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EAVES, Sally and WALTON, John

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An Introduction to STRIKE: *STR*uctured Interpretation of the Knowledge Environment

Sally Eaves and John Walton, Faculty of Arts, Computing, Engineering, and Sciences (ACES),
Sheffield Hallam University, UK.
research@sallyeaves.co.uk
J.R.Walton@shu.ac.uk

Abstract:

Knowledge forms a critical part of the income generation of the system and the complex environment in which actors participate in the creation of knowledge assets merits robust, eclectic consideration. STRIKE - *STR*uctured Interpretation of the Knowledge Environment affords an unobtrusive and systematic framework to observe, record, evaluate and articulate concrete and abstract elements of a setting, across internal and external dimensions. Inter-relationships between actor and environment are preserved.

STRIKE is supported by underlying techniques to enrich data and enhance the authenticity of its representation. Adoption of photography and videography tools provides illustrative and interpretive benefits and facilitates researcher reflexivity. This structured approach to data analysis and evaluation mitigates criticisms of methodological rigour in observational research and affords standardisation potential, germane for application in a verification or longitudinal capacity.

Advancing exploratory validation studies, the method is employed to evaluate the knowledge environments of two enterprises in the UK creative sector. These occupy a critical role in fostering entrepreneurial innovation alongside participant self-efficacy. Access Space in Sheffield and the Bristol Hackspace are committed to open software, open knowledge and open participation; sharing peer learning, creativity and socio-technical aims to address broadly similar community needs.

Drawing on Wittgenstein's Picture Theory of Meaning, the knowledge management perspective is abstracted from the STRIKE assessment. It is argued that the tiered analytical approach which considers a breadth of dimensions enhances representation and interpretation of the knowledge environment and presents a diagnostic and prescriptive capability to actualise change. The paper concludes by evaluating framework effectiveness, findings application and future direction.

Keywords:

Knowledge Environment; Knowledge Management; Observational Framework; Workplace Design; Innovation

1. Introduction: Knowledge Management in Praxis

Knowledge management is diverse in nature, difficult to demarcate and subject to multiple attempts at definition. It is broadly considered as formal and informal exploratory, evaluative and synthesising knowledge interventions (Wiig 1993), undertaken at the level of individual and collective intellectual assets. Approaches centre on harnessing the organisational knowledge base to support optimal performance through innovation, reutilisation and learning (Du Plessis 2007). Drawing on Freitas, Morais and Lopes' (2012) literature analysis presented at ECKM 2012, knowledge management practices cover nine core areas ranging from innovation management to lessons-learned, supported by technological tools. Mechanisms to facilitate these practices are equally broad, spanning fifteen dimensions from learning-by-doing to mentoring. Additionally, workplace design is increasingly recognised as a "*strategic instrument*" (Bakke 2007, p6) that can support knowledge management, particularly collaborative norms and creativity (Walter 2012).

Monitoring and evaluating a diversity of knowledge management components presents a critical challenge (Hulsebosch, Turpin and Wagenaar 2009). An array of macro and micro techniques to appraise *value* are available (Perkmann 2002) but can be difficult to align with organisational realities, especially in highly original settings. The rapidly evolving and cross-disciplinary creative sector is representative of this problem. It lies incongruent with the information-processing or object-centred perspective associated with quantitative measurement approaches and further, would benefit from new qualitative means to elucidate and appraise its socio-technical and place-centric dimensions. The development of an innovative, flexible and lightweight tool to surface, monitor and evaluate the knowledge environment from a holistic perspective, illuminating the learning and sharing behaviours therein, is therefore considered timely and germane.

1.1 The Creative Sector

The definition of a creative industry is nebulous but in this study it reflects the intersection of manufacturing and digital technologies with The Arts, underpinned by a socially meaningful purpose. The growth of open-access workshops, hacklabs, hackerspaces and makerspaces embody this approach, benefiting from the *pool of knowledge* afforded by an open source production model. Although terms are often used interchangeably, different groups afford their own specialisation, ideology and historical roots (Maxigas 2012). All provide opportunities for idea incubation and contagion, technical and social engagement, collaboration and skill support.

This presents an underexplored context within knowledge management research despite increasing recognition between the provision of such environments and advances in entrepreneurial local and global innovation (Mota 2013). Certain groups afford social action outcomes: nurturing individual empowerment, self-efficacy and the development of intellectual and social capital through practical learning which can foster wider population benefits (Walton 2010). Reflecting on *The Medici Effect*, this fusion of cross-disciplinary skills and shared purpose has the potent to create an inter-sectional space for “*remarkable, surprising and groundbreaking ideas*” (Johansson 2004, p6) to flourish.

2. Explication of STRIKE Technique

Observation can be employed to describe or represent a setting and is frequently unstructured in nature. STROBE – *STRuctured OBservation of the Business Environment* (Kendall and Kendall 1984) was conceived from film theory to provide a reliability and validity assessed framework to aid system analysts unobtrusively observe, classify and interpret the physical business environment of decision-makers and their interaction with it. This can advance understanding of human information requirements and the alignment between technology solutions and end-user needs.

The authors opine a capacity and underlying need to develop the system and business requirement analysis focus of STROBE to one affording a knowledge perspective, capable of application across multiple domains. A level of granularity is required to provide insight into increasingly complex and dynamic post-industrial contexts and the environment in which organisational actors participate in the creation of knowledge assets (Boisot 1998). This can illuminate the nuances of cultural norms which form the core driving dynamics for knowledge transfer to be supported (Ipe 2003).

STRIKE affords originality in terms of scope, breadth and flexibility of design, and the qualitative data acquisition and evaluation methods incorporated. The framework systematically evaluates dimensions across the internal and external knowledge environment and supports identification of any dissonance between them. Internal observations comprise Design/Layout; Aesthetics: Placement and Decoration of Workspaces; Knowledge Sources and Branding whilst external evaluation considers both Physical and Digital Presentation. This approach is congruent with the multiple, influential roles afforded by workspace design (Elsbach and Bechky 2007) and the need to enhance understanding of its relationship with creativity (Walter 2012). Place-centric creative enterprises therefore present a novel, rich and emergent context for STRIKE evaluation.

2.1 Technique Validation, Development and Theoretical Lens

Drawing on the Design Science Research Method (Heje, Baskerville and Venable 2012), STRIKE has been subject to descriptive ex-ante evaluation by iteration in a naturalistic setting. Face validity analysis was undertaken by Dr Gordon Rugg from Keele University, a knowledge elicitation expert. Successful ex-post evaluation within two verification studies in hi-technology private sector environments (Eaves 2013; Eaves and Walton 2013) has demonstrated a particular capacity to allow the semantic layer to become more transparent. This study explores and develops tool utilisation in a different contextual setting and is proposed to surface novel, interpretative insight into knowledge transfer, its management and any boundaries that hinder optimisation.

STRIKE aligns with the increasingly acknowledged yet underexplored perspective of sociomateriality (Leonardi, Nardi and Kallinikos 2012). This recognises organisations, individual actors and technologies as continually linked and re-linked with meanings, properties and respective boundaries entangled, temporal and subject to constant reproduction (Orlikowski and Scott 2008). It is also congruent with the material-semiotic perspective of Actor Network Theory (Latour 2005).

2.2 Supporting Techniques

Photography and videography were utilised to support researcher observation. Ethical concerns and image confidentiality were duly considered.

Photography offers both an illustrative capability that reflects its “*quasi-representational*” nature (Warren 2005, p861) and an interpretive capacity to develop a multi-layered narrative, providing a highly accessible frame of reference for reflection. It is employed to enrich, complement and augment observation and support researcher neutrality.

Video technology enables a multidimensional perspective on context and can facilitate focus on, and analysis of, actor behaviours (Coiro 2009) and their interactions with the knowledge environment. Although usage and analysis of videography lacks the comprehensive methodological guidance and case history of more traditional methods, its introduction within STRIKE is based on the purposeful intent to *bring something extra*, building on the non-digital methods employed within the validation studies. A time-lapse technique was used to record workshop/exhibition sessions and create stills.

3. Research Methodology

A dual organisation case-study approach was adopted with an inductive and qualitative perspective. The STRIKE method was enacted through researcher walk-through observation sessions, supplemented by photography and videography.

3.1 Access Space

Access Space (2013) in Sheffield was established in 2000 by CEO James Wallbank and remains the UK’s longest running open access media lab. In contrast to most hackerspaces, it operates under registered charity status with the aim to advance public education in IT and visual arts alongside supporting unemployment relief: a tripartite focus on The Arts, Education and Urban Regeneration. It therefore bridges the creative and third sectors. There are no preconditions or entry requirements - *anyone can take part*. This is particularly important in communities such as those served by the enterprise, where many individuals have traditionally felt “*digitally excluded*” (Walton 2010, p11). In 2012, Access Space was recognised as one of 50 “*New Radicals*”: organisations making Britain a better place to live and work (Nesta 2012). Despite these achievements, funding from Arts Council England was withdrawn in 2011 presenting a profound threat to its financial sustainability.

Within the physical space, there are two principal areas supported by a core of 6 staff. The media lab provides free internet access and facilities to develop expertise in open source software, web development and a range of audio and visual digital skills. The adjacent but separate *Refab Lab* was opened in 2009 and is based on the FabLab concept developed at MIT. This space houses fabrication equipment such as a 3D printer and laser cutter, supports materials recycling, and is used by artists-in-residence to develop exhibition projects.

3.2 Bristol Hackspace

The second creative context is Bristol Hackspace (2013), founded in November 2009 as a social enterprise with the goal to “*open up technology to anybody who takes an interest in it*”. It is similarly committed to the principals of open source and open knowledge. The hackspace is based in the Windmill Hill ward which experiences deprivation levels above average for the city. It is run entirely by volunteers at BV Studios, an artist-led shared project and art space arranged into units within a warehouse of 30,000 square-feet. Activities are practical and hands-on, ranging from projects in computing, robotics, electronics and metalwork to craft based creative skills.

Open evenings are held each Thursday with a *Hackkids* session for under-16’s taking place once per month. Strong links are maintained with local technology groups and across the wider hackerspace network. A minimum monthly subscription of £10 is requested from the 39 full members, with a small income obtained through public workshops, exhibitions and occasional externally funded projects. Membership levels are increasing with discussions ongoing regarding enterprise future direction and its accommodation within the physical space.


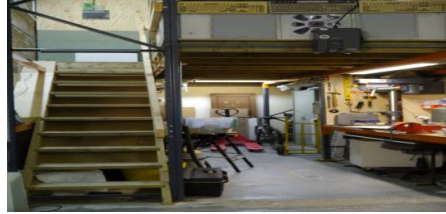




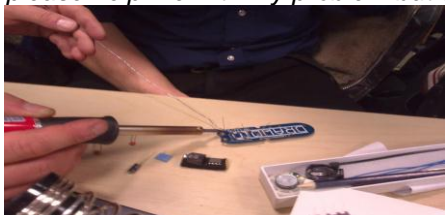

4. STRIKE Findings and Integrated Discussion



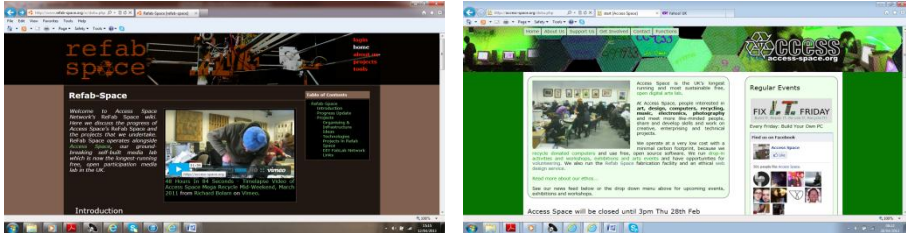
The environmental elements across each case setting are now fully elucidated. Images of workshop events are stills created from video recordings.

4.1 STRIKE Assessment of Access Space

Core dimensions from the STRIKE evaluation are presented in Table 2, supported by photography to enrich observation, support transparency and enhance audience capacity to actualise place.

Table 2: STRIKE Evaluation of Access Space

Environmental Element	Description and Supporting Photography
Design/Layout	<p>Open-plan main media lab with circular seating to enable socialisation. There is a separate Refab Space with secured access which houses heavy equipment alongside materials for recycling. A dedicated area created and used principally by one staff member is located above its floor plate.</p> <div data-bbox="448 607 895 819">  </div> <div data-bbox="911 607 1358 819">  </div>
Aesthetics; Placement and Decoration of Workspaces	<p>Dissonance is observed between cluttered areas and carpet in need of replacement in the open main area and the highly organised, tidy Refab Space which affords more staff and artist-in-residence privacy.</p> <div data-bbox="448 969 895 1189">  </div> <div data-bbox="911 969 1358 1189">  </div> <p>Further contrast identified between the personal, creative output of participants (not staff) displayed in the media space and strong evidence of <i>Industrial Art</i> and personalisation attributed primarily to one staff member found in Refab.</p> <p>Across both zones, work is evolving, practical and amorphous in orientation.</p> <div data-bbox="448 1368 895 1585">  </div> <div data-bbox="911 1368 1358 1585">  </div>
Knowledge Sources	<p>Hands-on practical peer learning leading to self-experimentation. Literature embracing community interests alongside technical themes is available to take away.</p> <p>One revelatory example of explicit knowledge is observed, a sign which emphasises the tacit, problem-solving emphasis of the space: <i>'please help me with my problem but do not solve it for me'</i>.</p> <div data-bbox="448 1798 895 2016">  </div> <div data-bbox="911 1798 1358 2016">  </div>

Branding	<p>Distinct branding for Access Space and the Refab Space. Local community focus exemplified by the urban fabric project exhibited. This uses rapid prototyping equipment to promote dialogue on the “new” Sheffield.</p> 
Physical External Presentation	<p>Accessible city centre location within a IT/Creative Industries district. Physical space lacks visibility and aesthetic evidence of the creativity within.</p> 
Digital External Presentation	<p>Facebook, Twitter and Vimeo (video) conduits preferred to Flickr (photo). Distinction between Access Space (media lab focus) and the Refab space. No significant evidence of online discussions regarding decision-making.</p> 

STRIKE evaluation is not indicative of deep knowledge management dysfunction but both strengths and opportunities for enhancement are inferred. Reflecting on Gensler's (2008) modes of working, the media lab is particularly well suited to the elements of collaborate, learn and socialise, whilst the Refab area allows more opportunities for individual focus. Access Space has a strong creative identity but this is not reflected in its physical external presentation which is understated – *you could easily walk past*. The digital presentation is more representative, supported by dual branding and a social network presence but still does not provide full visibility of the rich diversity observed.

Recording of day-to-day behaviour is revelatory of the actual breadth of knowledge activities in praxis which correspond to the pragmatic theory of truth. These demonstrate practical relevance and usefulness to an individual or group, with a strong problem-solving emphasis. This is verified and legitimised by prominent display of knowledge artefacts which allow idea expression (Walter 2012) and support a positive psychology. This aligns with symbolic functionality (Elsbach and Bechky 2007).

These artefacts demonstrate the individuality of participant works: *their* interests, creativity and priorities, congruent with the *do-ocracy* ethos described by Chen (2009, p55). It also illuminates a lack of personalised décor or visibility in respect to staff projects. One exception is identified with reference to the *Industrial Art* prominent in the Refab area which reflects the craftsmanship and discipline skills of an individual staff member critical in its construction. It is noted that in combination with the additional privacy and increased order observed in this separate zone, this physical arrangement has the potential to develop into dissonance impacting knowledge boundaries, even within a collegiate-style setting. Any design that enables significant separation between actors, and allows differences in the features afforded (Walter 2012) can experience such problems (Elsbach and Bechky 2007).




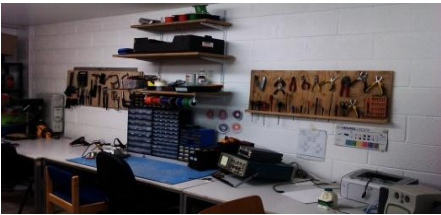


Further, it is argued that the knowledge artefacts observed afford a lens into organisational identity, the potential future direction of Access Space and its evolving superordinate goal: aspects that staff had found difficult to elucidate during individual reviews (Walton 2013). By demonstrating the *material structure of ideas* (Bieler 2001), STRIKE affords a means to demonstrate underlying interests and points of intersection expressed in artefacts. This can support the understanding of intersubjective meaning in action; it is revelatory of the knowledge that is most valued as a collective. This perspective is supported by the work of Gramsci (1971), who asserts that a level of philosophy is implicit in all forms of practical action.

In terms of knowledge management evaluation, the hands-on transfer, experiential development and dialogic norms identified in the space are difficult to express within SMART objectives: outcomes are not typically amenable to standard measurement approaches. Although the learning processes and knowledge sharing behaviours are clearly valued by beneficiaries including the committed staff, these are not easy to measure *and* are difficult to plan against. This problem maps against the knowledge exploration-exploitation dilemma and is a critical issue for creative enterprises with a charitable status, where articulating knowledge value is core to securing funding and sustainability.

4.3 STRIKE Assessment within Bristol Hackspace

The core elements emergent from the STRIKE evaluation are presented in Table 3.

Table 3: STRIKE Evaluation of Bristol Hackspace

Environmental Element	Description	Supporting Photography
Design/Layout	Clearly identifiable work zones for different activities. Connecting “corridors” allow flow between areas. Informal seating supports socialisation.	 
Aesthetics; Placement and Decoration of Workspaces	Whitewashed walls, clean lines, tidy and organised equipment. Provision of individual storage space. Limited evidence of personalised décor.	 
Knowledge Sources	Emphasis on practical demonstration and self-learning by experimentation. External flow into space encouraged by attracting speakers. The touchscreen table is a focal point for web access and dialogic discussion.	 

Branding	<p>Supported by consistent use of social media (Twitter and Flickr in particular) and attendance at Maker-Faire events. Publicity material promotes activities, affording a distinctive logo and providing a QR website code to create an integrated approach.</p>  
Physical External Presentation	<p>External aesthetics are consistent with internal observations. Accessible location near transport links, clearly signposted online.</p>  
Digital External Presentation	<p>Narrative emphasis on the association of hacking with <i>creativity</i> and <i>building</i>. Website design including wiki and blog are congruent in design and branding. A GoogleGroup account demonstrates strong collegiate style decision-making.</p>  

On evaluating and comparing the STRIKE data sets, the Bristol Hackspace displays greater symbiosis between the knowledge environment as a synchronous physical locale and as an asynchronous digital web presence: one which also affords increasingly synchronous communication opportunities through Web 2.0 tools that enable immediacy of response. This can positively impact the intensity of experience perceived by members (Mitchell 2003). Social media channels are used extensively and illuminate the projects and knowledge activities undertaken. Within the physical space, there is less demonstration of artefacts or personalisation in comparison to the exhibition of participant creativity within Access Space, reflecting differentiating nuances in group goals.

The physical environment is particularly suited to the dimensions of collaborate, learn and socialise Gensler (2008). There are some opportunities for focussed individual working but privacy to afford concentration can be limited. The setting design presents a calm, consistent and pleasing aesthetic which can support a positive sensory experience for participants (Elsbach and Bechky 2007). This is particularly utile to provide an appropriate setting for the under-16's supervised *Hackkids* workshops. Should future resources permit, attention to aesthetics within Access Space's media lab would similarly enable development of a knowledge environment that supports a younger audience.

Thematic analysis of the Bristol Hackspace GoogleGroup (2013) is revelatory of knowledge environment tensions congruent with the lifecycle development of an expanding enterprise. There is a high level of virtual organisation of ideas which was equally reflected within the zoned areas and order observed in the physical space. Underlying discussion concerns how to balance membership growth, collaborations and space management, alongside securing funding and long-term sustainability. In common with Access Space, identity is a persistent theme but here this is more explicitly

acknowledged with members articulating their respective and sometimes divergent interests, and engaged in dialogic discussion regarding how best to accommodate them. Supported by a strong capacity to act, this collective approach may aid the dissipation of potential knowledge boundaries, particularly pragmatic forms (Carlile 2004).

5. STRIKE Evaluation

STRIKE affords a systematic, unobtrusive framework which supports consistency of approach alongside flexibility of application and high communicability of findings. The tool demonstrates capability to perform in a variety of circumstances, moving from the hi-technology private sector organisations considered within validation studies, to the highly original creative sector enterprises appraised in this research. An authentic, panoptic lens to connect to the actor lifeworld is made available, providing structured and *in situ* capture, expression and evaluation of their knowledge environment. The approach conforms to Wittgenstein's (2001) picture theory of meaning affording a pictorial, representational and logical level which aids interpretation and articulation.

The method elucidates the importance of human interaction across the physical, technological and social environment to create and evolve meaning and value. The socio-technical and internal-external dimensions benefit holistic appreciation of knowledge practices and mechanisms, affording identification of presentational dissonance. It also enhances understanding of emergent and planned space design in creative settings, developing empirical support for the conceptual workspace creativity framework developed by Walter (2012).

It is opined that the multidimensional orientation of STRIKE provides a novel means to enable the verbalisation of tacit knowledge transfer practices (Seidler-de Alwis and Hartmann 2008) which is difficult to achieve through traditional interactive methods. It presents an unobtrusive language (Wittgenstein 2001) to express meaning and surface underlying issues, as exemplified by the materiality of ideas achieved through their physical demonstration and evaluation. This may be described as the reification from tacit to explicit knowledge which affords benefits for reviews and processes of organisational *translation* (Walton 2013) - aspects that impact both settings in distinct means, aligned to their respective lifecycle stages and goals.

STRIKE supports articulation of the *value* of the knowledge activities undertaken; this is pertinent to Access Space where it can aid demonstration of the "*Reach and engagement*" funding criteria explicated by Arts Council England (2011, p3). Its diagnostic-prescriptive capability is also considered germane for utilisation by practitioners across a range of settings. As an example, implementation of a high-level knowledge management initiative would equally benefit from an approach that can illuminate cultural nuances such as resistance versus acceptance behaviours and additionally, enable a form of transactional analysis of actor perspectives. Further, as the method provides a lens into a context at a particular juncture and across specific dimensions, it affords standardisation benefits. It can be employed in a verification or longitudinal capacity to validate or revisit research findings, or equally to evaluate the success of a knowledge management intervention over time. STRIKE would also be suitable for application in mixed methods research to support data triangulation.

Enactment of this framework is enhanced by visual tools which enable a multiplicity of perspectives and reduce reliance on direct researcher observation. Whilst a single image can present "*very particular information*", a cumulative group can begin to afford "*signifiers*" revelatory of the cultural context (Prosser 2012, p1). Videography proved effective for researcher reflection and to support the creation of additional stills but its full dimensionality is inherently difficult to articulate within a textual piece. It does however offer additional potent for presenting findings directly: as a familiar, rich, engaging and distinctive visual medium, video can convey a deep sense of "*direct experience with the primary phenomena*" (Pea 1999, p353). This supports the call to incorporate digital methods into the mainstream (NCRM 2013). In future studies, the application of social media evaluation tools such as Google Analytics will be considered to extend assessment of the digital external environment.

6. Knowledge Environment Conclusions

Access Space and Bristol Hackspace are exemplar enterprises which support, and are catalysts for, rapid technological innovation. From different perspectives, they are also considered drivers in a critical new social-economic model in which social economic change is regarded the embodiment of innovation: supporting the development of intellectual and social capital and affording the potential for sustainable entrepreneurship (Mota 2013). This is facilitated by an open knowledge production model

which co-exists with more traditional forms, alongside an enabling, almost *cosmopolitical* (Latour 2004) knowledge environment that bridges socio-technical dimensions to support curiosity, self-efficacy, idea incubation and artefact production. In congruence with the nature of the sector, knowledge management practices may be described as emergent. It is argued that the diagnostic-prescriptive tool STRIKE focuses attention to, and evaluation of, *knowledge in action* to benefit the overarching mechanisms that support them, including workspace design.

Technological developments and production model changes have indeed removed many of the barriers of time, space and restricted knowledge that have previously inhibited wider levels of collaboration and innovation. This study elucidates that despite this evolution, the physical environment and actor interaction with it plays a critical role in supporting the practices and mechanisms of knowledge management. It is important that this is integrated with its digital presence.

Specifically, the Refab environment within Access Space is demonstrative of the relationship between technology and architecture (Silver and McLean 2008): it affords a physical design solution that is creative as well as functional, fit for purpose but adaptable to future needs, elegant but also practical. In the Bristol Hackspace, the organised activity zones and easy flow between them is notably supportive of task organisation alongside exposure to multidisciplinary techniques and creative collaboration (Walter 2012).

The effectiveness of Access Space and the Bristol Hackspace may be attributed to the development of pragmatic, eclectic knowledge communities which balance individual and group goals, utilising dynamic, integrative and “*participatory technology-development techniques*” (Grenier 1998, p.vii). Place, tools, research and development, social structure and innovation are therefore increasingly merged and aligned. Drawing on the MOA framework (Gan, Kosonen and Blomqvist 2012), these enterprises exemplify a tripartite of staff/attendee *motivation* and developed *abilities*, alongside the *opportunity* afforded by place: providing both cognitive and physical space to those who work, volunteer or participate within them.

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