

A typology of creative tools and techniques for Operations Managers.

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Abstract

The importance for organisations to innovate and use creative thinking as part of being competitive, is a well known and strong research area within the UK. A recent DTI Think Piece (Whyte et al, 2005) has provided key issues for policy makers in this area. The recent EPSRC grant award EP/C534239/1 to Professor Ganns' 'Innovation and Productivity Grand Challenge' shows the area is significant to the survival and competitiveness of UK Industry. Many research outcomes have focused on innovation and creativity of the design of products and services (Cooper, 2005), however very little research has been carried out into the creative tools used at the operational level of an organisation within the 'order fulfilment' and 'support product/service' business processes. Innovation and creativity at the business process level has not been a key focus. Studies of the output of creativity have been carried out at this level concentrating on quality circles, problem solving groups and other means of involving employees (Bessant, 2003), and has highlighted that creative tools are used at different levels within an organisation. The issue of radical or incremental innovation is also well documented (Francis and Bessant, 2005) and (Tidd et al, 2005). The above research has highlighted various issues which include the 'inability to manage innovation as an integrated business process' and to make it repeatable (Whyte et al, 2005) and an 'inability to understand, access and use emerging innovation toolkits to its full potential'. Studies of innovation and creativity within SMEs have also focused, in the main on design. In this paper, I present a typology of creative thinking tools at three levels within an organisation: namely day to day action, process improvement and strategic change within business operations. Soft systems methods are used to identify define and clarify the purpose of creativity tools at these three levels.

Key words: Creativity, Operations, Soft systems methods

Introduction

A recent think piece for the DTI 'Management of Creativity and Design within the Firm' (Whyte et al, 2005) has highlighted the importance of innovation and creativity within organisations. Indeed, processes for innovation and creativity are a strong element of the competitive landscape for business (Leahy, 2006). Thematic change programmes for promoting competitiveness, namely lean operations, six sigma, business process re-engineering, process innovation, and total quality management have dominated the UK research agenda and the attention of companies seeking to improve their operational excellence. At the core of all these programs is the question: What makes an organisation successful in terms of operational business processes (value creation in order fulfillment)? It is the hypothesis of a wider research project that it is the use of creativity within operations, the creative energy and how this energy is transformed into results that may effectively make the competitive difference, in terms of order winners and order qualifiers. Creativity may be defined as 'the thinking of novel and appropriate ideas' (Coyne, 1996) and has been / is a high priority for design in businesses. This paper will identify, define and clarify creative tools that are used to encourage creativity in operations, and determine their suitability at three levels of activity within operations.

Techniques for promoting creativity range widely from checklists for brainstorming through to synectics promoting genuine innovation. Many of the thematic change programmes mentioned above incorporate some facet of creative thinking, in the form of divergent and convergent processes for idea generation, sorting, prioritising and implementation of new ideas. These include the PISCESm process (Vardis and Vasa-Sideris, 2000), which incorporates planning, imagining, selecting, creating, evaluating and starting, TRIZ (Altshuller, 1994) a theory for solving inventive problems, by providing tools and methods for developing problem definitions, systems analysis, prediction and analysis of failures and uses an 'algorithmic approach' to develop and refine systems. DMAIC (define, measure, analyse, improve and

control), which is intrinsic in six sigma implementations, Skunk Works - creative teaming (1994) amongst others. Processes for innovation typically make use of a variety of creative thinking techniques including mind maps (Buzan, 1996), 6 thinking hats (De Bono, 1999), Soft Systems Methodology (Checkland, 2006), synectics which uses analogies and contradictions in problem solving (Roukes, 1988), scenario planning, brainstorming, brain writing, photo sorting, and so on. McKee (2003) notes that it is important for businesses to choose which techniques carefully in terms of the nature of the situation, level of focus, level of precision required and also the time available to focus on a particular issue.

The intention of this paper is to present a framework that will facilitate the choice of appropriate techniques for creativity at three levels within the operations business processes, and to ultimately provide guidance on how to develop the intrapreneur from within the organisation at the three levels. The three levels are: day to day, process innovation and strategic operational change.

The target for this framework is Small to Medium sized Enterprises (SMEs - up to 250 employees) as they make up a large contribution to GDP. In providing 58.5% of UK employment and 51.3% of turnover (Small Business Service, 2005), it is also important that this sector has access to and knowledge of creative techniques in order to have a positive impact on the competitiveness of the UK. SMEs are known to be innovators. In one study Hoffman K et al (1998) found 60 % of SMEs had introduced a new major product or service in the last five years'. However SMEs typically do not have much time to spend on 'formal' creativity sessions within their order fulfillment and support product/ service processes and may not specifically think tactically or strategically in terms of operations. Hoffman notes that 'though innovation appears to be widespread, this does not translate directly into improved firm performance and, ultimately, greater profitability'. Whyte et al (2005) have provided a detailed think piece for the DTI considering 'Management of creativity and design within the firm' and confirm that the majority of research is carried out in to design innovations not operational / process innovations. This is noted in a European SME study (de Mozota, 2002) which surveyed 33 European SMEs and found that they generally focused on design innovation as opposed to process innovation.

OPERATIONAL CREATIVITY

It is acknowledged by many researchers that creativity and innovation is important, and many tools and techniques have been developed to assist in the creativity process. Indeed the current EPSRC grant EP/C534239/1 'Innovation and Productivity Grand Challenge' led by Professor Gann shows the importance of innovation and creativity at the industrial level and supports the timeliness of this proposal which is aimed at the operational level. The aims of the "Grand Challenge" are to produce knowledge, tools and new practices for innovation processes, and to provide guidance on how they can 'be managed to enable a greater number of results to be brought into practice more quickly' (EPSRC 2006).

The overall research of which this paper is the first stage, will develop an operational 'creative web' which will pull together creative techniques addressing aspects of people, processes and technology within operations. These techniques may be used at three distinctive creative levels within the operations. These include:

- Daily activities: such as sunset / sunrise meetings, problem solving sessions and quality circles, and the sustaining aspect of 5S 'Sort, Set in order, Shine, Standardise, Sustain' which is a fundamental part of implementing lean operations.
- Process Innovation events: such as kaizen and improvement blitzes events.
- Strategic operational changes: such as creative thinking in developing and implementing operations strategy.

The overall aim of this research is to: Develop and operationalise a 'creative web' (Figure 1) for SMEs by synthesising empirical research and state of the art creative thinking techniques. SMEs are interested in tangible outcomes and value creation, therefore the creative web will enable operational creativity output to be regarded as 'value added' within the operations environment. This paper reports on the first phase which aims to provide a typology of creative thinking techniques for use within operations management.

The 'Creative Web' will form a hub from which SMEs will be able to choose and apply appropriate tools bearing in mind the issues associated with People, Processes and Technology. This paper is focusing on the 'Processes' aspect regarding the choice and application of tools and techniques.

The Creative Web

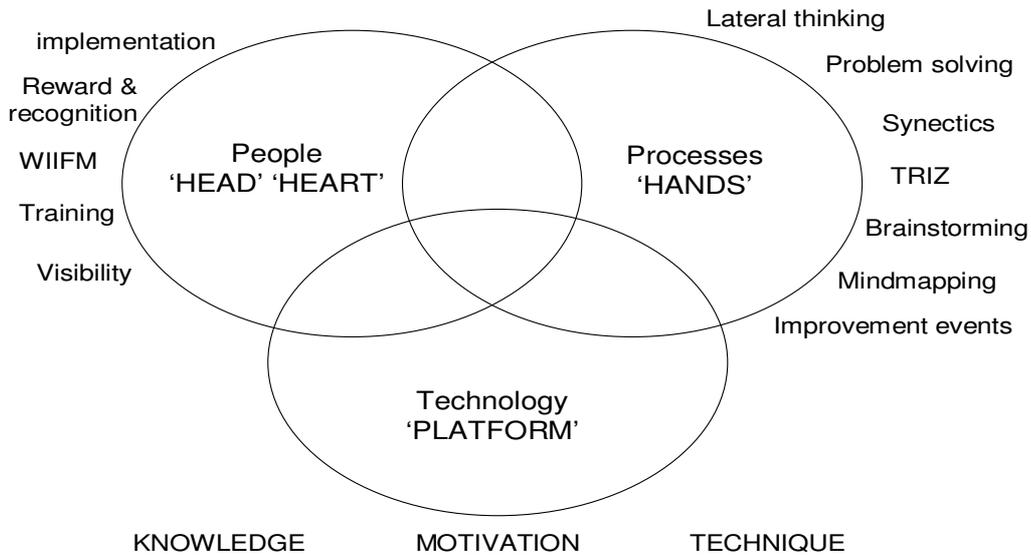


Figure 1 – The Creative Web

RESEARCH METHODOLOGY

This research uses a partial cycle of soft systems thinking to provide a typology of techniques and solutions to the issue of creativity at three operational levels. In Soft Systems Thinking, the researcher uses a process of enquiry where the end point is not yet clear, providing the opportunity for learning to take place. Figure 2 describes the approach taken to develop the typology.

Soft Systems Methodology	This work
Finding out about the 'real world'	Describe the context of the problem situation. The poor take up of creativity tools for use in Operations rather than Design.
Expressing the problem situation	Expressing the three levels of creativity in Operations: Day to day, process innovation and strategic breakthrough.
Developing models of creative thinking at three levels in operations.	Identify the relevant systems and develop root definitions for each to identify appropriate creative tools for each world view they encapsulate.
Building models of purposeful activity	Building models

The first four stages are covered in this paper, and have produced a typology of creative thinking techniques for debate and discussion in later stages. The results of stages 5 – 6 will form the next paper.

Questioning using models and perceived world	Comparing the models with the problem situations and the need for creativity
Debating / defining changes	Within the recommendations of this paper
Taking action	Defining next steps

Figure 2 – Developing the Creative Thinking Typology

Finding out about the real world problematical situation

Many creativity tools are available for innovation in design and some for use in non design activities. The problematical situation may be described as to what tools are suitable for use within an operations environment in order to promote creativity and sustain the output of good ideas which are needed within

operations management from all levels to ensure competitiveness. There is no guide as to what is suitable / applicable and relevant to operations at different levels of analysis. This cycle of soft systems will explore that assertion and recommend changes to remedy this.

Expressing the problematical situation

The following rich pictures were developed from the authors experience as an operations manager.

Figure 3

Day to day

A typical day in the life of an operations manager may start with a sunrise meeting with the current shift to discuss problems, targets, equipment failure quality levels and other pertinent issues which have arisen in the past 24 hours. S/he will prioritise actions for the day and initiate problem solving activities within the order fulfillment process as and when required. Operators, technicians, shift leaders and engineers will be on hand to address high priority immediate issues which are having an impact on product / service output, or on quality levels. Corrective action reports may be required if a quality failure has reached the customer and this may require creative tools to reach a satisfactory resolution. Creative thinking in this environment needs to be quick, appropriate, simple, visual and effective. Sunrise meetings will check the status of the 5S programme and total preventative maintenance schedule; visual measures will be updated and acted on.

Figure 4

Process Innovation

An event to improve an area within operations can take many forms, the most common is a 'kaizen' or 'improvement blitz' event which may last a couple of days and aims to radically improve a problem situation. Typically a team is formed from operators from the area, technical and engineering staff, six sigma specialists, performance measurement specialists and maintenance staff. The event is divided into

- Developing the plan
- Analysing the area
- Balancing the line
- Redesigning the layout
- Simplifying the paperwork trail
- Identifying next steps
- Implementation

Creative thinking in this environment may be more structured and measured than the day to day requirements. Issues are initially brainstormed and prioritized and creative 'games' are introduced to introduce and reinforce key operational concerns. Tasks are then allocated to the team who will use individual creative techniques to analyse the current situation and suggest improvements.

Strategic

Figure 5

Thinking strategically in operations requires inputs from the organisations supply network, marketing, technology and process experts. Strategic changes

to operations architecture, technology or ways of working should be aligned with or lead, business and corporate strategies. Currently it is generally accepted that there are three approaches to operations strategy, market led (outside – in), best practice, and the knowledge based approach (inside – out).

Typically creative thinking at this level is structured and facilitator led, however the ‘moment of truth’ insightful ideas are critical at this level.

The rich pictures show the challenges and issues faced by operations managers on a daily basis, at process innovation events and the need to be strategic and encapsulate three relevant systems, which may be used to further explore the use of creativity within operations.

Developing models of creative thinking at operational multi levels

The relevant systems are defined using the PQR formula and CATWOE to develop root definitions. One viewpoint for each root definition is presented at this stage.

PQR formula and C A T W O E Do P By Q in order to contribute to achieving R Customers, Actors, Transformation, Worldview, Owners, Environment	
Level 1 - Day to Day	<p><i>Do ‘problem solving’ on a day to day basis by using appropriate creative thinking tools and techniques in order to contribute to achieving output and quality targets and to solve immediate problems</i></p> <p><i>Customers / Beneficiaries:</i> End Customer, Operators, Technicians, Supervisory, Facilitators, Engineers <i>Actors:</i> Operators, Front line employees, Technicians, Supervisory, Facilitators, Engineers, <i>Transformation:</i> Ideas generated to improve day to day activities <i>Worldview:</i> That involving front line employees is useful for improving productivity and morale incremental change <i>Owner / s:</i> Front line employees <i>Environment:</i> Constraints in terms of time, money, skill level, reward and recognition</p>
Level 2 - Process innovation events	<p><i>Do ‘process innovation events’ by using appropriate creative thinking tools and techniques in order to contribute to substantially improving output and quality levels.</i></p> <p><i>Customers / Beneficiaries:</i> End Customer, Operators, Technicians, Supervisory, Facilitators, Engineers, Finance <i>Actors:</i> Operators, Front line employees, Technicians, Supervisory, Facilitators, Engineers, Engineers, External consultants <i>Transformation:</i> An operational area is transformed in a short timescale using various techniques to improve material and information flow, reduce takt time and lead time, to reduce wastage at all levels and to improve the operations environment <i>Worldview:</i> That process improvement events such as Kaisen Blitzes are useful, Step change <i>Owner / s:</i> Operations manager <i>Environment:</i> Constraints in terms of time, money, skill level, reward and recognition</p>

Level 3 - Strategic thinking	<p><i>Do 'strategic thinking' within operations by using appropriate creative thinking tools and techniques in order to contribute to changing process architecture, ways of working and technology to support business and corporate strategic objectives'</i></p> <p><i>Customers / Beneficiaries:</i> End Customer, Marketing, Technology specialists, supply chain specialists, Facilitators, Engineers</p> <p><i>Actors:</i> Operators, Front line employees, Technicians, Supervisory, Facilitators, Engineers,</p> <p><i>Transformation:</i> Transforming operations for strategic advantage</p> <p><i>Worldview:</i> That involving front line employees is useful for improving productivity and morale</p> <p><i>Owner / s:</i> Operations manager / director</p> <p><i>Environment:</i> Responding to external indicators, exploiting new knowledge / technology</p>
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Figure 6

Building purposeful activity models

The following models were developed for each relevant system.

Day to Day

The activity model describes a typical process that may be followed when a problem or issue arises on a daily basis.

A problem / issue is raised, a team is pulled together depending on the issue in hand and may include the shift leader, operators, technical and maintenance support, a quality / statistical expert and a facilitator. The issue may be addressed by using various creative tools which may include:

- Brainstorming
- Lateral thinking
- Mind mapping
- Simple process map
- The 5 whys
- Force field analysis
- Pareto charts
- Histograms
- Statistical Process Control charts
- Analytical trouble shooting
- Visual performance measures
- Short interval control chart

The team will brainstorm possible causes, then gather the appropriate data to in / validate the possible causes until the true cause is identified. Idea generation techniques and experience will then be used to identify the solution to remove the true cause and ensure the 'Fix' is permanent. The solution will be reviewed and added to appropriate documentation such as Standard Operating and Training Procedures.

Figure 7

Process innovation

The activity model describes a typical process that may be followed when a problem or issue merits a process innovation / improvement event. This occurs when a step change in output or quality levels, or reduction in costs or lead-time is required.

An issue / problem arises, or it is considered appropriate to initiate a step change / improvement in operations to meet a critical objective in terms of speed, cost, quality, dependability or reliability.

An event is deemed appropriate and the time and resources are allocated for this purpose. The team is set up to include a variety of skills and experiences

The area under consideration is addressed in a systematic way using a mixture of these creative tools

- Comprehensive process map of value and non value adding activities, and paperwork trails
- Brainstorming issues, alternatives, waste
- Lateral thinking and Mind mapping
- The 5 whys
- Statistical Process Control charts, Pareto charts / Histograms of demand, output, down time, quality yield, rejects
- Visual performance measures
- Takt time and lead time
- Visual layout and flow
- Line balance chart and rebalancing
- Affinity diagrams

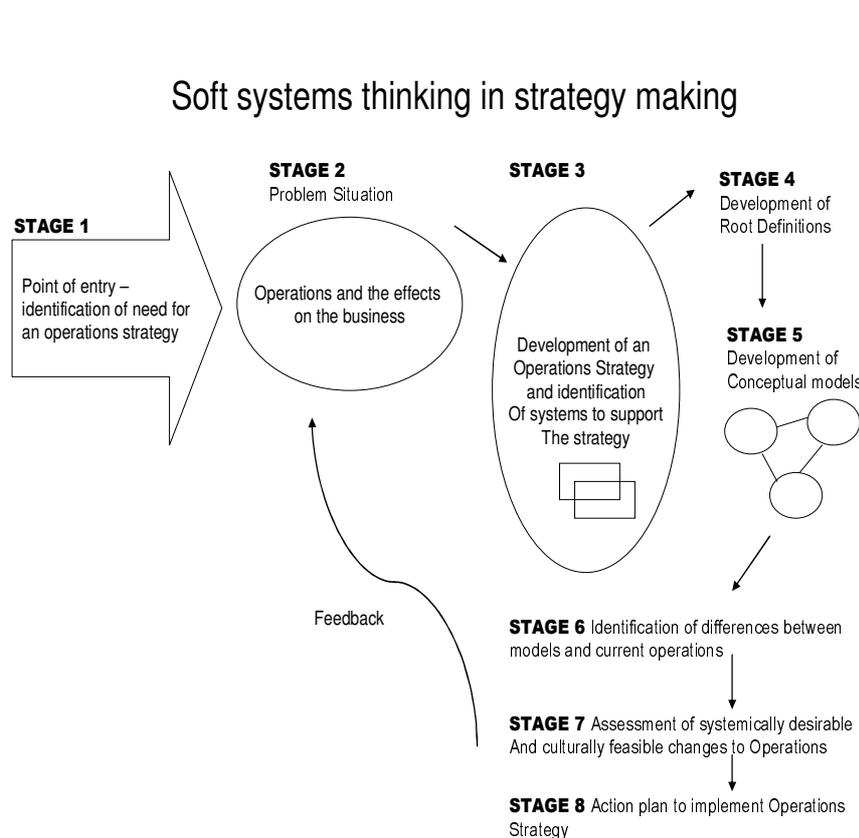
Figure 8

Solutions will be debated and verified using de Bono's 6 hats and implemented as per the roll out plan.

Strategic thinking in operations

The activity model describes a typical process that may be followed when a strategic changes or strategic creativity is required within operations. This occurs when a change in corporate or business strategy requires a realignment of operations to meet external and competitive challenges.

The point of entry (stage 1) is the 'moment of truth' when a need for an operations strategy is realised by the team, which should be made up of operations, marketing, technical, supply chain and commercial experts.



Stage 2 enables the team to question the current strategy and operations contribution to achieving the targets set

The team analyses the operations organisation, collecting data from key stakeholders, debating contentious issues and producing a shared understanding of the current situation.

A statement of what is expected from operations is then developed linked to the business strategy and a discussion of the appropriate operations

strategy approaches that could be useful and fit their particular organisation. Objectives are developed from the operations strategy statement, and relevant systems, which may be people, process or technology based (or a mixture) are identified that may have a significant role in achieving those objectives.

Figure 9

These systems may or may not exist at this stage. In stage 4, the systems identified are developed into root definitions, which focus the practitioner in defining exactly what the system is to deliver. In stage 5, the root definition/s is/are used to develop conceptual models based on the different worldviews expressed by the stakeholders. In stage 6, these conceptual models are compared with the real world situation to identify (stage 7) systemically feasible and desirable changes to the current operations organisation in line with the business strategy and operations objectives.

The area under consideration is addressed in a systematic way using a mixture of these creative tools.

- TRIZ
- Synectics
- Scenario planning
- Soft systems thinking
- Market gap analysis
- Brainstorming
- De Bono's 6 hats
- Process modeling and redesign

As described earlier stages 5 – 7 will be addressed with the comparison of the models and the real world will take place with focus groups and SME operations managers. The results of this will form the basis of another paper.

OUTCOMES

The following typology of creative thinking tools and techniques will be tested in SMEs to validate and or develop appropriateness to enable the 'creative web' to become a useful and invaluable tool for creative thinking in the value creating core of business. There are many other creative thinking tools which may be used in the phases of exploring, defining, gathering, generating, grouping, screening and prioritizing ideas. These may be found in the Creativity, Innovation and Change Technique Library (1999) The Open University for a comprehensive list

	Day to day			Process innovation			Strategic change		
	People 'Head & Heart'	Processes 'Hands'	Technology 'Platform'	People 'Head & Heart'	Processes 'Hands'	Technology 'Platform'	People 'Head & Heart'	Processes 'Hands'	Technology 'Platform'
Affinity diagrams (K J method)		X			X			X	
Brainstorming		X			X			X	
CATWOE		X			X			X	
Causal mapping		X			X			X	
Creative problem solving		X							
De Bono's 6 hats								X	
Fishbone diagram		X			X				
Flow charts / process modeling		X			X			X	
Kaizen blitz					X				

Kepner Tregoe	X	X	
Mind mapping	X	X	X
Quality circles	X		
Scenario planning			X
Soft systems method	X	X	X
Synectics			X
Think tanks	X		X
TRIZ		X	
Whys x 5	X	X	

Figure 10

DISCUSSION

The paper has described an analysis into the suitability of creative thinking tools within an operations management environment. Figure 10 shows a typology of tools for the three relevant systems identified which correspond to three levels of creative activity within operations management. The next stage in this research will expand the above table and will test the activity systems with focus groups of creative thinkers and problem solvers within an operations management environment. As can be seen from the table, some creative thinking approaches are suitable at any level within operations where as others are more appropriate for one such as scenario planning.

The typology is presented as a tool for choosing the appropriate technique to promote creative thinking within operations. Further research will use focus groups and interviews / discussions with managers to further populate the creative web and enrich the 'people' and 'technology' aspects of the creative web.

SUMMARY OF FINDINGS

In conclusion the paper presents a typology of creative thinking tools at three levels within an organisation: namely day to day action, process improvement and strategic change within business operations. The exploration of three levels of operational creativity has provided rich pictures and conceptual models which will be explored and developed in more detail. The advantage of considering creativity within operations in this way (using Soft systems methodology) provides a richness and clarity as to the usefulness of creative thinking at these operational levels. The main findings provide a springboard for further research in this important area.

DEFINING TERMS

The following definitions have been adopted for the following creative tools

E Exploring, D defining, G1 gathering, G2 Generating, G3 Grouping, S Screening, P1 Prioritising, P2 Planning, FP full process

		E	D	G1	G2	G3	S	P1	P2	FP
Affinity diagrams (K J method)	One of the 7 management tools used in Japanese quality management. Constrained brainstorming and checking causal relationships	X		X		X				X
Brainstorming	Generating ideas by freewheeling, or association, may be structured or unstructured, individual or team	X			X					
CATWOE	Mnemonic associated with Checkland and Poulter Soft systems method (2006) describing customer, actors, transformations, worldview, owner and environment		X							
Causal / cognitive mapping	Enables the creation of a diagram which is used to share information, inform debate, and identify causal relationships and consequences. Eden and Sims (1983)	X				X				
Creative problem solving	Process devised in 1950s by Sidney Parnes incorporating 1 mess finding, 2 data finding, 3 problem finding, 4 idea finding, 5 solution finding, 6 acceptance finding (Technique Library 1999)				X					X
De Bono's 6 hats	6 different approaches to a problem						X			
Fishbone diagram	Developed by Kaoru Ishikawa to structure the process of identifying possible causes of a problem	X				X				
Flow charts	Shows the flow of material and information in a process or a decision process or a mental process								X	
Kaizen blitz	An event where an area is radically transformed to improve performance	X	X	X	X	X	X	X	X	X
Kepner Tregoe	Rational approach to analytical trouble shooting, identifying deviations from the norm, differences and changes and specific steps to solving problems (Kepner and Tregoe, 1981)		X	X						X
Mind mapping	To represent ideas note information in the form of an organic tree, mirrors the way the brain handles information (Buzan, 1996)				X	X				
Quality circles	Sunrise meetings, group of 5 + 2 people brought together to solve work related issues									X
Scenario planning	Provides different descriptions of plausible futures helping to give a better understanding of potential environments, and factors need to be monitored over time (Miller WC, 1987)	X								
Soft systems method	An enquiry method and a method for 'orchestrating debate' (Checkland and Poulter 2006)	X								X
Synerctics	analogies and contradictions in problem solving Rourkes, 1988),				X					X
Think tanks / Skunk Works	Creative teaming(1994)	X		X	X					X
TRIZ	Theory for solving inventive problems, by providing tools and methods for developing problem definitions, systems analysis, prediction and analysis of failures and uses an 'algorithmic approach' to develop and refine systems. (Altshuller, 1994)									X
Whys x 5	Getting more and more information and finding the true cause by asking why ...	X		X	X					
		E	D	G1	G2	G3	S	P1	P2	FP

E Exploring, D defining, G1 gathering, G2 Generating, G3 Grouping, S Screening, P1 Prioritising, P2 Planning, FP full process (Groupings from The Open University B822 Techniques Library, 1999)

Figure 11

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