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Towards DUI Regional Innovation Systems

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Abstract
This paper marks a departure in seeking to develop the conceptual and practical apparatus of a regional innovation system (RIS) for science & technology-disadvantaged regions. It is empirically based and builds on insights about the limitations of STI (The Science-Technology-Innovation Approach, which is Linear, Specialist, Exclusive, Explicit/Codified, Global) and the strengths of DUI **(**The Doing-Using-Interacting Approach, which is Interactive, Diversified, Inclusive, Implicit, Regional/Local). DUI is highly compatible with Schumpeterian understanding that the core process of innovation is 'knowledge recombination'. From an evolutionary economic geography perspective, which is taken in the paper, this raises interesting issues for the economics of knowledge. First it underlines the need to pay serious attention to questions of the 'proximity' imperative, suggesting not that knowledge is easily appropriable for ('open') innovation but that it may be excessively difficult to identify because it lies hidden in possibly neighbouring - but different - industries and firms. Thus, second, it makes the notion of 'knowledge spillovers' problematic because the spillovers may not be forthcoming at all or may come in unrecognisable forms. Hence, third, this means that firms likely need more than usual RIS intermediation (including knowledge demonstration and transfer services) to avoid market failures of innovation. Assistance with identification of ‘modular’ policy elements is only one of the services required for DUI product, process and policy innovation. The complexity theory notion of 'transversality' has been advanced to capture the 'emergence' of novelty out of contexts of difference, unifying a solution to the three conceptual problem-issues raised in the paper.

Introduction

This paper is a research-informed contribution to a new kind of regional innovation policy based on evolutionary economic geography principles. It shows how a small, selection of regions are responding to economic, financial and sustainability crises by searching for models of development that take innovation seriously but do not confine it to an STI (science, technology, innovation) mode of 'policy framing'. Rather, each is keen to recognise and enhance formerly often-unrecognised, practical DUI (doing, using, interacting) innovation styles pursued by firms and other actors usually in the absence of formal science. The findings are interesting because until now there has been no 'model' of a DUI regional innovation system (RIS) either theoretically or practically, in any formalised sense.

The paper proceeds to three formalisations of RIS set-ups that formally involve DUI, albeit in a variety of hybrid forms in which STI is either weakly (Algarve) or more strongly (Centro, Skåne[1]) engaged. It begins with clarification of the differences between STI and DUI framings of innovation, after Jensen et al (2007; see fn. 2). This leads in the next section to an evolutionary theoretical discussion of the rise of 'modularity' as a new mode of policy formulation whose origins lie in process innovations in the ICT industry. Following this is are brief sections based on 'deliberative research' in which the author was both 'participant observer' and 'critical friend' to the process of learning how to more fully embed DUI support into regional innovation policy processes in Portugal's Algarve region. This involved analysis of an organisational process from the management of transitions to sustainable development practice, called 'strategic niche management', connecting STI and DUI, while formalising and externalising the resulting innovation processes. There are then two sections introducing different regional experiences of involving DUI alongside STI in regional innovation. Finally, there is a Discussion and Conclusions section.

What Is STI Type Innovation and What Is DUI?

The Science-Technology-Innovation (STI) approach might be referred to as the classic, top-down, internal, research and innovation (R&I) model first practised in

[1] Further detail on Skåne can be found in Cooke, P. (2012) *Complex Adaptive Innovation Systems*, London, Routledge

large corporate laboratories like GE and AT&T *transformed* into an externalised model of university laboratory research translated into technological innovation through "academic entrepreneurship". It is the source of start-up and spin-out SMEs in high-tech clusters such as Silicon Valley and Cambridge, Massachusetts. As such, it has been an innovation model, pursued with much rhetoric, investment and variable results throughout the world of regional and national economic development. It is sometimes characterised in terms of a "patenting - seed/angel/venture fund - incubator" model of new business growth. It thrives in economic boom times when venture capital is abundant but withers in economic downturns when risk capital is scarce. The approach is inclined to be *Linear* with some interactivity among science, finance and entrepreneurship (although the finance element often drives out the scientific founder element due to the perceived weak business management skills of the latter). It is *Technology-push* in inspiration. The approach is highly *Specialist*, taking often extremely advanced scientific findings (single molecule or function), to a hoped-for exit on the relevant market. Accordingly, it is *Exclusive*, being advanced, protected and proprietorial in terms of knowledge. This is even though patenting and publication nevertheless render such knowledge to a large extent *Explicit/Codified* and finally, because of codification it is knowledge that is, in principle *Global* in its reach and accessibility, i.e. anyone with the right skill-set can, in principle, exploit it.

This contrasts markedly with the Doing-Using-Interacting (DUI) approach to innovation. This is not immediate exploitation of laboratory bench knowledge, although some such knowledge may lie behind the current state-of-the-art or even contribute to its furtherance. DUI involves knowledge recombination among diverse knowledge and practice sets. Accordingly it is fundamentally *Interactive* among firms and/or intermediaries characterised by "related variety" in the first instance. However, research shows that such is the potential of Schumpeterian knowledge recombination that many innovations integrate sectorally very different firm or institutional knowledge-sets. One only has to think of the Wright brothers' first flight, the plane for which embodied boat propellers, kites, bicycle wheels and chains *inter alia*. In this respect, DUI is *Practice-driven*. Accordingly, DUI is *Diversified* in that it thrives on cross-fertilisation or cross-pollination of ideas and practice from different fields, for example the intelligent textiles for stay-clean car seats that

inspired the innovation of bacteria-free medical uniforms. This means DUI is *Inclusive* to firms that have the needed information about a shared innovation possibility provided demonstration effort is made (e.g. by a regional innovation & development agency – RIDA) through presentations, roadshows or living laboratory-based "innovation theatre". The entailed knowledge for DUI is thus *Implicit* rather than codified, and *Regional/Local* rather than globally available. Later in the paper, designs of evolving DUI regional innovation systems (RIS) are delineated to demonstrate both the specific characteristics these have but also showing how they are open to STI involvement where desirable and appropriate[2].

A New Modular Vision of Regional Innovation

On the question of a region's first-round vision for its regional innovation economy it may be hypothesised, as a thought experiment, that such an exercise identified six key sectors, half established and half 'emergent'. The point about 'emergence', the theory for which rests solely upon the central idea that innovation comes from recombination of (in science) *molecules* and (in social science) *modules* is extremely important to understand in envisioning a different regional future. *It means thinking of sectors as embodying modules that must be integrated to accelerate regional innovation. This modular approach is increasingly perceived to be the way forward for regional innovation policy*[3]. This overcomes the development blockage of sectoral specialisation in 'silos' by rotating recombinative interactions from the vertical into the horizontal (interaction at industry interfaces) through a full ninety degrees to enhance Schumpeterian 'recombinative' innovation.

Accordingly the 'emergent' vision for the region involves the following:

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[2] For further explication of STI/DUI characteristics, see: Jensen, M, Johnson B, Lorenz E. & Lundvall, B. (2007) Forms of knowledge and modes of innovation, *Research Policy*, 36, 680-693

[3]Henderson, R. & Clark, K. (1990) Architectural innovation: the reconfiguration of existing systems and the failure of established firms, *Administrative Science* Quarterly, 35, 9-30: Sturgeon, T. (2002) Modular production networks: a new American model of industrial production, *Industrial & Corporate Change*, 11, 3 451-496; Gawer, A. (ed.) (2009) *Platforms, Markets &* Innovation, Cheltenham, Elgar; Chapter 5 of Cooke, P. (ed.) (2013) *Reframing Regional Development*, London, Routledge

- Evolving a more dynamic, sustainable and innovative region (key vision statement), by
- Increasing openness to innovation at interfaces between innovation and entrepreneurship, by
- Implementation of new innovative content activities, e.g. a diverse food or tourism offer (not simply 'mass consumption' or 'sun & beach'), by
- Integration of healthcare, renewable energy and new 'creativity' (innovation by interactions among culture, heritage, ICT and performance resources) with economic processes

Source: See, for example, *RIS3 Algarve 2014-2020 Report*, p. 76 [4]

This represents an early RIS3 statement that may evolve into a more thoroughgoing methodology, based on demonstration, learning, exploring, modularising and creating innovative products, processes and methodological/organisational forms. It means absorbing more S&T for working out and working through a *new DUI system model* for regional innovation. More will be said on the outline sketch elements of such an integrative (transversal) model in the sections which follow.

DUI and Strategy to Set Innovation & Knowledge-based Development Priorities

With respect to innovation-led and knowledge-based development priorities many regions will stress that they have a different profile from the metropolis and from other economic regions. Hitherto, a consistent refrain has been the aim to make up lost ground in developing a stronger S&T infrastructure, which other regions and the metropolis may already have advantage for STI, and may be better-placed to transform it into commercial innovations. However, the STI *disadvantaged* region may now also seek to develop the productive, DUI character of its evolving innovation profile. Thus recognising that '....we can't get a Technology Park in our region because we only have some twelve or so relevant firms compared to the metro-region, which has many more....' the region now needs to think of a different model of knowledge transfer to firms. This echoes the sentiments about searching for

[4] J. Guerrero & H. Pinto et al. (2013) '*RIS3 – Algarve 2014-2020: Research & Innovation Strategy for Smart Specialisation'* (Version 0.2 – 30/4/2013), Faro, Algarve CCRD

'.....a new DUI model of regional innovation.....' mentioned previously. *It may be that a Technology Park or a Technopole is not the best way in which to raise absorptive capacity for innovation opportunities and entrepreneurial search/discovery in a DUI innovation context*. From a traditional metro-perspective, which is that of the linear, top-down and sectorally specialist recipe practised and promoted by the EU for decades, DUI regions lack the *critical mass* in specialist fields like nanotechnology to warrant a pole in such a field. Even where a different 'peripheral' region may have 'politicked' such an investment without the requisite profile either, to make it work will require the stimulation of 'transversality' across S&T interfaces to help foster positive R&I outcomes. In many regions, DUI innovation is the stronger suit, reinforced with S&T elements, and DUI requires either mixed R&I centres or a more multiplex, distributed intelligence for knowledge exchange and transfer represented by regional networks. This involves a process not of 'picking winners' but 'learning from your own industry' what it thinks it needs for future innovation. As will be seen, some regions have already embarked on this process with 'Sounding Boards' or 'Thematic Issues' 'labs' bringing together entrepreneurs and associations in the form of 'detailed working groups' as requested, for instance, in background RIS3 documentation. In this way, a bottom-up process of Niche Identification has already been embarked upon. The question is: what is the next step? How to engage in Niche Management or even 'Strategic Niche Management'[5]?

Strategic Niche Management

This is really the new task for DUI and STI regions throughout Europe and, indeed, the world. There are a number of steps already worked out in the 'niche management' literature:

- Overcome 'critical mass' (which is mainly a nuclear engineering 'metaphor') by mixing sectoral affiliation (if any) of firms and/or their

[5]On 'Strategic' Niche Management in the renewable energy and broader sustainable economy fields, see, for example, Geels, F. (2004) From sectoral systems of innovation to socio-technical systems: insights about dynamics and change from sociology and institutional theory, *Research Policy*, 33, 897-920; Geels, F. (2010) Ontologies, socio-technical transitions (to sustainability) and the multi-level perspective, *Research Policy*, 39, 495-510.

associations. As the basis for a new approach, a useful preliminary aim is to help form '….one single Regional Business Association.'

- This can then more firmly host the 'Thematic Issues' around which panels of industry representatives and/or entrepreneurs will focus, bringing together opportunities for niche management at industry interfaces with, subsequently, entrepreneurial discovery and exploitation [6].

- 'Learning from your industry' means the region paying serious attention to the considerations and conclusions of such panels regarding 'niche opportunities' for exploitation from knowledge recombination discussions.

- The region (through its Innovation and/or Development Agency) must then be 'catalytic' in organising 'innovation theatre' in the form of demonstrations, roadshows, and exhibitions across the community of regional entrepreneurs

- This involves: First, showing *existing* innovations (minimising *imitation*, which RIS3 officially eschews) from inside or outside the region, including abroad, that may be 'preadapted' (transferable) modules or whole solutions for re-use in a new problem or industry context,

- Second, showing potential innovations that may have niche value across interfaces, mainly involving the 'modular' deliberations of 'sounding boards' or entrepreneur panels (including R&I expertise), with outsiders invited to adjudicate or help take forward. Hence this explores the 'White Spaces' that no-one has yet identified and rests on bringing together 'knowledge modules' that are candidates for niche-based innovation.

- Third. the region must then 'orchestrate' contests in which competition for innovation subsidies and support (RIS3 + national/regional + private resources) occurs among the 'preadapted' and 'White Space' concepts respectively (this means 2 'concept contests') with the winners being rewarded

[6] The workings of this approach are shown in Melkas, H. & Uotila, T. (2013) Foresight and innovation: emergence and resilience of the cleantech cluster at Lahti, Finland, in P. Cooke (ed.) *Reframing Regional Development*, London, Routledge

with funded support projects (in which, to repeat, there must be substantial private as well as public investment funding).

- Fourth, these 'concept contests' will likely be project-based, (i) early-stage and exploratory, (ii) mid-stage and examinatory, and (iii) final-stage and exploitative in nature and status, (3 types of award per 'concept contest') with the aim always being to produce innovative outcomes,

- Finally, regions must establish a monitoring, learning and communication system to refine understanding and improvement upon successful practice. In this way, and following the 'strategic niche management' literature, the niche becomes, after time, 'the dominant design' or 'socio-technical paradigm' and eventually the 'landscape' or 'conventional wisdom' among innovation adopters.

Accordingly, it is clear that Innovation-led and Knowledge-based development priorities lie at the heart of DUI regional innovation (not excluding STI) ambitions and strategic process aspirations. However, crucially, this involves maintaining harmonious relations with the region's influential stakeholders. For example, municipalities may agree to more strategic thinking because "innovation" matters are usually accepted as regional fiefdoms. This marks recognition that R&I cannot satisfactorily be done at local level. Regarding 'niche identification', especially in fields with embryonic regional innovation status, the conventional view of what constitutes 'critical mass' hardly applies. The conventional view is perceived as primarily sectoral yet lacking any definition of what the term actually means[7]. Thus, in line with its aim of de-specialisation for the regional economy by seeking 'related variety' opportunities, core SME groups in, for example ICT would be augmented by user-driven SMEs and other firms in, for instance, tourism, agro-food, bio-marine, healthcare or renewable energy to seek to broaden regional 'critical mass', innovation base, knowledge 'transversality' and application.

In this way, regional innovation strategy will be related to but not confined by regional involvement in narrow sectoral entrepreneurial discovery processes. Even though these may grow from regional economic strengths and foster possible new

[7] It is a dull repeat of Zeno's Paradox where the philosopher asked, without answer: 'How many bees make a swarm?' Nowadays it is 'How many firms make a cluster?'

pathways emerging from those strengths, they are innovation, not industry, specific. Accordingly, 'critical mass' can be mobilised in an effective, efficient and flexible way. As an innovative response where little S&T-type innovation occurs – albeit with a longer-term aim of achieving greater balance in regional innovation style – the 'astute' or 'shrewd region' will more consciously pursue a DUI innovation process while also seeking to build up its S&T/R&I knowledge resources through RIS3 and associated national measures. The region will, accordingly, seek to moderate the following perceived 'Innovation Context' drawbacks:

- Where a region lacks conventional (R&I) innovation capacities it also implies low absorptive capacity by firms to R&D. This also limits the entrepreneurial base,
- Regional innovation infrastructure assets are constrained by a relative lack of past investments in technologies and their support infrastructures, hard and soft (i.e. innovation agency, cluster animators, incubators and associated services and technology centres or poles),
- In relation to 'interactive innovation' methodologies, a DUI region lacks strong intra-regional connectedness among innovation 'system actors' – especially between firms and knowledge producers (STI),
- Over-specialisation in industries like mining, agro-food or tourism emphasises the low innovation demand character of the regional economy. Hence innovation scoreboard indicators may be low for: R&D expenditures (especially private), employment in medium to high-tech activities (manufacturing and services), EPO patents and public-private co-publications. However, DUI indicators may show increasing tech product and process improvements, SME endogenous innovation and innovation sales new to firm and market.

To conclude this section, it is clear regional bodies have been dissatisfied with injunctions towards 'smart specialisation', 'triple helix' and 'academic entrepreneurship' but have been unclear why that should be so. Recognition has grown that policy – from national to georegional to global – is biased in favour of STI and, accordingly, supporting the rich regions. Simultaneously, it is dawning on such

poorly STI-endowed regions that they are also poorly-endowed with R&I innovation infrastructure which is STI-inflected and 're-framing' the issue towards re-valuing DUI seeks to correct that situation. Accordingly, the region may have begun rejecting S&T indicators, that actually do not measure *innovation* performance and potential, to discover and formalise its DUI innovation assets.

Does Strategy Identify Appropriate Actions or Policy Mix?

Regarding planned action-lines for the development of transition by despecialisation, we may briefly, as an example, review Algarve's preparatory outline RIS3, which can be itemised as follows. It represents a recent but extremely *ex ante* stage of the policy formulation process. The *RIS3: Algarve 2014-2020 Report* [8] contains, in brief, the following vision:

- '*Transforming Algarve by 2020 into a dynamic, inclusive and sustainable region based on higher value output drawing upon innovation and the scientific knowledge-base, anchored in the Sea and leveraged by Tourism*'
- The Smart Growth areas of activity to be focused upon accordingly include Tourism and the Sea as key activities, accompanied by 'emergent' economic and innovation activities in agro-food, renewable energy, health and life sciences, ICT and creative activities,
- These destinations have been reached at *ex ante* process stage by a discourse formation activity engaging the stakeholders in an Innovation Forum setting which has identified 'Thematic Issues' and will develop 'innovation conversations' about 'related variety ' *innovation at interfaces* among regional industries and representative Innovation Forum expertise panels,
- Thus, with the region at the helm, hopefully led by a new regional innovation agency capability (part of the RIS3 strategy) the 'Economic Dynamics' roadmap is directed towards
    - Implementation of new innovative content activities
    - Development of diverse tourism supply and quality standards

[8] See footnote 3

    - Use of renewable energy sources
    - Creation of an appropriate (possibly DUI) pole of competitiveness
- This involves a process roadmap which stresses:
    - Institutional co-operation and network management
    - Develop human capital
    - Diversify economy
    - Stimulate entrepreneurship
    - Polycentric development inclusive of rural and urban areas

Regarding bodies responsible, the lead authority in Algarve is the CCDR, the regional council, responsible for implementing the strategy in the region. A key support agency for design and delivery of important services will be the University of the Algarve.

Among key DUI and, as they develop, STI innovation activities, managed by the Innovation Forum panels of expertise, notably firm representatives, will be 'innovation at interfaces' opportunities among industries to stimulate and promote entrepreneurial search and discovery of innovations. The envisaged *MarAlgarve* platform linking algae and other resources to cosmetics, food ingredients and healthcare clusters is designed and awaiting funding from RIS3 to move swiftly ahead. Marine resources clearly possess this 'transversal' GPT (general purpose technology) characteristic. Public procurement will be mobilised where appropriate to help create markets for new products and processes in relation to the roadmap target economic activities. The methodology for costing, budgeting and allocating project and other RIS3 related funding exists. Details of service providing mechanisms operating generically in support of regional innovation in RIS3 will similarly be calculated and included in the strategy proposals as appropriate (e.g. venture capital).

Is Strategy Outward-looking?

As a case in point of 'specialisation syndrome' some coastal or mountain regions suffer from too much specialisation – in tourism, particularly for coastal regions the "sun and beach" specialism - as perceived by national government. Having said that, such regions are often highly entrepreneurial where entrepreneurs are capable of swift adaptation. So, if a niche opportunity presents itself, entrepreneurs are not slow in coming forward to make money. Notice also that local licensing can facilitate this

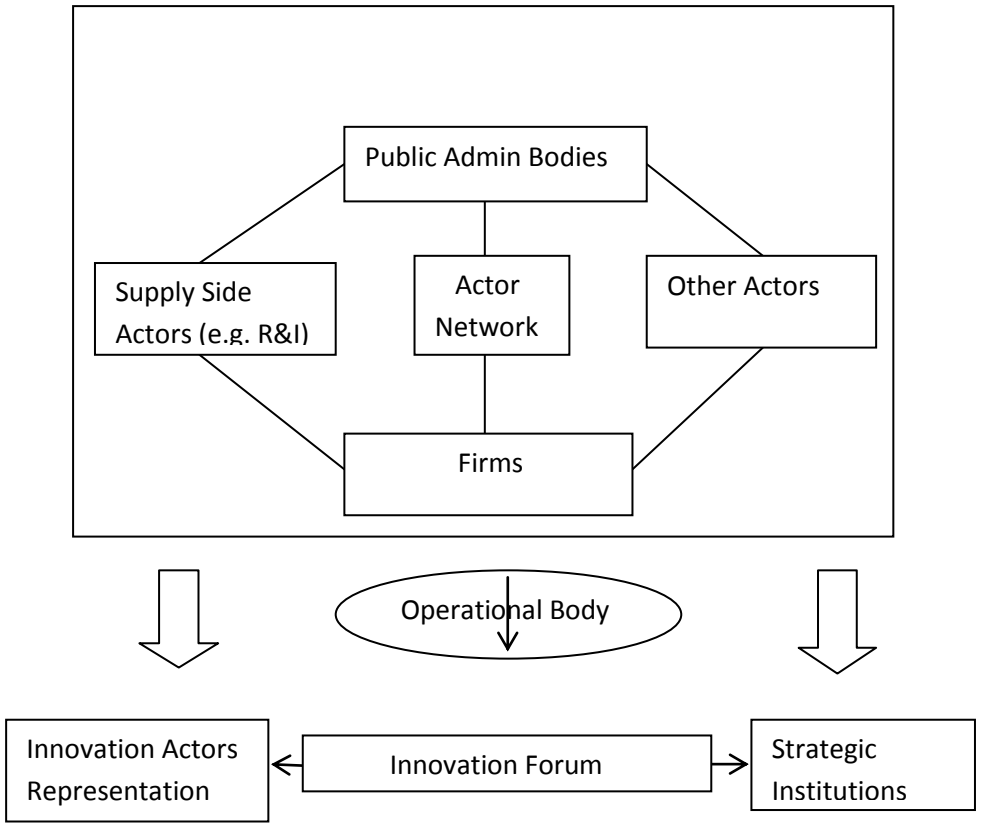

Fig. 1: Regional Innovation Governance Model for Algarve, 2007. (Source: Guerrero/Pinto, 2013)

process. There are municipal licenses and licenses for economic activity, so some advantage may accrue from regions being decentralized in terms of authority. This may even be advantageous in attracting 'prestigious' FDI (foreign direct investment) projects complementary to national priorities. But national governments may steer specialized FDI to the appropriately specialized region, too. Accordingly, specialized regions may suffer from 'lock-in' meaning the region is specialized, adaptable, but not particularly "smart" because of old perceptions of its 'role' in the national

economy. What the specialized region needs, in consequence of this character, is "Smart Diversification". Regions' past achievements will have moved them up the learning curve and may include: experience in managing EU Structural Funds Operational Programmes; specific record of managing MLG (multi-level governance) innovation initiatives; achievement of (DUI) results in raising innovative behaviour of indigenous firms; assisting traditional firms learn about ICT and adaptations; and experience with policy decentralisation to municipalities. Now the challenge is to raise the learning and monitoring practice in the region under, for example the EU's

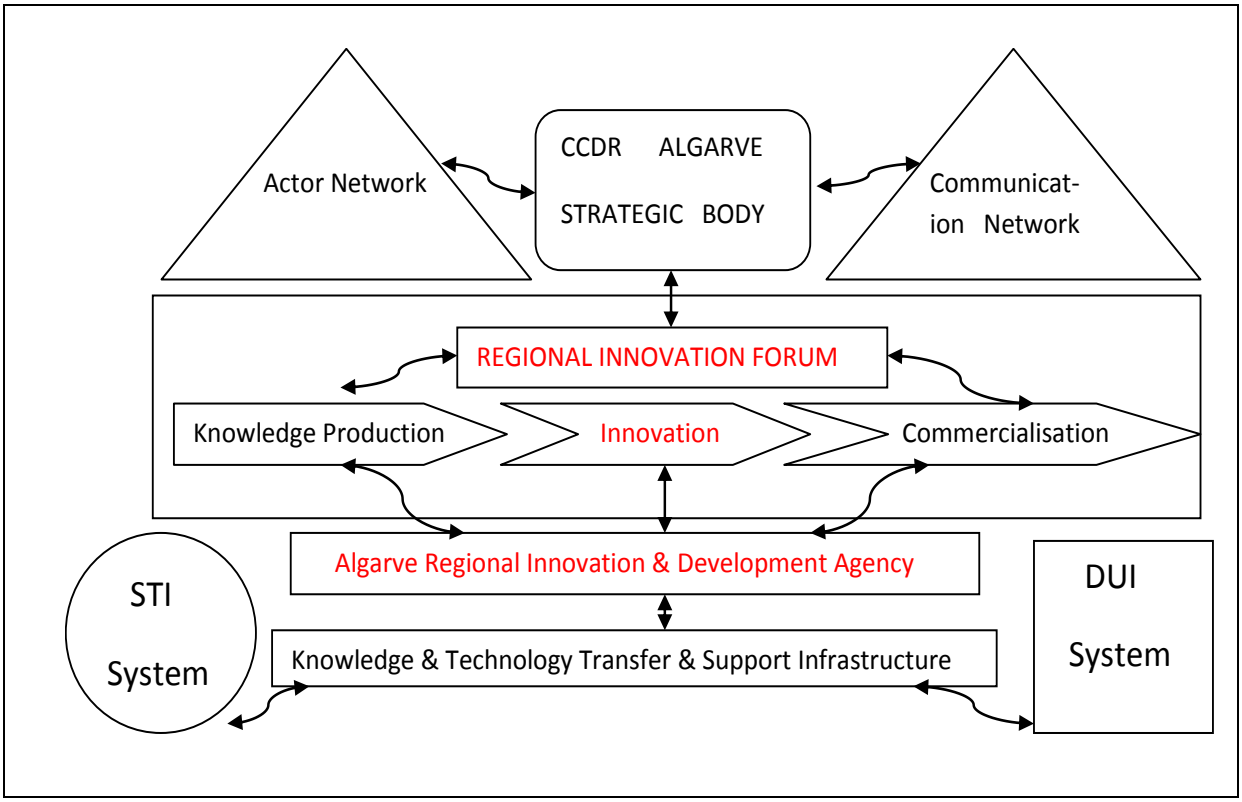

Fig. 2: RIS3 Phase Conceptual Model of DUI/STI Regional Innovation System (2013)

Source: Author's Interpretation of Algarve CCDR's RIS Model

RIS3 programme. An example of this is found in the Algarve region's evolving effort to establish a DUI innovation system model for that over-specialised touristic region. Part of the vision for RIS3 is to establish a framework for undertaking DUI innovation support governance, to be translated into clear strategic goals and objectives. The region's governance and monitoring system is the subject of analytical design in the Guerrero/Pinto report. This early attempt at a DUI

innovation governance model for the Algarve region reveals (Fig. 1) an actor-centred governance model with good stakeholder engagement mechanisms which was to be further augmented with a Communication Strategy. By 2013 the demands from EU DGs for European regions to evolve *Regional Innovation Strategies* to be eligible for regional development (ERDF/FEDER) funds would cause a *rapid* evolution in thinking, for Algarve and elsewhere, about the appropriate governance and delivery model. In this, as can be seen (Fig. 2), the emphasis on *innovation* as the primary mechanism for securing regional economic development meant the regional support function for , in particular, DUI innovation became of equivalence to the STI approach. In parenthesis, it would be expected that highlighting DUI would produce more measurable innovation success than an exclusive reliance upon a thin infrastructure of STI institutions and assets had in the past. That is not to say that STI was to be downgraded in support or policies but rather DUI was to be introduced and stimulated as a more down-to-earth, but nevertheless valuable, mode of securing regional innovation. The newer, evolved regional innovation governance model with functional spaces for both DUI and STI approaches to innovation is shown in Fig. 2.

This demonstrates three key 'innovation governance discoveries'. First *innovation* is now both highlighted and placed at centre stage in the governance model. This is further supported by a Regional Innovation & Development Agency (RIDA) to manage the DUI/STI project assessment and overall management function, to facilitate the 'learning from your industry' process annually, and to arrange 'innovation theatre' opportunities in living lab-type settings. Previously, as Fig. 1 shows, all of this was outside the main ambit of the policy development arena. Second, the innovation support infrastructure is bi-directional, linking to the STI knowledge base where appropriate and available but also aligning with the more ubiquitous DUI knowledge base in the quest for more practical innovation opportunities. Third, the strategic governance body has taken on responsibility for ensuring openness and transparency towards the public by installing a Communication network function, complementing the previously included Actor network policy input function.

Centro Region's STI/DUI Hybrid RIS Model

The new EU regional economic development measure that embeds funding in the successful submission of a Regional Innovation Strategy (RIS3) to qualify for EU regional aid (ERDF/FEDER) has released highly DUI-dependent, over-specialised and 'locked-in' regions like Algarve to think innovatively in policy terms. As we have seen this has meant evolving mechanisms to enhance 'transversality' across industry boundaries and bring regional innovation from the edge to the heart of the regional economic development process by proposing a regional innovation agency (ARIDA) to lead policy governance. But what happens in regions where, while DUI has been something of a policy 'orphan', it has long been practised in a context where STI has been highlighted as the key regional economic and innovation development need? To that end, Portugal's Centro region exemplifies some of the opportunities for hybrid regional innovation system evolution by virtue of its RIS3 process.

Space does not allow for more than a sketch of how transversality among STI and DUI across the boundaries of a biotechnology, a construction and a forestry cluster are planned to facilitate such hybrid innovation strategy. In an emergent Centro field, biotechnology, BIOCANT has been a successful and fast-growing research entity (including business, a 24 firm incubator, and venture capital) that now 'translates' its findings into commercial innovations in healthcare and other biotechnology-related fields. Thus stem cells, microbial biotechnology and computational biology are BIOCANT strengths being applied experimentally to biomaterials and agro-forestry (biofungicides; oenobiotechnology) as well as ICT diagnostics in human healthcare. One of BIOCANT's fields of expertise is in the analysis of the DNA of biofungicides, work that began in relation to biofungicidal issues in human healthcare. However, innovation opportunities arose in relation to the transfer of such biotechnological knowledge from human to agro-food and, particularly, agro-arboreal applications.

A specific development project in Centro's RIS3 programme funding bids involves the two other Centro clusters, mentioned earlier, one of which, HABITAT, is the 115-member house construction cluster within which are many timber-utilising firms, for example in the flooring, fitting and furniture (including fitted furniture) industries. One success of this cluster has been the production of low-cost dwellings for less-developed countries, including refugee camps and slum-upgrading schemes (e.g. in Angola, Mozambique and Kurdish Iraq). In such countries high humidity causes rot

to occur in native softwoods commonly used in the Centro cluster. Biotechnology knowledge from BIOCANT shows this can be controlled by the application of biofungicides to the growing tree/live timber. However, a delivery mechanism is necessary and this can be supplied from nanotechnology, or more specifically, bionanotechnology. Such a knowledge centre, capable of delivering the requisite molecule to the living tree organism exists at Bragancia in neighbouring Norte region. Such a partnership, crossing regional boundaries from laboratory bench biotechnology and nanotechnology (STI) to the wooden dwelling construction and furniture industries (DUI) utilising Centro regional forest products indicates just how powerful platform/hub thinking integrating diverse knowledge and innovation modes at knowledge and industry interfaces can actually be.

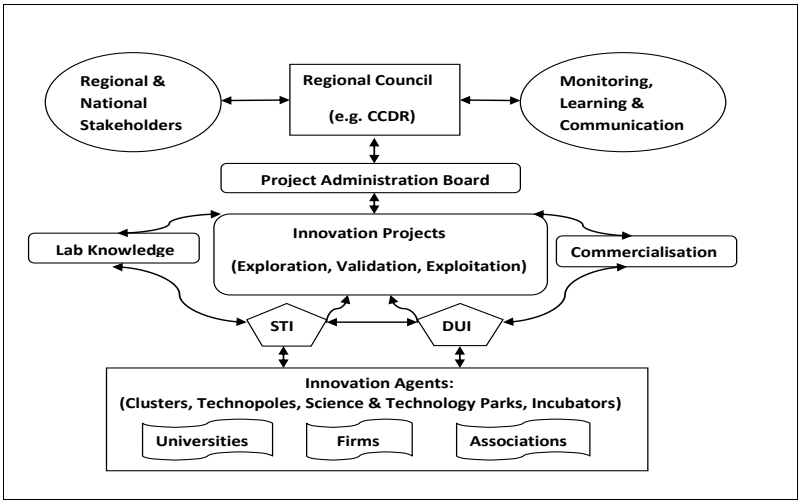

Fig. 3. Centro's STI/DUI Hybrid Regional Innovation System
Source: Author's Interpretation of Centro CCDR's RIS Model

Instead of an external regional innovation agency Centro's RIS model builds on its past (EU & central government) matching-funded investments in STI infrastructures, including new universities, Technopoles and clusters, to lead programme bids for funding its regional innovation strategy (Fig. 3). This occurs under the regional council's leadership but, as with Portugal's other regions, eventually subsumed in the national RIS3 strategy. Frequently, such asymmetric power relations would be expected to lead to conflict or stasis as local versus national developmental tensions would be worked through or become blockages to progress.

However, Centro's intelligent solution to this has been consciously to engage large numbers of stakeholder interests (some 300 at least) in a process of 'socio-economic challenge' identification. Four of these: Sustainable industrial solutions; endogenous resource efficiency; quality of life; and territorial (especially rural) innovation, have been adopted. Unlike the national institutional proclivity for prioritising sectors, Centro's model is deliberately issue-focused and cross-sectoral, as we have seen. Accordingly, tensions such as those arising from national insensitivity to local concerns seem potentially to be defused in large measure. Inspection of Fig. 3 also shows STI and DUI to be more closely integrated in the strategising process than in Algarve, but a project-based approach to be equally favoured and with firms, universities and business associations in the same policy-box for progressing projects to fruition.

A Further Example of a DUI-friendly regional innovation system architecture

Skåne region in Sweden has this as a conscious regional innovation development mechanism. It consists (Table 3) of a regional innovation forum known as the 'Sounding Board' bringing together key regional and national representative stakeholders. These search for innovation opportunities in what are called 'White Spaces' where different sectoral or institutional interests may come together to explore new innovation opportunities and means for focusing these. In Table 3 This sub-system is referred to as the regional innovation 'regime'. This, in turn, interacts with the regional 'paradigm' of industry, mostly SMEs, some large firms e.g. (formerly) Astra Zeneca in life sciences or Ericsson in ICT and interactions between the regime and paradigm have led to the identification of two cross-sector/cluster strategic innovation platforms that are pursuing, with project subsidy support innovations in White Space fields of 'Sustainable Cities' on the one hand, and 'Personal Healthcare', on the other. Feedback from 'paradigm' to 'regime' then informs further refinement of policies. Although STI-inflected innovation efforts are

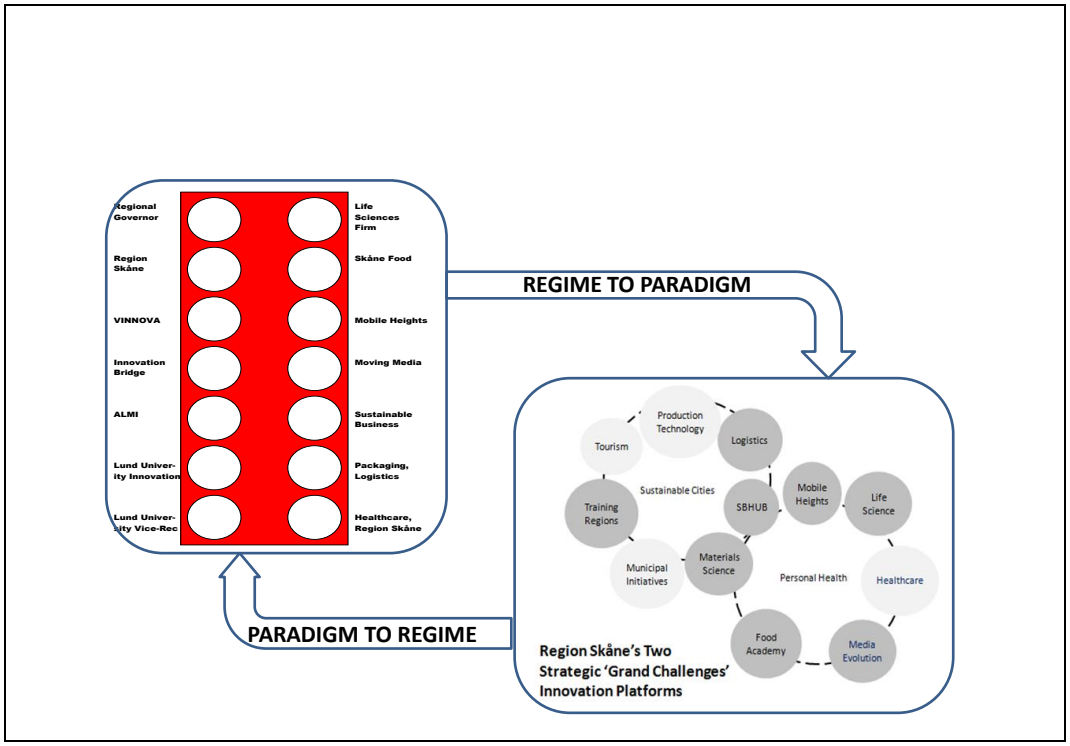

Fig. 4: Regional Innovation: DUI/STI 'Sounding Board' Regime & 'Transversality' Paradigm (Skåne).

part of this process, much of the rest of it is DUI such as the packaging cluster (Packbridge) working with the digital media cluster (Media Evolution) to evolve supermarket product finding apps on smartphones. Clearly the latter uses technology and ultimately, long ago, science but the innovation can be seen to be quite practical.

Innovation Policy Business Intervention Models (BIMs)

Innovation Twists (Preadaptations)

These require innovation theatre in the form of 'fashion shows' where potential 'attractors' may be drawn together to discuss 'twisting' (i.e. both transferring and changing) an innovation from one application in one industry to another one in a different industry. Such industry and firm 'attractors' can include both 'natural attractors' who are near to predictable, coming from neighbouring industries in the technical sense, and 'strange attractors' coming from largely unconnected industries. In 'living lab' type *innovation theatre* settings attractors can meet and absorb knowledge spillovers from sectoral 'others'. These settings should include stages (theatre-style) or 'living labs' with 'red thread' narratives, 'storytelling' discourses

and dramaturgies, as practised in Finland's 'Regional Platform Development Methodology'[9]. Fundamentally, firms in one industry or cluster are presented with accounts of useful innovations developed in a different industry. If this process sparks off some inspiration to adapt it in a new field, firms begin 'conversations'. These may be brokered by a third party from the RIDA to provide 'neutral territory' and 'trusted third party' facilitation, which also serve learning and policy co-creation purposes from an 'innovation platform' point of view.

Reverse innovation

There may also be 'reverse innovation' business models like that regarding General Electric's medical scanning machines for LDCs – targeting Prahalad's 'bottom of the pyramid' markets - in BRICs and elsewhere [10]. In the GE case this involved recognition that the world market for its Optima CT Scanners was becoming saturated as most hospitals had purchased one or other of the desired models. Accordingly, the firm engaged in retro-innovation by designing a hand-held scanner integrated with a smartphone that could perform a similar, albeit more localised, scanning task on the patient. The imaging and data, relayed to a control centre in a host country could then be analysed and swiftly relayed to the clinician in the target market 'at the bottom of the pyramid' in a less developed country. The difference in price was from at least $1 million for a conventional scanner to approximately $1,000 for the smartphone-enabled hand scanner. So successful has the retro-innovation been that it is regularly deployed by police and paramedics at accident sites in GE's US homebase.

User-driven innovation

There may also be user-driven as well as reverse innovation or innovation 'twists' (preadaptations). Here twists can occur in supply chains depending upon the shift from global production networks (GPNs) to global innovation networks (GINs). Such twists must be understood by RIDA intermediaries working with and learning from cluster expertise in technological and business model transitions occurring worldwide. One such twist negatively affecting former ICT leaders like *Nokia*,

[9] Melkas, H. & Uotila, T. (2013) Foresight and innovation: emergence and resilience in the cleantech cluster at Lahti, Finland, in P. Cooke (ed.) *Reframing Regional Development*, London, Routledge

[10] On this, see: Immelt, J, Govindarajan, V. & Trimble, C. (2009) How GE is disrupting itself, *Harvard Business Review*, 85, 56-65; Prahalad, C. (2005) *The Fortune at the Bottom of the Pyramid*, London, Pearson

Blackberry, *Motorola* and *Sony Ericsson* is that they pursued endogenous systems applications long after Asian competitors like *Samsung, HTC* and *Huawei* were pursuing *Apple* into the 'smartphone market'. The demise of *Sony Ericsson* and the sale of *Nokia* mobile telephony interests to *Microsoft* signifies the price of not having third-party monitoring of the GIN of the kind user-driven requirements that contemporary smartphone markets regularly display.

'White Spaces' Innovation

Learning from your industry

If the former three points refer mainly to 'innovative twists', the next three refer mainly to 'White Spaces' adjacent possible explorations. First we may refer to notion of 'Learning from your Industry' in a context of 'From Producer Innovation to User and Open Collaborative Innovation'[11]. Innovation development, production, distribution and consumption networks can be built up horizontally – with actors consisting only of innovation users (more precisely, 'user/self-manufacturers'). Some open source software projects are illustrative of such networks, and examples can be found in the case of physical products as well. It may be concluded that conditions favourable to horizontal user innovation networks are often present in the economy. In these circumstances, the BIM demands that the RIDA keeps a knowledge management system (KMS) of its large and SME 'system integrator' firms. Each year all are asked what solutions they need and these become the regional system's initial innovation market for 'exploration' and 'exploitation' innovation projects. Thus, the 'system' learns through the RIDA of the innovation needs and functioning or projected innovation projects in demand from specific types of large firm users, system integrators and the knowledge capabilities of regional start-ups and research laboratories. In this way, existing path dependences are exploited and renewed with the possibility that new paths may open up in consequence. The transversality in this process is managed by face-to-face meetings, presentations and adjudications before exploration or examination projects are earmarked for appropriate 'attractors'.

Regional system–integrator knowledge

[11] Baldwin, C. & Von Hippel, E. (2009) Modelling a paradigm Shift: From Producer Innovation to User and Open Collaborative Innovation, Cambridge, MA, Working Paper 4764-09, MIT Sloan School of Management

Among suppliers of software and systems-based services of the kind in demand from users in increasingly automated industries such as mining, metallurgy, forest products, energy, and so on, are mainly regional but some national and international firms that act as 'hub' or 'pivotal' innovative systems-integrator firms. In such a knowledge distribution system, knowledge from regional research and system integrators is presented to regional client firms individually or in partnership with one or two others. Theoretically, this is a process involving 'learning about confidentiality', aiming to move gradually towards more 'open kimono' postures on the part of firms that are even today hyper-secretive. Eventually, a collective or sub-group 'showcasing' business model may be designed by the RIDA but a major trust-building process has first to be implemented. This filters into customer minds new business practices, new technical solutions, new opportunities for exploring 'White Spaces' according to those who occupy positions as the 'internal radar' of global innovation networks (GINs). These are firms seeing, thinking about, understanding and proposing to move, if partners can be found, into new strategic niches. Here the role of the RIDA as innovation broker of solutions to final users in and beyond the region is also crucial – as 'orchestrator' of shared interests and relatedness 'storyteller'.

Demand-driven Innovation: Exploratory projects

These are especially important for 'White Spaces' and Grand Challenges (e.g. Climate Change, Ageing Demography, Personalised Healthcare) investigations as more strategic action lines than typical 'innovation twist' projects, discourses or narratives. They are, accordingly, funded across cluster interfaces within and between clusters either within 'emergent' Grand Challenge' 'attractors' or among clusters interfacing outside Grand Challenges involvement. This evolves as a collaborative business model and 'exploratory' innovation projects may later mutate into 'exploitative' ones. New Tools for Health (NTH) is a Swedish cluster initiative in East Gotland. In the early 2000s regional stakeholders began conceptualising how to deliver health and social care in a distributed and personalised way (domestically, not in hospitals and care-homes until necessary) long before it became, in many countries, a live issue from both healthcare and public expenditure perspectives, as it is today. Accordingly, this is a 'White Space' of major proportions and much experimental thinking and work have already been conducted. One of the primary issues over the initiating and

middle years of the scheme (2005–11) was convincing powerful interests in regional governance, regional healthcare services and regional academe that the idea of 'personalised healthcare' was valid. All were wedded to a vertical 'separation of powers' path dependence on established certitudes mainly that the economy, in the first place, and the national government in the form of tax revenue, in the second, would provide the necessary resources to continue unchanged *ad infinitum*. But authoritative government statements on demographics, rising costs and declining public budgets finally 'shocked' holders of these presumptions into a condition of serious incertitude. At this point NTH gained sufficient legitimacy and institutional support to facilitate assembly of a regional healthcare 'stakeholder system' for procurement of innovations in personalised healthcare. Even though regional healthcare systems are inordinately complex, often lacking large firm providers of innovative solutions, while start-up businesses are too small and specialised, the system initiator NTH must take on the catalysing and co-ordinating functions of regional healthcare system integrator. Accordingly, it commissions innovative solutions through innovation projects between hospitals, healthcare research and existing or start-up SMEs while building relational capital with large, external firms with some relevant competence areas. However, so new is this mission that relatively few large-scale personalised healthcare providers of the kind required are to be found anywhere. Accordingly, experimentation through exploratory projects, building alliances, absorbing experience, and articulating hitherto unconceived innovation demands are the drivers of this initiative.

Conclusions/Advice for improvement of Strategy

Conclusion 1. Most Regional Innovation Plans, as noted earlier, exclude monitoring, learning and communication strategies. Accordingly they need updating, refining and inclusion of explicit mechanisms for monitoring, learning and communication.

Conclusion 2. In broad outline the strategic thinking and *ex ante* practice of DUI is highly appropriate to the condition in which the typical region finds itself. It simply does not need to specialise further for Smart Growth. Rather, as proposed, the region needs to innovate by:

- Diversifying its 'specialised' offer (away from 'narrow' specialisms e.g. old fashioned marine engineering or 'sun & beach' mass tourism,
- Leveraging nascent and emergent sectors upon metallurgy or tourism (e.g. ICT; healthcare; agro-food; renewable energy)
- Developing new 'related variety' opportunities, notably based on other assets and drawing upon public procurement as a 'lead user' of innovative, commercially viable products and processes

This is a far more appropriate approach to RIS3 innovation policies than further regional specialisation, especially in an already over-specialised regional economy

Conclusion 3. The areas in need of improvement are usually clearly outlined in SWOT analyses.

- Governance of innovation (especially 'network management') is one area that needs changing or improving in light of the crisis and experiences from studied OECD regions elsewhere,
- Receptivity of firms to innovation, especially the DUI innovation model outlined in earlier parts of this report,
- Recognition that a 'one size fits all' STI innovation model will take time to build given the SWOT weaknesses in the 'academic entrepreneurship' experienced in most regions,

Conclusion 4. More attention should be paid to innovative opportunities to build markets based on under-used regional assets (e.g. empty housing built before the crisis) and international demand (e.g. not only healthcare but social care of the elderly and sheltered care for the fragile but not ill elderly, for example from northern Europe, where there is a widespread 'care crisis'). This kind of innovation will involve some degree of public not only private engagement (e.g. standards and licensing, certification of skills etc.)

Conclusion 5. Regions should build sensitive but confident and sustainable partnership links with their national governments and seek to influence these in

anticipation that this may also help to influence enlightened self-interests shared with other regional partners and the EU.