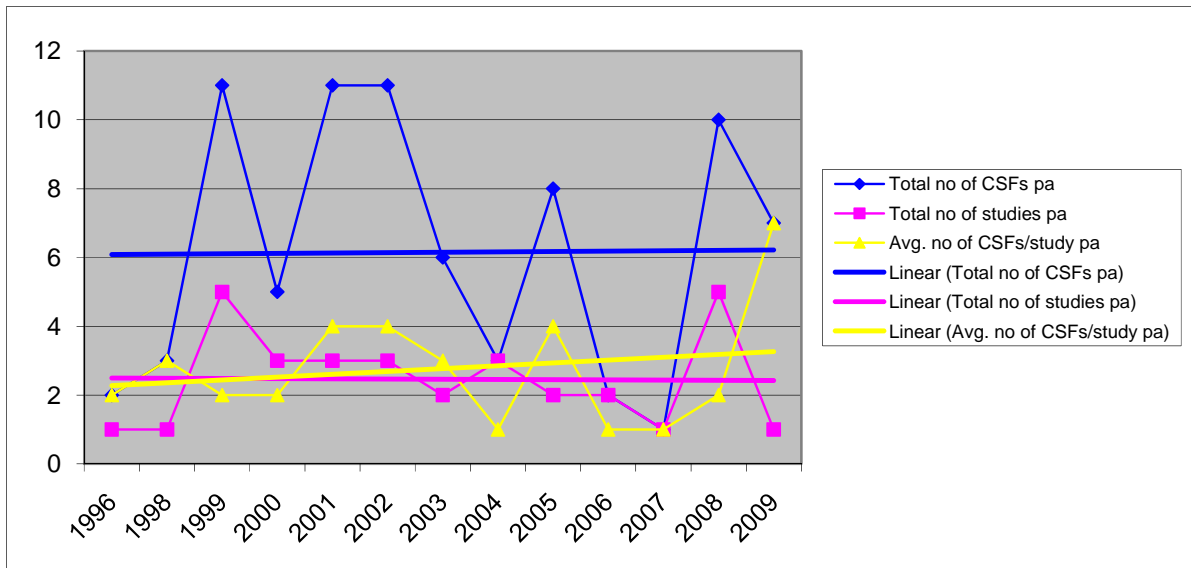
The above also delineate some areas of further research. For example concerning the model's enrichment and refinement (both in terms of the CSFs and their implicated objects) on the basis of additional literature and empirical evidence. The model could also be calibrated for example by introducing different weights to each CSFs in different cluster life-cycle-stages or cluster-specialisations

Nonetheless, the model provides an important first step towards the rigorous treatment of the factors that underpin cluster, and by implication regional, success, while opening up an exciting research agenda that can only bring rewards to the researchers and policy makers alike that intend to engage with it.

Appendix 1

#	CSFs	Implicated objects	Literature
1	<i>Right</i> (e.g. clear, focused, flexible) <i>vision</i>	Government (agencies), policy makers, and firms (e.g. industry leaders)	Klofsten and Jones-Evans (1996), Ecotec (2001), Lundequist and Power (2002), Hallencreutz and Lundequist (2003), Etkowitz and Klofsten (2005), Athiyaman and Parkan (2008), Sölvell (2008)
2	Existence of <i>trust</i> between actors	Firms, government and policy makers	Klofsten and Jones-Evans (1996), Gordon and McCann (2000), Ottati (2004), Gaggio, (2006) Iammarino and McCann (2006)
3	<i>Proximity</i> of actors to each other	Government, HEIs & Research Institutions, firms	Porter (1998), Porter (2000), Expert group (2002), Etkowitz and Klofsten (2005), John and Pouder (2006), Sölvell (2008), Weil (2009)
4	<i>Pre-existing knowledge</i> and strong science/ technology base within the region	Region	Porter (1998), Ecotec (2001), Expert group (2002), Hospers and Beugelsdijk (2002), Lundequist and Power (2002), Hallencreutz and Lundequist (2003), Adams (2005), Johansson and Forslund (2008), Weil (2009)
5	<i>Addressing lock-ins</i> (to technology, supplier, etc.)	Government and policy makers, cluster, region	Porter (1998), Expert group (2002), Bergman (2008)
6	Developing the cluster as a <i>brand-name</i>	Cluster /media, government and policy makers	Peneder (1999), Raines (2000), Expert group (2002), Lundequist and Power (2002), Athiyaman and Parkan (2008), Sölvell (2008)
7	Appropriate <i>political setting</i>	Region/ government and policy makers (as creator of CSF for region)	Legendijk and Charles (1999), Sainsbury (1999), OECD (2001), Expert group (2002), Hospers and Beugelsdijk (2002), Lerch et al. (2007), Aziz and Norhashim (2008), Borrás and Tsagdis (2008), Sölvell (2008)
8	Existence of at least one <i>strong actor</i> (e.g. large firms, innovative university)	Cluster	Klofsten et al. (1999), Sainsbury (1999), Raines (2000), Ecotec (2001), Hallencreutz and Lundequist (2003), Adams (2005)
9	<i>Communication networks</i> and knowledge integration	Cluster, firms, HEIs/ competence support org.	Ceglie et al. (1999), Sainsbury (1999), Ecotec (2001), Expert group (2002), Morosini (2004), Weil (2009)
10	Appropriate <i>physical infrastructure</i>	Region/ government	Sainsbury (1999), Ecotec (2001), Expert group (2002), Adams (2005), Sölvell (2008)
11	Access to <i>finance</i>	Firms, financial institutions, government and policy makers, HEIs	Sainsbury (1999), Ecotec (2001), Adams (2005), Sölvell (2008), Weil (2009)
12	Presence of strong <i>skill base</i> within firms	Firms/ HEIs	Sainsbury (1999), Ecotec (2001), Lundequist and Power (2002)
13	<i>Capacity for innovation/ R&D</i>	Cluster, Firms, HEIs	Sainsbury (1999), Ecotec (2001), Sölvell et al. (2003)
14	Presence of <i>entrepreneurial spirit</i>	Entrepreneurs, region/ HEIs	Sainsbury (1999), Ecotec (2001), Adams (2005), Weil (2009)
15	<i>Growing company base</i>	Cluster	Sainsbury (1999), Adams (2005)
16	<i>Staff attraction</i>	Region, Cluster, firms/ Government	Sainsbury (1999), Weil (2009)
17	Capacity for <i>consensus</i>	government and policy makers	Raines (2000), Hallencreutz and Lundequist (2003)
18	<i>External links</i> to outside market/environment	Cluster, firms, international market	Klink and Langen (2001), OECD (2001), Expert group (2002), Sölvell et al. (2003), Tambunan and Suptarinko (2004), Sölvell (2008)
19	<i>Balance</i> between public and private involvement in cluster development	Government and policy makers, firms	Expert group (2002), Lundequist and Power (2002)
20	Competence <i>support</i> for firms	Firms /competence support organizations	Lundequist and Power (2002), Hallencreutz and Lundequist (2003), Athiyaman and Parkan (2008)
21	<i>Solidarity</i> between actors in peripheral region (suffering from lack of legitimacy)	All actors (generally speaking)	Weil (2009)

APPENDIX 2



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