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Summary

Background and objective

The objective of this observation is to contribute a psychological insight into the 'dot-voting' process for prioritising opportunities and other topics of interest identified in the Cambridge 'S-Plan' strategic roadmapping process[1] during roadmap landscape population. The aim was to assess the extent to which psychological and procedural factors influence individual voting behaviour in what is an efficient but potentially biased / gamed process. This has been observed through marking and tracking a small selection of voting dots, time-lapse photograph's of the landscape as votes are placed and a specific feedback questionnaire presented at the end of the workshop. Data has been kept confidential and treated as group data and no company or individual names have been used.

After three pilot observations the study continued with a total of three roadmapping workshops, all with the University of Cambridge Institute for Manufacturing (IfM) industrial and academic organisations over a six-month period.

Observations

The study has identified possible patterns of voting behaviour, which may be of interest to both researchers and practitioners in further developing and deploying the approach. The most significant of these appear to be:

1. Delegate self assessed influences

The delegate responses indicate voting for one's self is a particularly important factor in an individual's voting decision however in comparison to the vote tracking results individuals do not vote for themselves a very large percentage of the time. In both the pilot and full observation results clustering and linkages also appear to play a large role in these self-report influences, although the data does not appear to support this. Participant's comments suggest personal views guide voting. Other key aspects of the process appear to relate to visibility of the roadmap and the post-its. Participants frequently remark on the influence of readability whether it's a result of post-it stacking or writing legibility.

[1] Phaal, R., Farrukh, C.J.P. and Probert, D.R. (2007), 'Strategic roadmapping: a workshop-based approach for identifying and exploring innovation issues and opportunities', *Engineering Management Journal,* 19 (1), pp. 16-24.

2. *Build up of votes during the 'Landscaping' process*

The real-time photography output in both the pilot and the full observation indicate that votes often build considerably up to a point and then level off. If votes already placed on the landscape did not influence latter individuals voting choice then a gradual progression may be seen however most of the highest scores reach peak then stabilize. This observation supports the suggestion that there may be an element of later voting decisions being made based on votes which have already been placed. This may potentially be due to individuals understanding that once a topic has received enough votes it will be further discussed in the roadmapping process therefore their votes may be of more value on alternative topics which they also believe to be of importance.

3. Observations of marked voting dots

Results indicate participants choose to vote for themselves a relatively small percentage of the time. In addition low percentages are being recorded for the amount of votes placed on the same post-it. Although comments gathered from the questionnaires indicate voting for one's self is a key influential factor these results indicate it does not dominate the voting process, these samples are voting for multiple ideas and are not only voting for themselves.

4. Observations of top ten voted outputs

As supported by comments received from the questionnaires the amount and clarity of wording on a post-it is an important factor in individual's voting decision. This may be a simple area in which advice can be given to delegates in order to help them convey their views successfully. In all workshops where data was taken the top ten voted post-its had between six and ten words.

Although questionnaire comments indicate that the number of linkages on a post-it below the Trends and Drivers layer are an important factor analysis of the actual data suggests that in fact links to multiple post-its in the layers above are not necessary for post-it to become popular.

The location (timing) of the most popular post-its appear to vary between workshops which may be in fitting with the individual workshop directive.

Feedback to Facilitators

1. Number of words on post-its

Delegates frequently comment regarding amount and clarity of wording, and this is supported by analysis of voting patterns. Delegates should be made aware about the importance of clear handwriting and to ideally articulate their idea in six to ten words in order for their idea to be read and processed by others.

2. Clustering and visibility

Facilitators appear to vary in the degree to which clustering is used. When formal clustering is used it does appear to exert a medium influence on voting. Participants repeatedly comment on problems of visibility, overload of post-its and writing eligibility. Where possible distinct clusters can be used as a tool to counteract these problems and allow participants to capture the key idea of multiple post-its in a more manageable form and timeframe.

3. Influence of votes already placed

A recurring pattern of the 'plateau' effect is visible on real-time voting data suggesting participants are being influenced by previous votes & refraining from voting on post-it's once they have received a significant amount of votes. If it is desired to increase discrimination in the voting process delegates should be made aware of this effect and encouraged try to vote based on content of the idea. This

awareness may promote further objectivity from the organisation without using a semi blind or blind voting system.

4. Post-it timeline

The most voted for post-it's are spread across the short-, medium- and long-term time frame however in some circumstances a single timeline can become significantly more popular or can be neglected. Facilitators may need to use techniques to steer attention appropriately in relation to the outcome needed. Equally they need to be vigilant of any bias in timeframe if it is not appropriate to the directive.

5. Linkages

Theoretically multiple linkages are of great value to the development of the roadmap however this is a considerately low number. Although organisations are quantitatively reporting linkages as an important factor many post-it's have had little if any links and some qualitative comments indicate organisations are not fully grasping the linkages significance. Facilitators may need clear instructions for delegates to fully understand the use and importance of linkages and be aware of accepting a post-it with no or very little linkages. Clear display of linkages need to be present in order for delegates to use them.

6. Highlight arrow

Not all facilitators use post it arrows for delegates to highlight salient ideas. Equally, when present, not all delegates choose to use them. A few delegates indicate that the arrows confused the process. If facilitators choose to use the highlight arrow delegates may need clear reminders each layer regarding their use and purpose.

7. Author of the post-it

Low percentages have been recorded for the amount of votes placed on the same post-it multiple times. This possibly indicates that participants are voting for multiple ideas and are using their votes for the same post-it on the occasions where they perceive the idea to be of particular importance. Were this observation to be repeated with larger samples, it might suggest organisations do not need to be too restricted by facilitators in the allocation of their voting dots as when given the opportunity to spend them however they choose they still spread their votes over a range of ideas.

8. Voting for one's self

Participants indicate that voting for one's self is a very influential factor. However In workshops where delegates have been allowed to vote for their own ideas low percentages of such occasions have been recorded. This suggests that although participants may vote for themselves it does not overthrow the process. Facilitators may use this information in deciding whether to allow participants to vote for themselves.

9. Other

Questionnaire results indicate where possible pre printed copies of the landscape would be helpful. Additionally facilitators need to be focussing on bringing out a smaller number of well thought through and expressed post-its rather than allowing the landscape to become overpopulated. These suggestions may aid the prevention of cognitive overload and frequent problems with visibility.

Recommendations for further Study

1. Benefits and opportunities to IfM and to organisations

Throughout the process all organisations have been welcoming and interested in the research. This observation highlights the potential use and capability of continued research within the roadmapping process while complimenting the needs of the organisations.

2. Increased sample sizes

Conclusions have been limited to the results of a restricted number of workshops and would benefit from additional research to gain a larger data sample.

3. Alternative voting systems

Results have demonstrated that the amount of votes already placed does influence latter voting; these results along with participant comments indicate it would advantageous to continue exploring alternative systems of voting.

4. Real time vote build up

Exploration of the real time vote build up could be extended through analysis using correlation methods in order to better understand the nature and strength of vote build. This would give increased objectivity in the current system and further support to the exploration of alternative voting systems

5. Importance of linkages

If further data could be gathered it would also be of interest to plot the relationship of the number of votes compared to number of linkages on an X-Y axes. Alternatively with a larger data set a standard deviation may be plotted for the number of votes attracted by post-its with and without linkages, the number of votes attracted by individual post-its and clusters and the amount of words alongside the standard deviation of votes per number of words.

Contents

Objective

To contribute a psychological insight into the 'usual practice' voting workshop process during roadmap landscape population and assess whether social and procedural influences affect individual voting behaviour in order to develop best practice techniques to help guide and develop the roadmapping process.

This observation has only been based on the 'usual practice' voting method. In consequence the observations are restricted to these styles of workshop and are not be generalisable to any new methods of voting. However they may contribute further insight into ways in which the voting process can be developed.

Rationale and Research Justification

The observation has focused on the voting process due to its fundamental importance in roadmapping workshops. It is the primary determinant of workshop outputs and provides an opportunity for key behavioural and social processes to be observed and quantified, particularly in complex, unsure and ambiguous situations.

1. Procedural Influences
These factors have been explored in order to produce a further understanding of how practical factors within the roadmapping procedure influence voting. This will be done in order to help develop and enhance the roadmapping process.

2. Social Psychological Influences
These factors have been explored in order gain a deeper picture of the social aspect of roadmapping voting in order to understand how these influences affect individual's decisions. Exploring these influences creates an opportunity both to examine social psychological theory within a professional setting and to use this information for process improvement.

Theories and concepts from psychology

This observation draws upon theories from Social Psychology, particularly a selection of those relating to social Influence.

1. **Kelman(1958)** ***identifies three broad forms of social influence***
Compliance: People appear to agree with others, however maintain personal opinions privately.
Identification: Both an individual's public and personal opinions are influenced. Kelman (1958) suggests this behaviour is adopted as it is in fitting with their personal belief system.
Internalization: The individual conforms to a style of behaviour they believe is expected of them.

This founding theory provides background on initial identifications of social influence and helps to define the various forms. These forms of influence may be present during the voting process where individuals' decisions are in part based upon the opinions or expectations of others.

2. Informational Social Influence
A first psychological theory to consider is a social psychological theory known as 'informational social influence'. This is a form of conformity in ambiguous situations. In these unsure circumstances individuals will look to each other for cues of information regarding appropriate and desirable behaviour. This can result in these behaviours being personalised and accepted, the individual's believing that others are correct. This concept is influential when others around are viewed as knowledgeable (Aronson, Wilson & Akert, 2005).

This theory implies that if people feel unsure about the voting process, or feel there is ambiguity in their task they may observe others to gauge appropriate actions and believe these are correct.

3. Social Validation
This concept relates to social norm setting, which is the tendency within people to use others' actions as a standard of behaviour and in consequence use this standard to judge/set the appropriateness of their own behaviour (Cialdini and Goldstein, 2004). This concept is an important determinant of conformity.

This theory implies that people may be influenced by others in the workshop through setting their behaviours and actions in a way which fits others around them.

4. Asch's Conformity

The classic Asch experiment highlighted individual's conformity when confronted with unanimous group opinion, even when this was quite visibly inaccurate. Some argue the Asch effect may be more unpredictable than once thought rather than a stable tendency of human behaviour (Lalancette & Standing, 1990) however others suggest this theory is still observable (Neto, 1995).

This theory may imply that in workshops people may be swayed into voting in a way, which they don't necessarily feel is accurate due to feelings of pressure.

5. Ingroup Outgroup Discrimination (Tajfel et al. 1971 minimal group paradigm Tajfel & Turner 1979, Social identity theory)
People are willing to discriminate against members of an out-group even when the group they belong to is meaningless and arbitrary. This discrimination can be anonymous and can be used to enhance self-image.

This theory implies people may be more likely to vote for people they consider to be a part of a group in which they also belong, sacrificing the aim of the task for individuals self image.

6. Cognitive Load Theory (Sweller, 1988)

'Cognitive load refers to the total amount of mental activity imposed on working memory at an instance in time' Cooper (1998). A key determinant of cognitive load is the quantity of stimuli that requires attention. Cognitive Load Theory is founded on the idea that working memory is a limited resource in terms of capacity and duration (Cooper, 1998) and can only retain and perform on a certain amount of information. These limitations may hinder learning thus implying this limitation is something, which must be considered to optimize the use of working memory.

As well as being applicable to other aspects of the workshop this theory may be applicable to post-it positioning and amount of words written on a post-it.

7. Self Interest Theories

Although factors and people external to the individual appear to play a role on a person's actions and attitudes a key element of self interest must be considered in relation to these influences. The discussion by Mills (1963) suggests self interest plays an influential role in individual's attitudes, behaviours and even their justifications of their actions & views. Miller (1999) goes on further to describe the 'norm of self interest' present within Western societies. This concept depicts self-interest as a common and commanding influence on human behaviour. Rationalist theorists may argue this view is too simplistic and propose an alternative view. Two rationality standards are discussed; the self interest standard states 'rational people consider only costs and benefits that accrue directly to themselves.' The present-aim standard states 'rational people act efficiently in pursuit of whatever objectives they hold at the moment of choice.' (Frank, 1997, p.18).

The self interest theories are applicable when exploring peoples incentives behind their voting decisions and in consequence the choices they make in the voting process. These theories imply people will vote in line with their own motivations, perhaps choosing to vote for themselves or voting in a way that benefits self interest in another form, perhaps voting for a particular individual.

Ethical Considerations

It must be noted that throughout the workshops the organisation's objectives have and have taken first priority and all observations will occur unobtrusively in fitting with organisation needs.

Previous to all workshops organisations were made aware of the intentions of the observer and explained that data will be handled anonymously and treated as group data.

Collected data has been kept by the researcher and password protected.

Questionnaires have been kept anonymous and confidential, no names have been recorded and participation was not mandatory.

A debrief form has been made available to all participants of the workshops explaining in more detail the aims of the study and contact details of the observer and an additional member of the IfM (Appendix 8).

This observation has been based on current 'normal practice' voting method. In consequence the observations are restricted to these styles of workshop and are not be generalisable to any new methods of voting however may contribute further insight into ways in which the voting process can be developed.

Prediction

It was predicted that there will be a variety of mechanisms at work that influence voting choice both social psychological influences and procedural influences. The following have therefore been further explored:

Procedural Influences	**Prediction**
Post-it timing (S,M,L)	Frequently voted for post-its will be located more frequently in a certain timeline
Linkages	Frequently voted for post-its will have a large amount of linkages
Post-it being part of a cluster	Frequently voted for post-its will commonly belong to a cluster
Highlight Arrow	The highlight arrow will encourage people to vote for the highlighted post it or cluster
Social Psychological Influences	
Amount of votes already placed	Individuals will be influenced by the amount of votes already placed on a post-it
Author of the post-it	Individuals will vote for certain individuals post-its on more than one occasion
Voting for one's self	When people are given the opportunity they will vote for themselves in order to enhance self interest
Amount of words written on a post-it	There will be a key amount of wording written on post-its, enough to successfully convey the point before leading to a cognitive overload

Approach

Initial observation commenced with four workshops, in which the observer worked as an active facilitator, in order to understand the road mapping process and select a potential topic for study. After forming an interest in voting behaviour this was discussed and agreed upon with Dr. Rob Phaal (Cambridge Universities Institute of Manufacturing).

With organisation and IfM Project Manager approval the observation has developed through continuing work as an active facilitator piloting the observation method (see below). This has been used as an opportunity to confirm the methodology.

Pilot data has been analysed through writing up the landscape and delegate work for the organisation. When organisations have chosen to perform the write up independently, with organisation permission; photographs have been taken to record the results.

A further three workshops have been observed to collect the information while continued facilitation assistance has occurred, to ensure value for money to the organisation.

Feedback/input was provided to the project facilitators in terms of process improvement and to organisations as to the conclusions/outcomes of the research.

Observational Protocol

The observational protocol has been devised from the mapping in table (1) below, which shows the linkages of research principles, hypothetical decision methods and associated data sources. Wherever possible at least one quantifiable source is sought to compare with participant opinions as submitted in the questionnaires. The pilot study demonstrated that these observations can be carried out without impact of the workshop activity. Four data gathering methods are proposed:

1) Participant Questionnaires
2) Analysis of time-lapse photographs of the build-up of the landscape
3) Analysis of 'top ten voted' outputs
4) Analysis of the marked voting dots

Table 1: prior research, hypothesis and data mapping

			Data Gathering Method			
Procedural/ Psychological	**Decision making influences**	**Prior research topic**	**Questionnaire**	**Photographs**	**Tracked votes**	**Top 10**
Procedural	Post-it timeline	*N/A*	■			■
	Linkages	*N/A*	■			■
	Cluster	*N/A*	■			■
	Highlight Arrow	*N/A*	■			■
Psychological	Author of the post-it	Ingroup/Outgroup, Social Influence, Social Validation & Self Interest Theories	■		■	
	Amount of votes already placed	Conformity, Social influence & Social Validation	■	■		
	Voting for one's self	Self Interest & Rational Choice Theories	■		■	
	Amount of words	Cognitive Load	■			■

Analysis

A logic trail has been established to show how individual observations will be recorded and analysed in order to establish the validity of the predictions we have made.

The key steps in the trail are as follows:

1. Theory
2. Prediction
3. Why it is important
4. What data will be gathered
5. How the data will be analysed
6. What will be fed back

This logic trail is outlined in detail for each prediction in the table below (Appendix 1, large view)

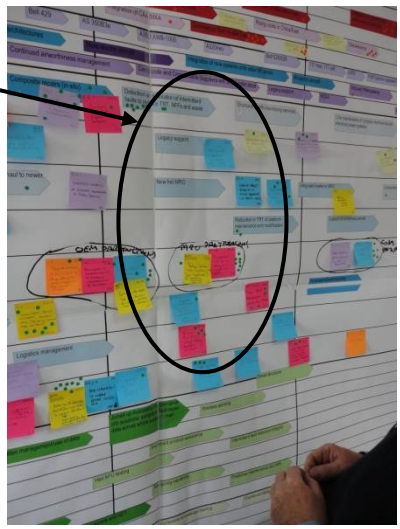
	Post it timeline (s,m,l)	Linkages	Cluster	Highlight Arrow	Amount of votes already placed	Author of Post-it	Vote for Self	Amount of words
Theory	These items relate to the FACTUAL CONTENT of the Landscape: Their influence is sought as a means of comparison to the behavioural items on the right hand side of this chart.				Conformity Theories, Social Influence Theories & Social Validation Theories	Ingroup Outgroup Theories, Social Influence and Social Validation Theories and Self Interest Theories	Self Interest Theories & Rational Choice Theories	Cognitive Load Theory
Prediction	Frequently voted for post-it's will be located more frequently in a certain timeline	Frequently voted for post-its will have a large amount of linkages	Frequently voted for post-its will commonly belong to a cluster	The highlight arrow will encourage people to vote for the highlighted post it or cluster	Individuals will be influenced by the amount of votes already placed on a post-it	Individuals will vote for certain individuals post-it's on more than one occasion	When people are given the opportunity they will vote for themselves in order to enhance self interest	There will be a key amount of wording written on post-it's, enough to successfully convey the point before leading to a cognitive overload
Why it is important	In order to understand if there is a common section of the roadmap participants tend to focus on and whether this fits with the aims of the Landscaping process	In order to understand whether the linkages are being used by delegates in a beneficial way , as an item with more linkages might offer more impact in responding to more items in the layer above	In order to understand whether being a part of a cluster will result in ideas being deemed more popular	In order to understand the influence a highlight arrow has on the voting process and whether this will aid further workshops	Considering people's influence on one another the voting process will be captured in a real-time observation in order to view whether any patterns of voting behaviour are demonstrated	In order to understand whether social affects are occurring. Whether people are expressing their genuine opinions or whether additional influence is manipulating results	In order to understand the extent to which people try and carry their own ideas through the workshop, whether output is a valid picture of the groups views or a product of self interest	Considering the amount of stimuli clients are having to attend to an optimum amount of wording written on post-it's will be recorded
What data will be gathered	The top 10 post-it's/clusters with the highest amount of votes will be recorded to gain insight into on what timeline on the roadmap these were placed	For the top 10 post-it's/clusters the number of votes received will be gathered compared to the number of linkages.	For the top ten post-it's/clusters it will be noted whether the total applies to a cluster or an individual post-it.	For the top ten post-it's/clusters it will be noted whether the total applies to a point with one or more arrows.	A real time observation using photography at 2 minute intervals of the second timeline, second layer will produce a numerical build up of votes over time	In order to evaluate whether people are voting for the same individual multiple times a selection of random participants will be given marked voting dots and these tracked after the voting process	In order to evaluate whether people are voting for the themselves a selection of random participants will be given marked voting dots and these tracked after the voting process	The top 10 post-it's/clusters with the highest amount of votes will be recorded to track the amount of words written on each of these post-it's.
What data will be gathered	The top 10 post-it's/clusters with the highest amount of votes will be recorded to gain insight into on what timeline on the roadmap these were placed	For the top 10 post-it's/clusters the number of votes received will be gathered compared to the number of linkages.	For the top ten post-it's/clusters it will be noted whether the total applies to a cluster or an individual post-it.	For the top ten post-it's/clusters it will be noted whether the total applies to a point with one or more arrows.	A real time observation using photography at 2 minute intervals of the second timeline, second layer will produce a numerical build up of votes over time	In order to evaluate whether people are voting for the same individual multiple times a selection of random participants will be given marked voting dots and these tracked after the voting process	In order to evaluate whether people are voting for the themselves a selection of random participants will be given marked voting dots and these tracked after the voting process	The top 10 post-it's/clusters with the highest amount of votes will be recorded to track the amount of words written on each of these post-it's.
How the data will be analysed	The most common timeline has been assessed as well as which percentage of the top 10 votes were in each section	The average total amount of linkages on top 10 post-its will be observed in order to understand whether the most voted for post-its are those with a high frequency of links.	A percentage of top 10 post-its belonging to a cluster has been calculated in order to understand the extent to which clustering is connected to a high frequency of votes.	This has been recorded in order to understand the build up of highlight arrows and whether the development interacts with voting patterns	To address the pattern of vote build up charts were created to observe any patterns of voting and consequently indicate whether individual's are being influenced by the amount of votes already placed.	A percentage has been calculated to show on how many occasions votes were placed on the same individuals post-it	A percentage has been calculated to show on how many occasions votes were placed on ones own post- it	An average amount of words on top 10 post-it's has been calculated and considered alongside the standard deviation of votes per number of words
What will be feed back	If it is shown that clients do tend to lean towards voting for ideas in a particular time frame facilitators might be made aware of the tendency and encourage and inspire clients into valuing ideas across all time frames (tailored to clients aims)	If a particularly low number of linkages is shown on popular post it's this may indicate that the linkage process may not be fully understood by clients as theoretically multiple linkages can be of great value to the development of the roadmap. Equally an optimum number of linkages may be evident. This might suggest opportunities for the further validation of voting results at the end of each layer.	If the results indicate that clusters attract more votes than individual post-its this may suggest that further work is required to ensure clusters are well understood and defined through the process, perhaps before voting.	This information can be used by facilitators to lead voting in a way they believe to create a valid more output	This can help develop the voting process through indicating positive or negative patterns of voting potentially suggesting the benefit of alternative ways of voting e.g. semi blind or blind voting	This can help develop the voting process through indicating positive or negative patterns of voting potentially suggesting the instructions and restrictions needed to be given to participants	This can help develop the voting process through indicating the extent to which factors other than simply the quality of the idea influence voting and ultimately output. This will indicate the extent to which alternative ways of voting and/or delegate instructions will be beneficial e.g. instructions to limit the number of votes per post-it and/or NOT to vote for one's own post its/clusters	This can help shape the instructions of the facilitator helping clients to articulate their ideas in ways which will be read and processed by other members

1. Participant questionnaires

A specific voting related questionnaire was presented at the end of the later workshops in order to gain participants opinions of the voting system and their decisions to vote (Appendix 2). This data will be used to achieve a deeper understanding from participant's perspectives and these have then be compared against actual voting data.

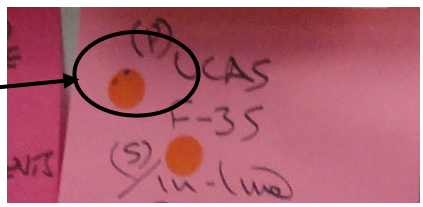
2. Analysis of time lapse photographs

A real-time observation involved the use of photography of the middle of the roadmap (medium term) at two-minute intervals (the precise time interval within which individual photographs are taken has been recorded). This was be done in order to gain insight into the build up of votes on the roadmap over time and provide quantitative information on the way in which votes build up on individual post-its.



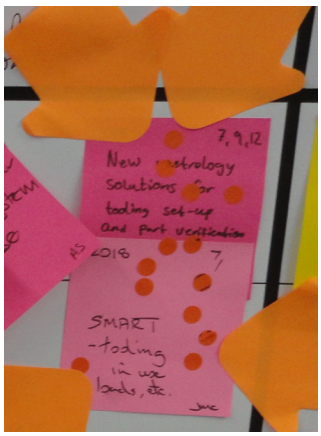
3. Analysis of marked voting dots

A small selection of voting dots was marked with a subtle pen point. Each person with the tracked dots has had their own unique mark e.g. person two has two small marks on all of their voting dots. These were then located after completion of the workshop and used to explore possible voting influences; voting for one's self, voting for the inputs of a particular individual and voting on the same post-it multiple times.



4. Analysis of 'top ten' voted ouputs

The overall top 10 most voted for post-its during each workshop were be recorded and evaluated for amount of words, positioning in time and number of linkages relating to the corresponding layer above. This method has been used in order to understand the qualities post-its deemed important through voting.



Notes were taken of any specific voting instructions given to the delegates by the facilitator, in order to determine if this potentially offers a source of variability, which needs to be accommodated. The workshops were selected to be a close to 'standard' as possible, but where the voting instructions varied significantly from the norm consideration was given to the exclusion of the data from the study analysis, although this has not proved to be necessary.

Analysis was undertaken on each of the four methodologies:

Analysis of time lapse photographs (Appendix 3)

Amount of votes already placed: To address the pattern of vote build up charts were created to observe any patterns of voting and consequently indicate whether individual's are being influenced by the amount of votes already placed.

Highlight Arrow: This has been recorded in order to understand the build up of highlight arrows and whether the development interacts with voting patterns.

Analysis of marked voting dots

Author of post-it: The extent to which people use their voting dots on the same post-it multiple times was evaluated through creating a 'percentage to indicate on how many occasions votes were placed on the same individual's post-it.

Voting for self: The extent to which people use their voting dots on their own ideas was evaluated through a percentage to indicate on how many occasions votes were placed on one's own post- it.

Analysis of top 10 post-its (Appendix 4)

Timeline: The most common timeline has been assessed as well as which percentage of the top 10 most voted for post-its were in each section.

Linkages: The average total amount of linkages on top 10 post-its will be observed in order to understand whether the most voted for post-its are those with a high frequency of links.

Clusters: A percentage of top 10 post-its belonging to a cluster has been calculated in order to understand the extent to which clustering is connected to a high frequency of votes.

Amount of Words: An average amount of words on top 10 post-its has been calculated in order to understand whether there is an optimum amount of words needed for a post-it to be repeatedly voted for.

Participants Questionnaires (Appendix 2)

This quantitative data gained from the tracked votes, the top 10 post-its and the photographs has been compared against the quantitative and qualitative information provided by the workshop attendees through the questionnaire. Further questions relating to any comments on voting process improvement have also been used in order to gain insight into attendee's views.

Whilst a considerable amount of data will be generated tests of statistical significance may be required once individual data sets have been created and assessed.

Results from the individual workshops

1.0 Pilot studies

Three workshops were used to pilot the aforementioned method and have helped to strengthen the approach.

1.1.1 Pilot Workshop A Background

Amount of attendees	17
Amount of voting dots per person	5
Room set up	This workshop occurred in a small room with cabaret seating focused around the presentation slides with the landscape placed at the back of the room. The organisation chose to impose a seating plan to mix participants from different backgrounds.
Landscape set up	The landscape used a traditional voting style on all three layers working from the top layer down. Pilot data was not gained on the first layer as aspects of methodology needed refinements.
Landscape end date	2025+
Any specific voting instructions	Participants were not restricted on voting for themselves and were not restricted on the amount of votes they placed on a single post it.

1.1.2 Pilot Workshop B Findings

It must be acknowledged that data gained is from a small sample of 2 workshops however this preliminary output has indicated....

1. Participant questionnaires
These have not been used in this pilot workshop

2. Analysis of time-lapse photographs

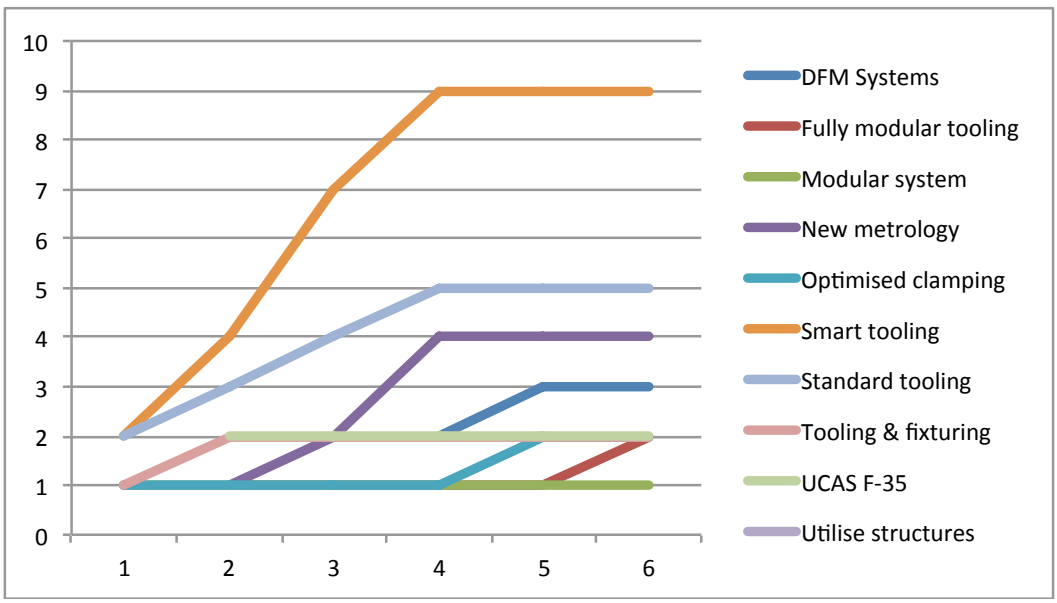


Figure 1: Pilot B real-time observation, Layer 2

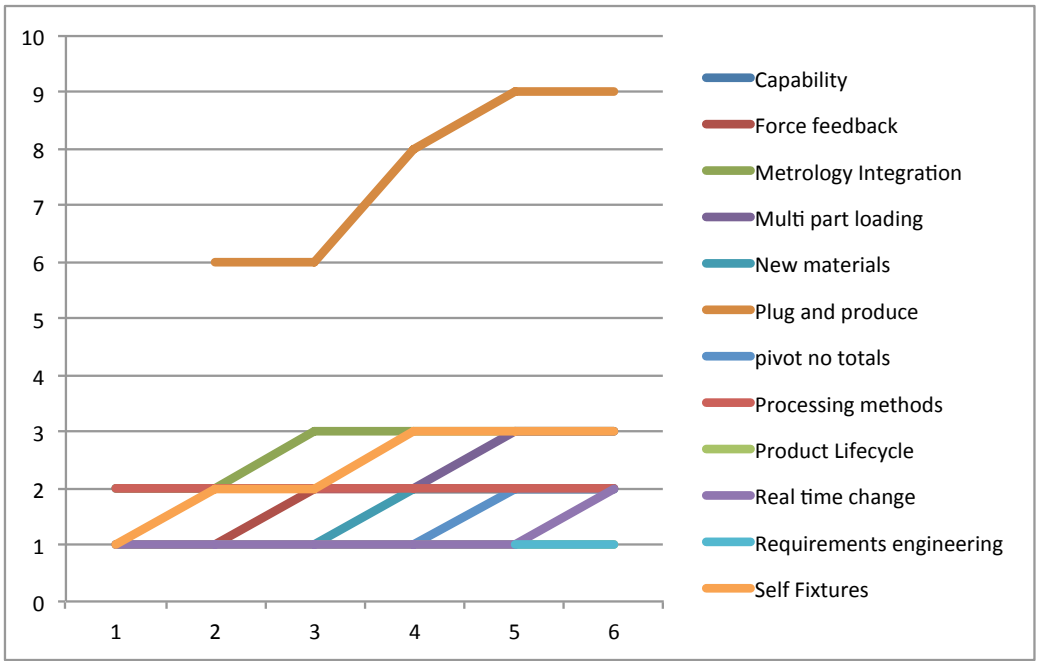


Figure 2: Pilot B real-time observation, Layer 3).

3. Analysis of marked voting dots

From this pilot observation tracking five individuals voting dots has revealed:

- 18.87% of all votes placed were votes for one's self
- 11.32% of all votes placed were placed on the same post-it

4. Analysis of top ten voted outputs

- The average amount of words on a top 10 post-it (including clusters) is 6.83
- The average amount of linkages on a top 10 post-it (including clusters) is 1.35
- Top 10 post-its were frequently located on the long term timeline (S 30%, M 30%, L 40%)
- 40% of Top 10 post-its belonged to a cluster

1.2.1 Pilot Workshop C Background

Amount of attendees	18
Amount of voting dots per person	8
Room set up	This workshop took place in a large room with cabaret seating focused around the presentations slides with the landscape placed to one side of the presentation. No seating plan was imposed.
Landscape set up	This landscape was heavily pre populated requiring participants to produce post-its for layer 2 only. This meant any voting data is gained from this layer only.
Landscape end date	2022
Any specific voting instructions	Participants were not restricted on voting for themselves and were not restricted on the amount of votes they placed on a single post it.

1.2.2 Pilot Workshop D Findings

1. Participant questionnaires

These have not been used in this pilot workshop

2. Analysis of time-lapse photographs

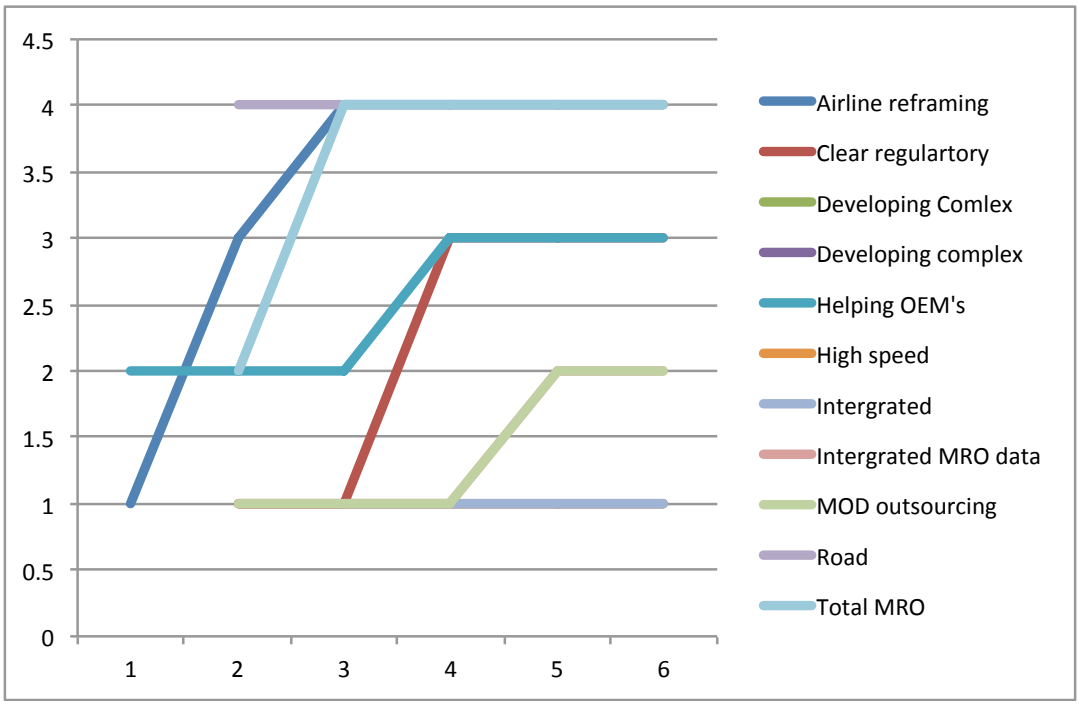


Figure 3: Pilot D real-time observation, Layer 2).

3. Analysis of marked voting dots

From this pilot observation tracking three individuals voting dots has revealed:

- 27.27% of all votes placed were votes for one's self
- 18.18% of all votes placed were placed on the same post-it

4. Analysis of top ten voted outputs

- The average amount of words on a top 10 post-it (including clusters) is 9.56
- The average amount of linkages on a top 10 post-it (including clusters) is 1.8
- Top 10 post-its were frequently located on the short term and medium term timeline (S 50%, M 40%, L 10%)
- 30% of top 10 post-its belonged to a cluster

1.3.1 Pilot Workshop F Background

Amount of attendees	9 (8 for layers 1 and 2)
Amount of voting dots per person	5
Room set up	This workshop took place in a large room with U style seating focused around the presentations slides with the landscape placed to the left of the presentation. No seating plan was imposed.
Landscape set up	This landscape was quite bare with no specific swim lanes. All post-its were grouped into clusters so no singular post-its were free standing. This method along with the small amount of participants meant voting occurred quickly.
Landscape end date	2020-Vision
Any specific voting instructions	Participants were not restricted on voting for themselves and were not restricted on the amount of votes they placed on a single post it.

1.3.2 Pilot Workshop 02/05/2012 Findings

1. Participant questionnaires

Eight questionnaires were received back.

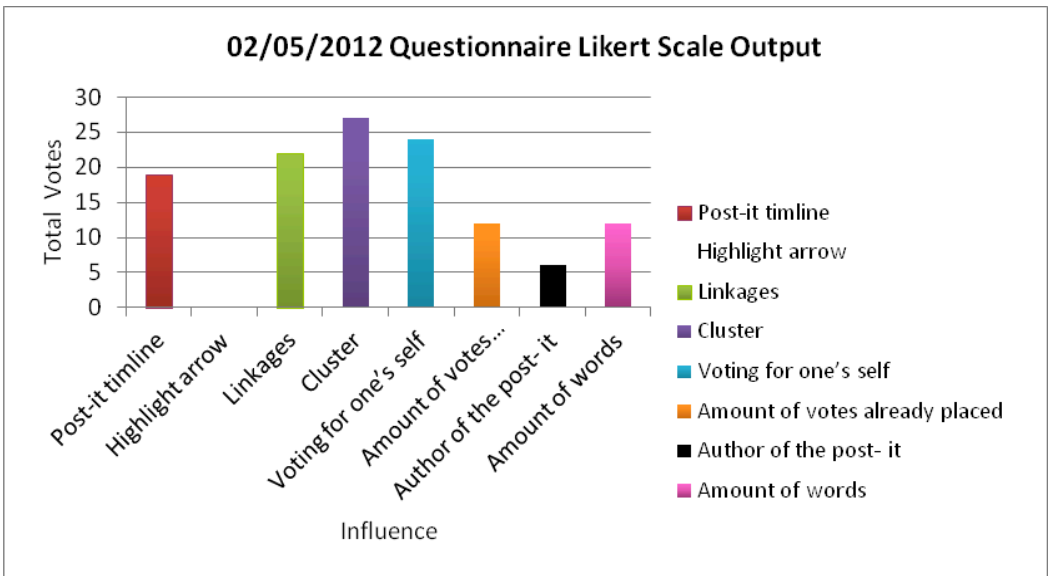


Figure 4: Pilot F questionnaire Likert scale output

Participants rated the most influential factors during voting to be:
1. Clusters
2. Voting for one's self
3. Linkages

There were minimal additional comments or suggestions for process improvement however there was a noticeable pattern of people indicating personal experience and views produced their decision to vote.

2. Analysis of time-lapse photographs
Data was not available

3. Analysis of marked voting dots
Data inapplicable due to clustering

4. Analysis of top ten voted outputs
Data inapplicable due to clustering

2.0 Fully observed workshops:

Three full workshops have been observed following the pilot set. These differed from the pilot workshops in that in each case the full set of data and questionnaire responses was gathered, whilst the pilot workshops data sets were in each case short in some or other respect.

2.1.1 Workshop 1 Background

Amount of attendees	29 (28 actively voting)
Amount of voting dots per person	5
Room set up	This workshop took place in a large room with cabaret style seating focused around the presentations slides with the landscape placed to the right of the presentation. No seating plan was imposed.
Landscape set up	The workshop used a traditional voting style on all three layers working from the top layer down. The landscape was laid out specific swim lanes, particularly dense around the technologies and capabilities layer. Grouping together of similar post-its occurred however no formal clusters were imposed.
Landscape end date	2025+ Long Term
Any specific voting instructions	Participants were not restricted on voting for themselves and were not restricted on the amount of votes they placed on a single post it.

2.1.2 Workshop 1 Findings

1. Participant questionnaires

29 Questionnaires were received back

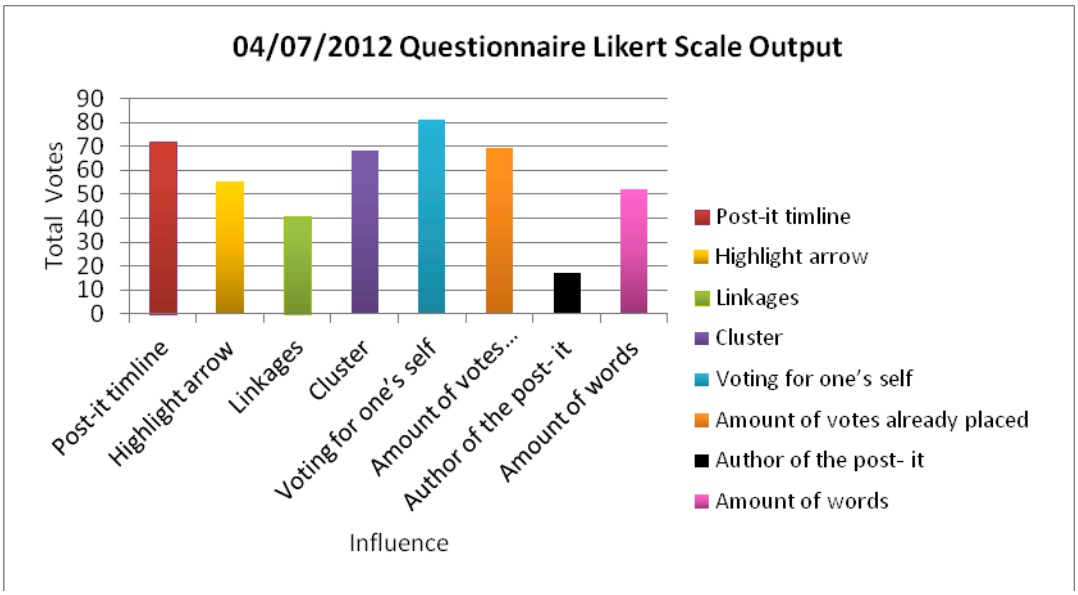


Figure 5: Workshop 1 Questionnaire Likert scale output

Participants rated the most influential factors during voting to be:

1. Voting for one's self
2. Post-it timeline
3. Amount of votes already placed

Comments on the voting influence

Participants frequently state the key influence in their voting decision was their own background knowledge and views (business or personal). Additional factors include; whether clear language was used on the post-it and visibility of the post-it

Comments on process improvement

Attendees indicated that fewer swim lanes would have been more useful as the landscape became difficult to read and remember. Overall comments indicate that visibility was quite a challenge both for the linkages/projected votes and for the landscape. Some suggest a print out would have been helpful to accommodate for this. A few people believed not enough voting dots were allocated (one person states particularly for the last section) and that people should be limited to not vote all on one post it. Multiple comments were made that the day was very enjoyable, informative and valuable.

2. Analysis of time-lapse photographs

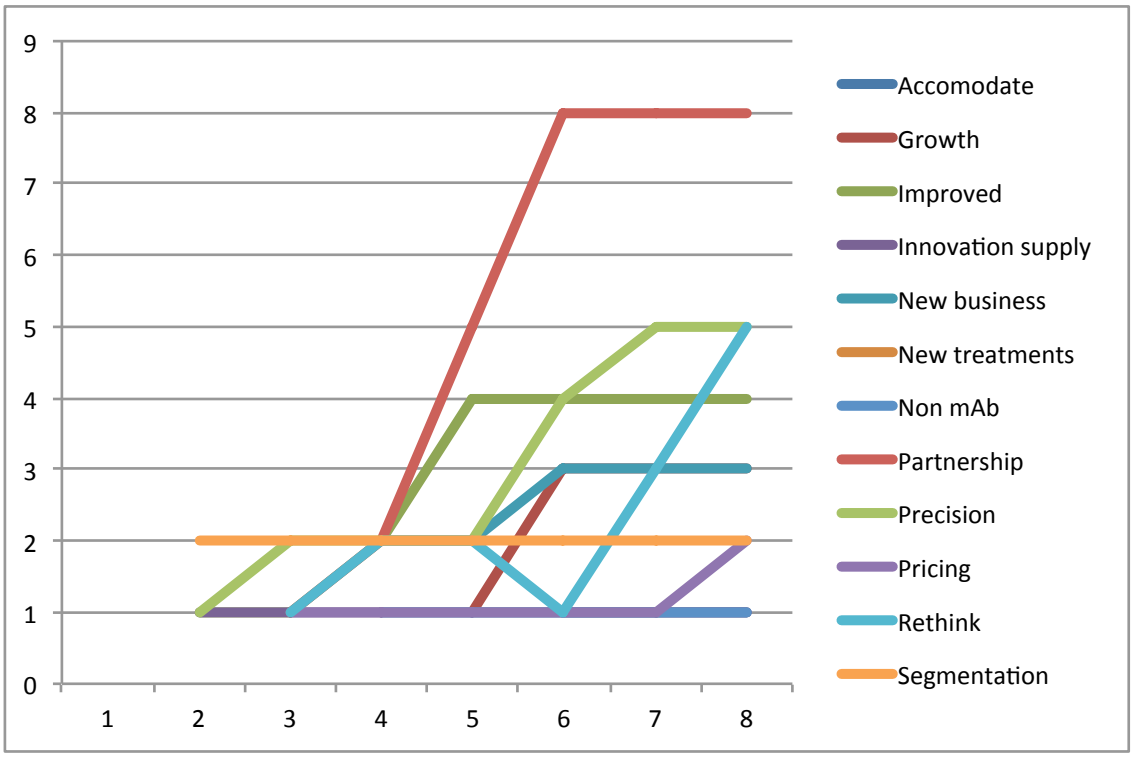


Figure 6: Workshop 1 Real-time observation, Layer 1

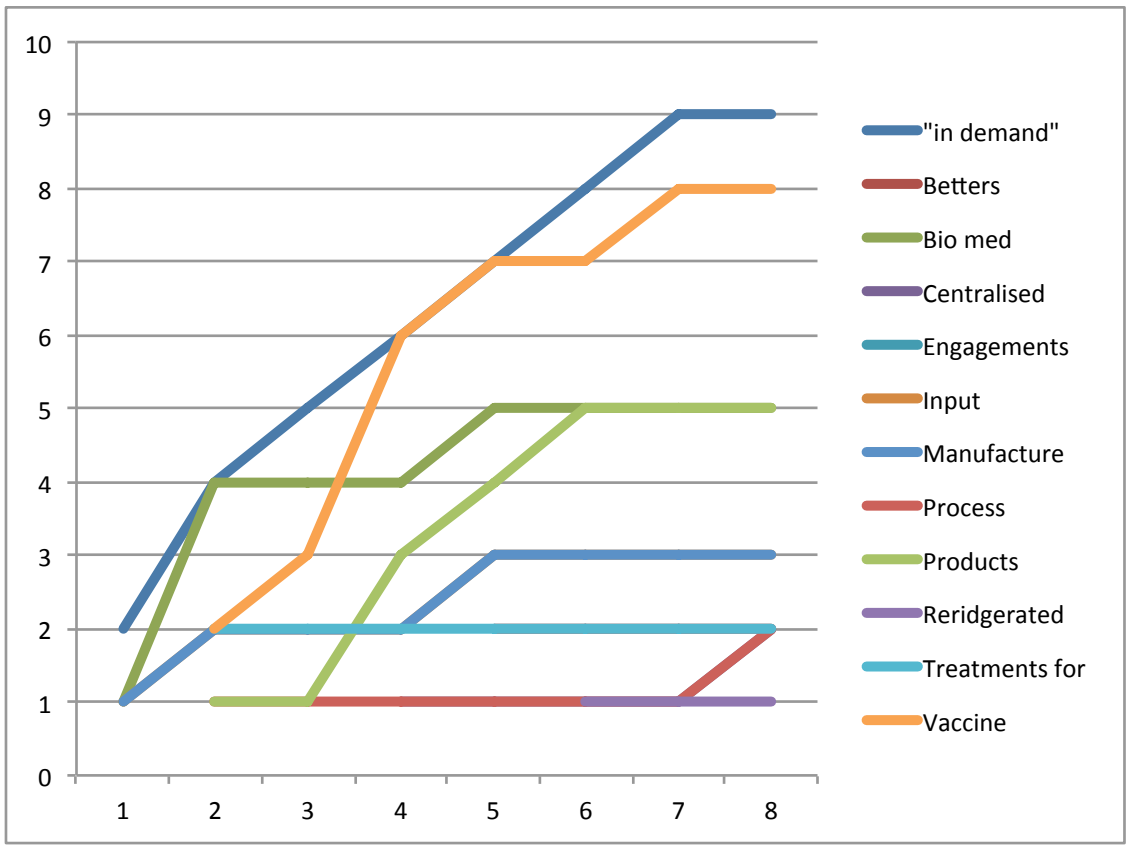


Figure 7: Workshop 1 Real-time observation, Layer 2

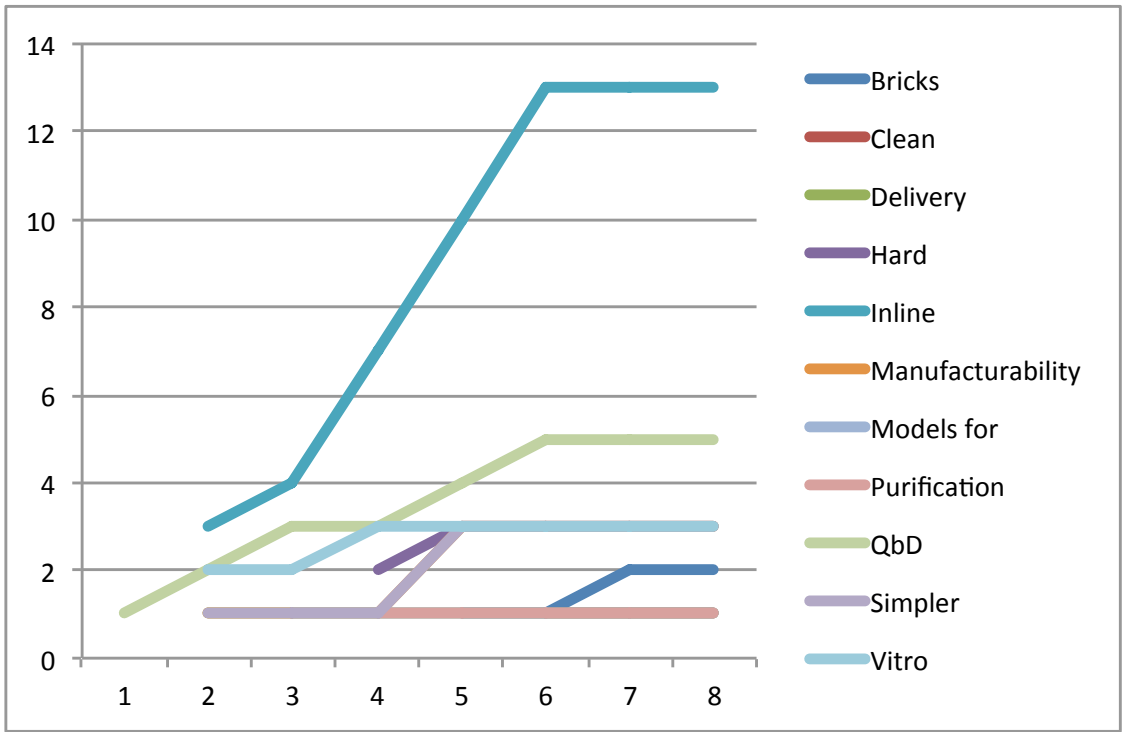


Figure 8: Workshop 1 Real-time observation, Layer 3

3. Analysis of marked voting dots

From this observation tracking five individuals voting dots has revealed:

- 23.88% of all votes placed were votes for one's self
- 28.36% of all votes placed were placed on the same post-it

4. Analysis of top ten voted outputs

- The average amount of words on a top 10 post-it is 6.2
- The average amount of linkages on a top 10 post-it is 1.67
- Top 10 post-its were frequently located on the short term timeline (S 40%, M 30%, L 30%)

2.2.1 Workshop 2 Background

Amount of attendees	18 (21 participating in layer 3)
Amount of voting dots per person	5
Room set up	This workshop took place in a large room with cabaret style seating focused around the presentations slides with the landscape placed to the left of the presentation. No seating plan was imposed.
Landscape set up	The workshop used a traditional voting style on all three layers working from the top layer down. The landscape was laid out with specific swim lanes, reasonably dense around the technologies and capabilities layer. Grouping together of similar post-its occurred however no formal clusters were imposed.
Landscape end date	2025+ Vision
Any specific voting instructions	Participants were not restricted on voting for themselves and were not restricted on the amount of votes they placed on a single post it.

2.2.2 Workshop 2 Findings

1. Participant questionnaires

19 Questionnaires were received back

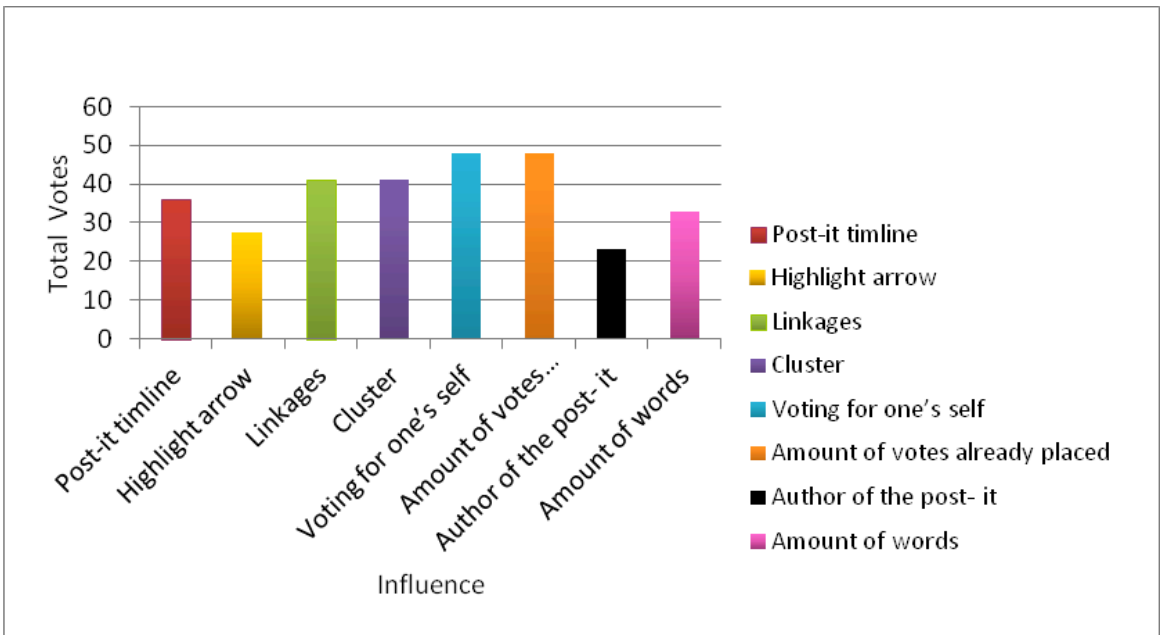


Figure 9: Workshop 2 Questionnaire Likert scale output

Participants rated the most influential factors during voting to be:

1. Voting for one's self/ amount of votes already placed

2. Linkages/Clusters
3. Post-it timeline

Comments on the voting influence
As previously noted in previous workshops participants frequently state the key influence in their voting decision was their own background, interest and industry needs. Additional factors include; pre-existing knowledge, legibility of writing and discussion with the other participants.

Comments on process improvement

Participants indicates that where possible post-it stacking needs to be avoided for people to get a better opportunity to read all of the post-its. Comments were also made suggesting "work through" examples for each of the layers before brainstorming would be helpful. Overall the delegates believed roadmapping was a structured concept that worked well, they enjoyed the debates and noted that changes did not need to be made to the process as it worked well as it stood.

2. Analysis of time-lapse photographs

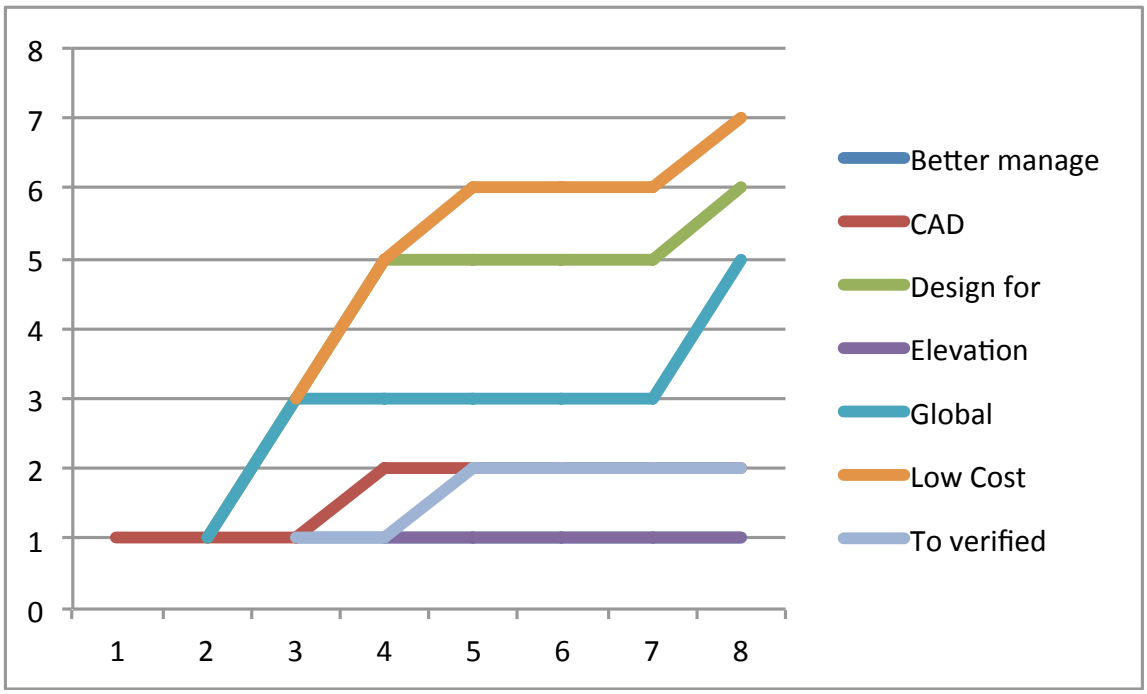


Figure 10: Workshop 2 Real-time observation, Layer 1

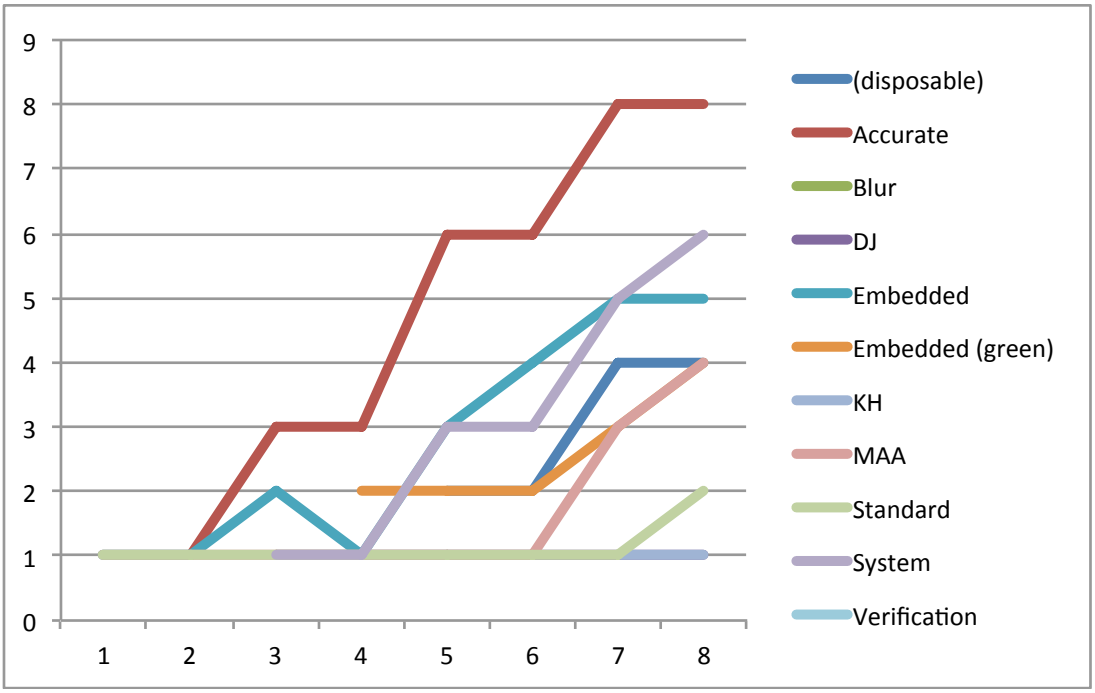


Figure 11: Workshop 2 Real-time observation, Layer 2

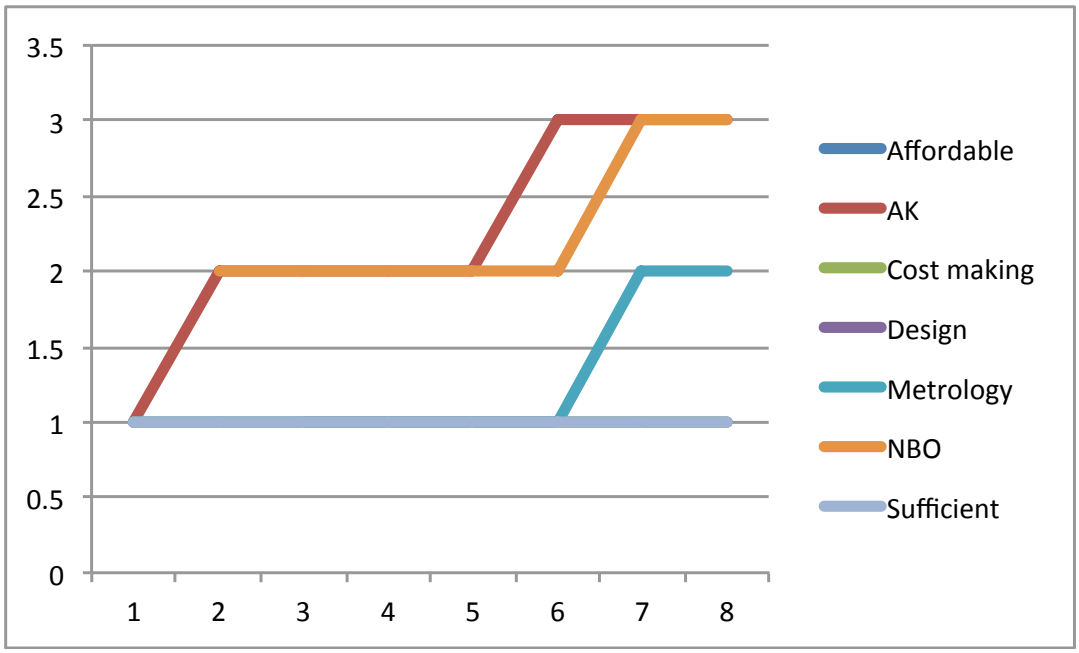


Figure 12: Workshop 2 Real-time observation, Layer 3

3. Analysis of marked voting dots

From this observation tracking five individuals voting dots has revealed:

- 20.37% of all votes placed were votes for one's self
- 14.81% of all votes placed were placed on the same post-it

4. Analysis of top ten voted outputs

- The average amount of words on a top 10 post-it is 7.8
- The average amount of linkages on a top 10 post-it is 3.33
- Top 10 post-its were frequently located on the short term timeline (S 70%, M 30%, L 0%)

2.2.1 Workshop 3 Background

Amount of attendees	25
Amount of voting dots per person	6
Room set up	This workshop took place in a smaller room with 'board room' style seating focused around the presentations slides with the landscape placed to the left of the presentation. No seating plan was imposed.
Landscape set up	The workshop used a traditional voting style on two layers working from the top layer down. The landscape was laid out with specific swim lanes, densely populated around the technologies and capabilities layer. Formal clusters were imposed leaving minimal single standing post-its.
Landscape end date	2025+
Any specific voting instructions	Participants were not restricted on voting for themselves and were not restricted on the amount of votes they placed on a cluster. Voting was guided so that people only voted for the cluster heading and not individual post-it's.

2.2.2 Workshop 3 Findings

1. Participant questionnaires

15 Questionnaires were received back

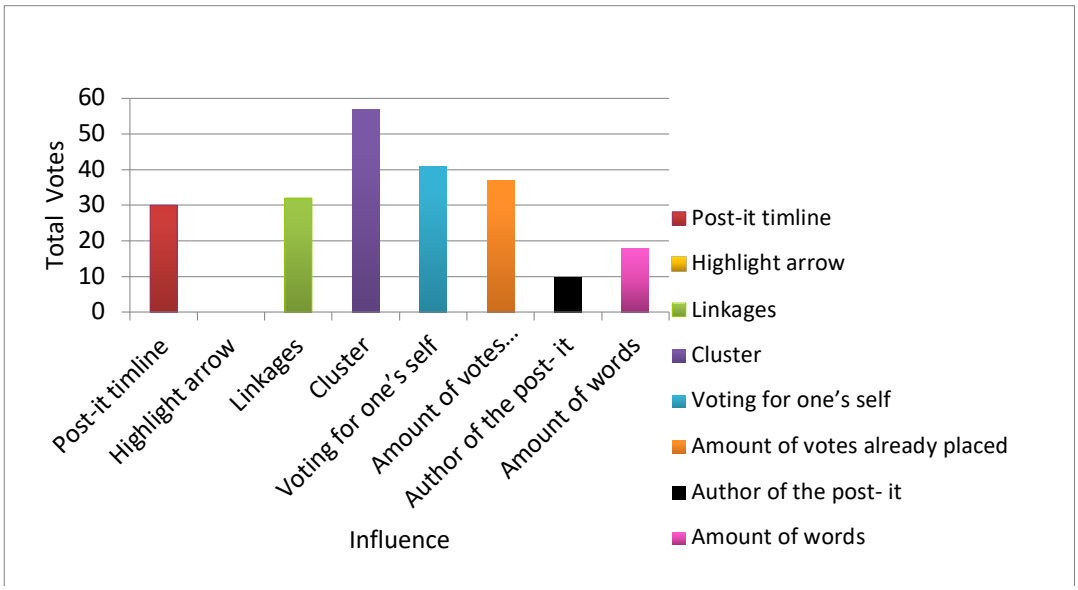


Figure 13: Workshop 3 Questionnaire Likert scale output

Participants rated the most influential factors during voting to be:

1. Clustering
2. Voting for one's self
3. Amount of votes already placed

Comments on the voting influence

Typically areas of interest, personal experience and business perspective were commonly reported to influence voting. Two participants also commented that they were guided through 'gut feel' as well as other people's opinions.

Comments on process improvement

Attendees indicate six voting dots may have been too many as they felt compelled to use them all. Further comments were made about using a blind electronic voting system to reduce bias.

2. Analysis of time-lapse photographs

The facilitator made significantly more extensive use of post-it clustering to identify themes upon which delegates voted than in other workshops. This may have affected the build up of votes as the choice available to delegates was considerably more limited through this approach.

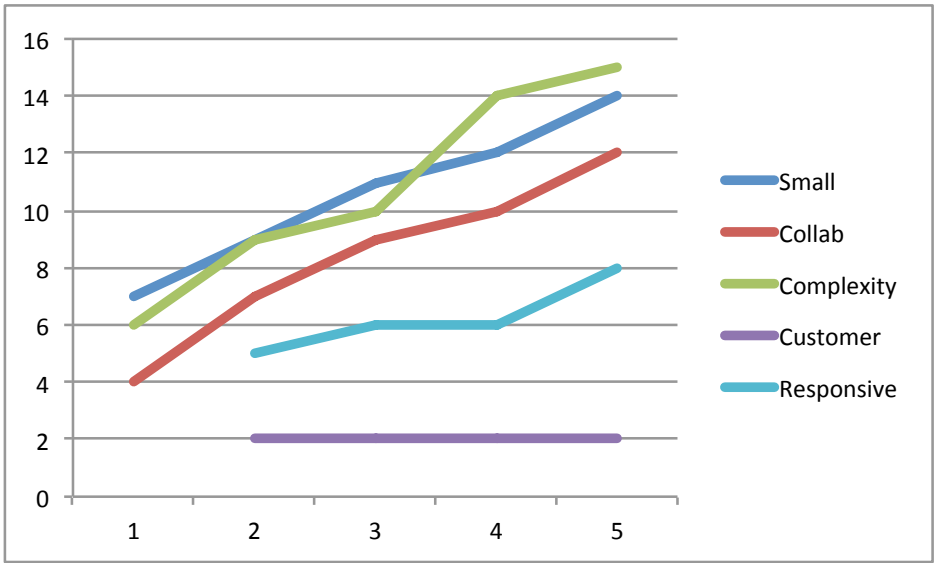


Figure 10: Workshop 3 Real-time observation, Layer 1

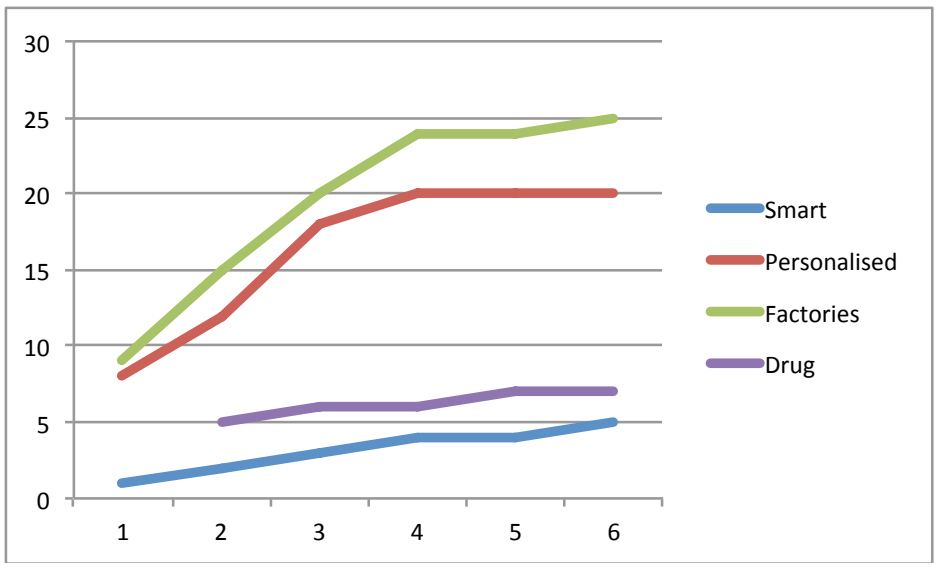


Figure 14: Workshop 3 Real-time observation, Layer 2

3. Analysis of marked voting dots
Data inapplicable due to clustering

4. Analysis of top ten voted outputs
Data inapplicable due to clustering

Result Summary

Method: Questionnaires	Pilot A	Pilot B	Pilot C	Workshop 1	Workshop 2	Workshop 3
Top 3 Most influential factors:	Not Used	Not Used	1.Clustering 2.Voting for one's self 3.Linkages	1. Voting for one's self 2. Post-it timeline 3. Amount of votes already placed	1. Voting for one's self/ amount of votes already placed 2. Linkages/Clusters 3. Post-it timeline	1.Clustering 2.Voting for one's self 3.Amount of votes already placed

Method: Marked Voting Dots	Pilot A	Pilot B	Pilot C	Workshop 1	Workshop 2	Workshop 3
% of votes for self	18.87%	27.27%	Data inapplicable due to clustering	23.88%	20.37%	Data inapplicable due to clustering
% of votes on the same post-it	11.32%	18.18%	Data inapplicable due to clustering	28.36%	14.81%	Data inapplicable due to clustering

Method: Analysis of Top 10 Post-its	Pilot A	Pilot B	Pilot C	Workshop 1	Workshop 2	Workshop 3
Average amount of words	6.83	9.56	Data inapplicable due to clustering	6.2	7.8	Data inapplicable due to clustering
Average amount of linkages	1.35	1.8	Data inapplicable due to clustering	1.67	3.33	Data inapplicable due to clustering
Location frequency	S 30% M 30% L 40%	S 50% M 40% L 10%	Data inapplicable due to clustering	S 40% M 30% L 30%	S 70% M 30% L 0%	Data inapplicable due to clustering
Percentage of Post-its belonging to a cluster	40%	30%	All post-its clustered	No formal clusters	No formal clusters	All post-its clustered

Observations

1. Observations of questionnaires

The Likert scale results indicate voting for one's self is a particularly important factor in an individual's voting decision however in comparison to the vote tracking results individuals do not vote for themselves a very large percentage of the time. In both the pilot and full observation results clustering and linkages also appear to play a large role in these self-report influences.

Participant's comments continue to suggest personal views guide voting. Other key aspects of the process appear to relate to visibility of the roadmap and the post-its. Participants frequently remark on the influence of readability whether it's a result of post-it stacking or writing legibility.

2. O*bservations of time-lapse photographs*

The real-time photography output in both the pilot and the full observation indicate that votes often build considerably up to a point and then level off. If votes already placed on the landscape did not influence latter individuals voting choice then a gradual progression may be seen however most of the highest scores reach peak then stabilize. This observation supports the suggestion that there may be an element of later voting decisions being made based on votes which have already been placed. This may potentially be due to individuals understanding that once a topic has received enough votes it will be further discussed in the roadmapping process therefore their votes may be of more value on alternative topics which they also believe to be of importance.

An exception to this observation is the Workshop 2 layers one and two. On these occasions votes appear to continue to build until voting cessation. This pattern may reflect conditions of this particular workshop such as limited time to vote or may suggest participants were not adjusting their votes based on amount of votes already placed.

3. Observations of marked voting dots

Results continue to indicate participants choose to vote for themselves a relatively small percentage of the time. In addition low percentages are being recorded for the amount of votes placed on the same post-it. Although comments gathered from the questionnaires indicate voting for one's self is a key influential factor these results indicate it does not dominate the voting process, these samples are voting for multiple ideas and are not only voting for themselves.

4. Observations of top ten voted outputs

As supported by comments received from the questionnaires amount and clarity of wording on a post-it is an important factor in individual's voting decision. This may be a simple area in which advice can be given to delegates in order to help them convey their views successfully. In all workshops where data was taken the top ten voted post-its had between six and ten words.

Although questionnaire comments indicate that the number of linkages on a post-it below the Trends and Drivers layer are an important factor analysis of the actual data suggests that in fact links to multiple post-its in the layers above are not necessary for post-it to become popular.

The location of the most popular post-its appear to vary between workshops which may be in fitting with the individual workshop directive. The post-its appear spread considerably evenly across the three timelines with an exception being the Workshop 2 this may reflect the workshop objective or a problem delegates encountered.

Due to variation between facilitation data is limited regarding the extent to which popular post-its belong to clusters however it does indicate that when imposed an influences is notable. In accordance to the style of the third pilot workshop (all post-its clustered), as expected, participants self report results indicate this caused clustering to be the most important factor in voting decision. Equally

during the 04/07/2012 workshop where no formal clusters were imposed a result of clustering not featuring as high in importance was gained. However, Workshop 2 indicated participants viewed clustering as important yet no formal clusters were imposed. This may be due to a difference in the definition of 'clustering'.

Feedback to Facilitators

1. Number of words

Due to frequent comments regarding amount and clarity of wording, supported by analysis of voting patterns, delegates must be made aware about the importance of clear handwriting and to ideally articulate their idea in six to ten words in order for their idea to be read and processed by others.

2. Post-it timeline

Results indicate that the most voted for post-it's are spread across the short, medium and long time frame however in some circumstances a single timeline can become significantly more popular or can be neglected. Depending on the individual workshop objective a certain time frame may require delegate's concentration or a spread across different timelines therefore facilitators may need to use techniques to steer attention appropriately in relation to the outcome needed. Equally facilitators must be vigilant of any bias in timeframe if it is not appropriate to the directive as this may reflect confusion amongst the delegates.

3. Clustering and visibility

Facilitators appear to vary in the degree to which clustering is used. When formal clustering is used (clear and defined groups of post-its) it does appear to exert a medium influence on voting. From the questionnaires participants across workshops repeatedly comment on problems of visibility, overload of post-its and writing eligibility, where possible distinct clusters can be used as a tool to counteract these problems and allow participants to capture the key idea of multiple post-its in a more manageable form and timeframe

4. Influence of votes already placed

A recurring pattern of the 'plateau' effect is visible on real-time voting data suggesting participants are being influenced by previous votes & refraining from voting on post-it's once they have received a significant amount of votes. In order to increase discrimination in the voting process delegates can be made aware of this effect and encouraged try to vote more exclusively based on content of the idea. This awareness may promote further objectivity from the organisation however without using a semi blind or blind voting system previous votes will always play a certain role in voting decisions whether this it is at a conscious or unconscious level. Comments from delegates suggest they would welcome trying out a new blind system of voting in order to prevent biases.

6. Linkages

Theoretically multiple linkages are of great value to the development of the roadmap however this is a considerately low number. In contrast the most voted for post-it's never had more than an average of 3.33 linkages. Although organisations are quantitatively reporting linkages as an important factor many post-it's have had little if any links and some qualitative comments indicate organisations are not fully grasping the linkages significance. Facilitators may need clear instructions for delegates to fully understand the use and importance of linkages and be aware of accepting a post-it with no or very little linkages. Further comments from participants highlight the point that a clear display of linkages need to be present in order for delegates to use them.

7. Highlight arrow

Not all facilitators use post it arrows for delegates to highlight salient ideas. Equally, when present, not all delegates will choose to use them. A few comments captured from the questionnaire indicate that the arrows confused the process. If facilitators choose to use the highlight arrow delegates may need clear reminders each layer regarding their use.

8. Author of the post-it

Low percentages have been recorded for the amount of votes placed on the same post-it multiple times. This is positively indicating participants are voting for multiple ideas and may simply be using their votes for the same post-it on the occasions where they perceive the idea to be of particular importance. This would suggest organisations do not need to be too restricted by facilitators in the allocation of their voting dots as when given the opportunity to spend them however they choose they still spread their votes over a range of ideas.

9. Voting for one's self

Quantitative data gained from the questionnaires indicates voting for one's self is a very influential factor in voting, equally qualitative data suggests having the ability to use vote for one's own views is deemed as very important to participants. In workshops where delegates have been allowed to vote for their own ideas low percentages of occasions have been recorded. This suggests that although participants may vote for themselves it does not overthrow the process. Facilitators may use this information in deciding whether to allow participants to vote for themselves.

10. Other Comments

Questionnaire results indicate where possible pre printed copies of the landscape would be helpful,. Additionally facilitators need to be focussing on bringing out a smaller number of well thought through and expressed post-its rather than allowing the landscape to become overpopulated. These suggestions may aid the prevention of cognitive overload and frequent problems with visibility.

Recommendations for further Study:

1. Benefits and opportunities to IfM and to organisations

Throughout the process all organisations have been welcoming and interested in the research. This observation highlights the potential use and capability of continued research within the roadmapping process while complimenting the needs of the organisations.

2. Increased sample sizes

Conclusions have been limited to the results of a restricted number of workshops and would benefit from additional research to gain a larger data sample.

3. Alternative voting systems

Results have demonstrated that the amount of votes already placed does influence latter voting; these results along with participant comments indicate it would advantageous to continue exploring alternative systems of voting.

4. Real time vote build up

Exploration of the real time vote build up could be extended through analysis using correlation methods in order to better understand the nature and strength of vote build. This would give increased objectivity in the current system and further support to the exploration of alternative voting systems

6. Importance of Linkages

If further data could be gathered it would also be of interest to plot the relationship of the number of votes compared to number of linkages on an X-Y axes. Alternatively with a larger data set a standard deviation may be plotted for the number of votes attracted by post-its with and without linkages, the number of votes attracted by individual post-its and clusters and the amount of words alongside the standard deviation of votes per number of words.

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Appendices

The appendices are laid out IN SEQUENCE for the data gathering and analysis of a specific workshop (16/07/12) to demonstrate the approach and serve as a ‘how to’ guide for future studies.

The full data set is available in a separate Excel File.

Photographs from individual workshops are held separately as they contain information from which individual organisation staff and data might be identified.

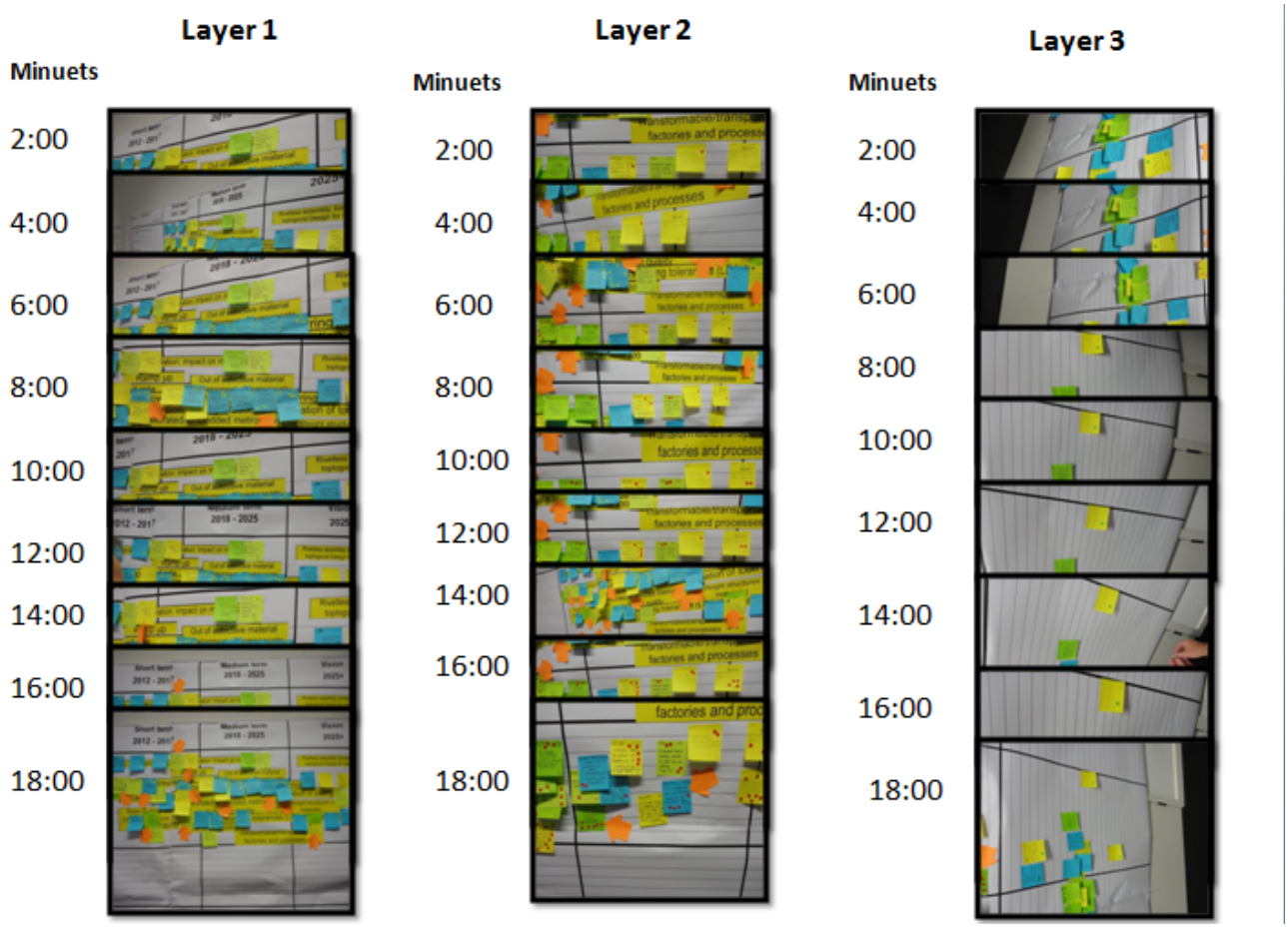
Appendix 1: Workshop 2 Tracked Voting Dots

	A	C	D	E	F	H	I	K	L
213	Workshop	Individual	Vote no	Layer	Initials	Vote for self (n=1,y=2)	Post it Initials	Total votes on post it	
214	16/07/2012	1	1	1	MDS	2	MDS	4	
215	16/07/2012	1	2	1	MDS	2	MDS	4	
216	16/07/2012	1	3	1	MDS	1	PGM	8	Voting on the same post it more than once
217	16/07/2012	1	4	1	MDS	1	JK	7	Data not available
218	16/07/2012	1	5	1	MDS	1	PGM	7	Vote for self
219									
220	16/07/2012	2	1	1	KH	1	DJ	7	
221	16/07/2012	2	2	1	KH				
222	16/07/2012	2	3	1	KH	1	DEW	1	
223	16/07/2012	2	4	1	KH	1	RW	2	
224	16/07/2012	2	5	1	KH				
225									
226	16/07/2012	3	1	1	NM	1	AH	3	
227	16/07/2012	3	2	1	NM	1	KL	7	
228	16/07/2012	3	3	1	NM	1	JK	7	
229	16/07/2012	3	4	1	NM	1	MDS	1	
230	16/07/2012	3	5	1	NM				
231									
232	16/07/2012	4	1	1	JK	2	JK	2	
233	16/07/2012	4	2	1	JK	1	MDS	4	
234	16/07/2012	4	3	1	JK	1	KH	5	
235	16/07/2012	4	4	1	JK	1	JK	7	
236	16/07/2012	4	5	1	JK	1	DEW	1	
237									
238	16/07/2012	5	1	1	NRO	1	KL	7	
239	16/07/2012	5	2	1	NRO	1	KH	5	
240	16/07/2012	5	3	1	NRO	1	DJ	5	
241	16/07/2012	5	4	1	NRO	1	PGM	7	
242	16/07/2012	5	5	1	NRO	1	PGM	7	
243									
244	16/07/2012	1	1	2	MDS	2	MDS	5	
245	16/07/2012	1	2	2	MDS	2	MDS	5	
246	16/07/2012	1	3	2	MDS	1	KL	6	
247	16/07/2012	1	4	2	MDS	1	KL	6	
248	16/07/2012	1	5	2	MDS	1	NRO	9	
249									
250	16/07/2012	2	1	2	KH	1	KL	4	
251	16/07/2012	2	2	2	KH	1	RW	9	
252	16/07/2012	2	3	2	KH	1	RW	8	
253	16/07/2012	2	4	2	KH				
254	16/07/2012	2	5	2	KH				
255									
256	16/07/2012	3	1	2	NM	2	NM	1	
257	16/07/2012	3	2	2	NM	2	NM	1	
258	16/07/2012	3	3	2	NM				
259	16/07/2012	3	4	2	NM	1	NRO	5	
260	16/07/2012	3	5	2	NM	1	NRO	9	

261								
262	16/07/2012	4	1	2	JK	2	JK	1
263	16/07/2012	4	2	2	JK	1	RW	9
264	16/07/2012	4	3	2	JK	1	RW	8
265	16/07/2012	4	4	2	JK	1	AK	5
266	16/07/2012	4	5	2	JK	2	JK	4
267								
268	16/07/2012	5	1	2	NRO	1	KL	5
269	16/07/2012	5	2	2	NRO	1	RW	9
270	16/07/2012	5	3	2	NRO	1	DJ	1
271	16/07/2012	5	4	2	NRO			
272	16/07/2012	5	5	2	NRO			
273								
274	16/07/2012	1	1	3	MDS	1	DJ	4
275	16/07/2012	1	2	3	MDS	1	DEW	7
276	16/07/2012	1	3	3	MDS	1	PN	5
277	16/07/2012	1	4	3	MDS			
278	16/07/2012	1	5	3	MDS			
279								
280	16/07/2012	2	1	3	KH	1	DJ	4
281	16/07/2012	2	2	3	KH	1	DEW	7
282	16/07/2012	2	3	3	KH	2	KH	2
283	16/07/2012	2	4	3	KH	1	NM	1
284	16/07/2012	2	5	3	KH	1	PGM	3
285								
286	16/07/2012	3	1	3	NM			
287	16/07/2012	3	2	3	NM			
288	16/07/2012	3	3	3	NM			
289	16/07/2012	3	4	3	NM			
290	16/07/2012	3	5	3	NM			
291								
292	16/07/2012	4	1	3	JK			
293	16/07/2012	4	2	3	JK			
294	16/07/2012	4	3	3	JK			
295	16/07/2012	4	4	3	JK			
296	16/07/2012	4	5	3	JK			
297								
298	16/07/2012	5	1	3	NRO	1	DJ	3
299	16/07/2012	5	2	3	NRO	1	MDS	7
300	16/07/2012	5	3	3	NRO	1	DJ	4
301	16/07/2012	5	4	3	NRO			
302	16/07/2012	5	5	3	NRO	2	NRO	3
303								

Appendix 2: Workshop 2 Real time Photographs

(For confidentiality purposes the detail of the post-its must remain hidden)



Appendix 3: Workshop 2 Marked Voting Dots Database

	A	B	C	D	E	F	G	H	I	J
504	Workshop	Lager	Time	Time gap	Highlight Arrow	Lager time/finish time	Post it Number	Description	Votes	Total Votes per person per lager
505	16/07/2012	1	02:00	02:03		18:00	1	CAD	1	5
506										
507	16/07/2012	1	04:00	04:08		18:00	1	CAD	1	5
508	16/07/2012	1	04:00	04:08	1	18:00	2	Design for	1	5
509	16/07/2012	1	04:00	04:08		18:00	3	Global	1	5
510										
511	16/07/2012	1	06:00	06:00		18:00	1	CAD	1	5
512	16/07/2012	1	06:00	06:00		18:00	2	Design for	3	5
513	16/07/2012	1	06:00	06:00	1	18:00	3	Global	3	5
514	16/07/2012	1	06:00	06:00		18:00	4	Better manage	1	5
515	16/07/2012	1	06:00	06:00		18:00	5	Low Cost	3	5
516	16/07/2012	1	06:00	06:00		18:00	6	To verified	1	5
517										
518	16/07/2012	1	08:00	08:08		18:00	1	CAD	2	5
519	16/07/2012	1	08:00	08:08	1	18:00	2	Design for	5	5
520	16/07/2012	1	08:00	08:08		18:00	3	Global	3	5
521	16/07/2012	1	08:00	08:08		18:00	4	Better manage	1	5
522	16/07/2012	1	08:00	08:08		18:00	5	Low Cost	5	5
523	16/07/2012	1	08:00	08:08		18:00	6	To verified	1	5
524	16/07/2012	1	08:00	08:08		18:00	7	Elevation	1	5
525										
526	16/07/2012	1	10:00	09:59		18:00	1	CAD	2	5
527	16/07/2012	1	10:00	09:59	2	18:00	2	Design for	5	5
528	16/07/2012	1	10:00	09:59		18:00	3	Global	3	5
529	16/07/2012	1	10:00	09:59		18:00	4	Better manage	1	5
530	16/07/2012	1	10:00	09:59		18:00	5	Low Cost	6	5
531	16/07/2012	1	10:00	09:59		18:00	6	To verified	2	5
532	16/07/2012	1	10:00	09:59		18:00	7	Elevation	1	5
533										
534	16/07/2012	1	12:00	12:02		18:00	1	CAD	2	5
535	16/07/2012	1	12:00	12:02	2	18:00	2	Design for	5	5
536	16/07/2012	1	12:00	12:02		18:00	3	Global	3	5
537	16/07/2012	1	12:00	12:02		18:00	4	Better manage	1	5
538	16/07/2012	1	12:00	12:02	1	18:00	5	Low Cost	6	5
539	16/07/2012	1	12:00	12:02		18:00	6	To verified	2	5
540	16/07/2012	1	12:00	12:02		18:00	7	Elevation	1	5
541										
542	16/07/2012	1	14:00	14:01		18:00	1	CAD	2	5
543	16/07/2012	1	14:00	14:01	2	18:00	2	Design for	5	5
544	16/07/2012	1	14:00	14:01		18:00	3	Global	3	5
545	16/07/2012	1	14:00	14:01		18:00	4	Better manage	1	5
546	16/07/2012	1	14:00	14:01	1	18:00	5	Low Cost	6	5
547	16/07/2012	1	14:00	14:01		18:00	6	To verified	2	5
548	16/07/2012	1	14:00	14:01		18:00	7	Elevation	1	5
549										
550	16/07/2012	1	16:00	16:02		18:00	1	CAD	2	5
551	16/07/2012	1	16:00	16:02	2	18:00	2	Design for	6	5
552	16/07/2012	1	16:00	16:02		18:00	3	Global	5	5
553	16/07/2012	1	16:00	16:02		18:00	4	Better manage	1	5
554	16/07/2012	1	16:00	16:02	1	18:00	5	Low Cost	7	5
555	16/07/2012	1	16:00	16:02		18:00	6	To verified	2	5
556	16/07/2012	1	16:00	16:02		18:00	7	Elevation	1	5
557										
558	16/07/2012	1	18:00	18:00		18:00	1	CAD	2	5
559	16/07/2012	1	18:00	18:00	2	18:00	2	Design for	7	5
560	16/07/2012	1	18:00	18:00		18:00	3	Global	5	5
561	16/07/2012	1	18:00	18:00		18:00	4	Better manage	1	5
562	16/07/2012	1	18:00	18:00	1	18:00	5	Low Cost	7	5
563	16/07/2012	1	18:00	18:00		18:00	6	To verified	2	5
564	16/07/2012	1	18:00	18:00		18:00	7	Elevation	1	5
565										
566	16/07/2012	2	02:00	02:00		18:00	1	Embedded	1	5
567	16/07/2012	2	02:00	02:00		18:00	2	MAA	1	5
568	16/07/2012	2	02:00	02:00		18:00	3	Standard	1	5
569										
570	16/07/2012	2	04:00	03:59		18:00	1	Embedded	1	5
571	16/07/2012	2	04:00	03:59		18:00	2	MAA	1	5
572	16/07/2012	2	04:00	03:59		18:00	3	Standard	1	5
573	16/07/2012	2	04:00	03:59		18:00	4	Accurate	1	5
574										

575	16/07/2012	2	06:00	06:06		18:00	1	Embedded	2	5	
576	16/07/2012	2	06:00	06:06		18:00	2	MAA	1	5	
577	16/07/2012	2	06:00	06:06		18:00	3	Standard	1	5	
578	16/07/2012	2	06:00	06:06		18:00	4	Accurate	3	5	
579	16/07/2012	2	06:00	06:06		18:00	5	DJ	1	5	
580	16/07/2012	2	06:00	06:06		18:00	6	System	1	5	
581											
582	16/07/2012	2	08:00	08:06		18:00	1	Embedded	1	5	
583	16/07/2012	2	08:00	08:06		18:00	2	MAA	1	5	
584	16/07/2012	2	08:00	08:06		18:00	3	Standard	1	5	
585	16/07/2012	2	08:00	08:06		18:00	4	Accurate	3	5	
586	16/07/2012	2	08:00	08:06		18:00	5	DJ	1	5	
587	16/07/2012	2	08:00	08:06		18:00	6	System	1	5	
588	16/07/2012	2	08:00	08:06		18:00	7	Blur	1	5	
589	16/07/2012	2	08:00	08:06		18:00	8	Embedded (green)	2	5	
590											
591	16/07/2012	2	10:00	09:58		18:00	1	Embedded	3	5	
592	16/07/2012	2	10:00	09:58		18:00	2	MAA	1	5	
593	16/07/2012	2	10:00	09:58		18:00	3	Standard	1	5	
594	16/07/2012	2	10:00	09:58		18:00	4	Accurate	6	5	
595	16/07/2012	2	10:00	09:58		18:00	5	DJ	1	5	
596	16/07/2012	2	10:00	09:58	1	18:00	6	System	3	5	
597	16/07/2012	2	10:00	09:58		18:00	7	(disposable)	2	5	
598	16/07/2012	2	10:00	09:58		18:00	8	Embedded (green)	2	5	
599											
600	16/07/2012	2	12:00	12:01		18:00	1	Embedded	4	5	
601	16/07/2012	2	12:00	12:01		18:00	2	MAA	1	5	
602	16/07/2012	2	12:00	12:01		18:00	3	Standard	1	5	
603	16/07/2012	2	12:00	12:01		18:00	4	Accurate	6	5	
604	16/07/2012	2	12:00	12:01		18:00	5	DJ	1	5	
605	16/07/2012	2	12:00	12:01	1	18:00	6	System	3	5	
606	16/07/2012	2	12:00	12:01		18:00	7	(disposable)	2	5	
607	16/07/2012	2	12:00	12:01		18:00	8	Embedded (green)	2	5	
608											
610	16/07/2012	2	14:00	14:00		18:00	2	MAA	3	5	
611	16/07/2012	2	14:00	14:00		18:00	3	Standard	1	5	
612	16/07/2012	2	14:00	14:00		18:00	4	Accurate	8	5	
613	16/07/2012	2	14:00	14:00		18:00	5	DJ	1	5	
614	16/07/2012	2	14:00	14:00	1	18:00	6	System	5	5	
615	16/07/2012	2	14:00	14:00		18:00	7	(disposable)	4	5	
616	16/07/2012	2	14:00	14:00		18:00	8	Embedded (green)	3	5	
617	16/07/2012	2	14:00	14:00		18:00	9	KH	1	5	
618											
619	16/07/2012	2	16:00	16:04		18:00	1	Embedded	5	5	
620	16/07/2012	2	16:00	16:04	1	18:00	2	MAA	4	5	
621	16/07/2012	2	16:00	16:04		18:00	3	Standard	2	5	
622	16/07/2012	2	16:00	16:04		18:00	4	Accurate	8	5	
623	16/07/2012	2	16:00	16:04		18:00	5	DJ	1	5	
624	16/07/2012	2	16:00	16:04	1	18:00	6	System	6	5	
625	16/07/2012	2	16:00	16:04		18:00	7	(disposable)	4	5	
626	16/07/2012	2	16:00	16:04		18:00	8	Embedded (green)	4	5	
627	16/07/2012	2	16:00	16:04		18:00	9	KH	1	5	
628	16/07/2012	2	16:00	16:04		18:00	10	Verification	1	5	
629											
630	16/07/2012	2	18:00	17:58		18:00	1	Embedded	5	5	
631	16/07/2012	2	18:00	17:58	1	18:00	2	MAA	4	5	
632	16/07/2012	2	18:00	17:58		18:00	3	Standard	2	5	
633	16/07/2012	2	18:00	17:58		18:00	4	Accurate	8	5	
634	16/07/2012	2	18:00	17:58		18:00	5	DJ	1	5	
635	16/07/2012	2	18:00	17:58	1	18:00	6	System	6	5	
636	16/07/2012	2	18:00	17:58		18:00	7	(disposable)	4	5	
637	16/07/2012	2	18:00	17:58		18:00	8	Embedded (green)	4	5	
638	16/07/2012	2	18:00	17:58		18:00	9	KH	1	5	
639	16/07/2012	2	16:00	17:58		18:00	10	Verification	2	5	
640											
641	16/07/2012	3	02:00	02:01		18:00	1	Sufficient	1	5	
642	16/07/2012	3	02:00	02:01		18:00	2	Metrology	1	5	
643	16/07/2012	3	02:00	02:01		18:00	3	Cost making	1	5	
644	16/07/2012	3	02:00	02:01		18:00	4	AK	1	5	
645											
646	16/07/2012	3	04:00	04:05		18:00	1	Sufficient	1	5	
647	16/07/2012	3	04:00	04:05		18:00	2	Metrology	1	5	
648	16/07/2012	3	04:00	04:05		18:00	3	Cost making	1	5	
649	16/07/2012	3	04:00	04:05		18:00	4	AK	2	5	
650	16/07/2012	3	04:00	04:05		18:00	5	NBO	2	5	
651											
652	16/07/2012	3	06:00	05:58		18:00	1	Sufficient	1	5	
653	16/07/2012	3	06:00	05:58		18:00	2	Metrology	1	5	
654	16/07/2012	3	06:00	05:58		18:00	3	Cost making	1	5	
655	16/07/2012	3	06:00	05:58		18:00	4	AK	2	5	
656	16/07/2012	3	06:00	05:58		18:00	5	NBO	2	5	
657	16/07/2012	3	06:00	05:58		18:00	6	Affordable	1	5	
658											
659	16/07/2012	3	08:00	08:01		18:00	1	Sufficient	1	5	
660	16/07/2012	3	08:00	08:01		18:00	2	Metrology	1	5	
661	16/07/2012	3	08:00	08:01		18:00	3	Cost making	1	5	
662	16/07/2012	3	08:00	08:01		18:00	4	AK	2	5	
663	16/07/2012	3	08:00	08:01		18:00	5	NBO	2	5	
664	16/07/2012	3	08:00	08:01		18:00	6	Affordable	1	5	
665											
666	16/07/2012	3	10:00	09:59		18:00	1	Sufficient	1	5	
667	16/07/2012	3	10:00	09:59		18:00	2	Metrology	1	5	
668	16/07/2012	3	10:00	09:59		18:00	3	Cost making	1	5	
669	16/07/2012	3	10:00	09:59		18:00	4	AK	2	5	
670	16/07/2012	3	10:00	09:59		18:00	5	NBO	2	5	
671	16/07/2012	3	10:00	09:59		18:00	6	Affordable	1	5	
672											
673	16/07/2012	3	12:00	12:05		18:00	1	Sufficient	1	5	
674	16/07/2012	3	12:00	12:05		18:00	2	Metrology	1	5	
675	16/07/2012	3	12:00	12:05		18:00	3	Cost making	1	5	
676	16/07/2012	3	12:00	12:05		18:00	4	AK	3	5	
677	16/07/2012	3	12:00	12:05		18:00	5	NBO	2	5	
678	16/07/2012	3	12:00	12:05		18:00	6	Affordable	1	5	
679											

666	16/07/2012	3	10:00	09:59		18:00	1	Sufficient	1	5	
667	16/07/2012	3	10:00	09:59		18:00	2	Metrology	1	5	
668	16/07/2012	3	10:00	09:59		18:00	3	Cost making	1	5	
669	16/07/2012	3	10:00	09:59		18:00	4	AK	2	5	
670	16/07/2012	3	10:00	09:59		18:00	5	NBO	2	5	
671	16/07/2012	3	10:00	09:59		18:00	6	Affordable	1	5	
672											
673	16/07/2012	3	12:00	12:05		18:00	1	Sufficient	1	5	
674	16/07/2012	3	12:00	12:05		18:00	2	Metrology	1	5	
675	16/07/2012	3	12:00	12:05		18:00	3	Cost making	1	5	
676	16/07/2012	3	12:00	12:05		18:00	4	AK	3	5	
677	16/07/2012	3	12:00	12:05		18:00	5	NBO	2	5	
678	16/07/2012	3	12:00	12:05		18:00	6	Affordable	1	5	
679											
680	16/07/2012	3	14:00	14:05		18:00	1	Sufficient	1	5	
681	16/07/2012	3	14:00	14:05		18:00	2	Metrology	2	5	
682	16/07/2012	3	14:00	14:05		18:00	3	Cost making	1	5	
683	16/07/2012	3	14:00	14:05		18:00	4	AK	3	5	
684	16/07/2012	3	14:00	14:05		18:00	5	NBO	3	5	
685	16/07/2012	3	14:00	14:05		18:00	6	Affordable	1	5	
686											
687	16/07/2012	3	16:00	16:02		18:00	1	Sufficient	1	5	
688	16/07/2012	3	16:00	16:02		18:00	2	Metrology	2	5	
689	16/07/2012	3	16:00	16:02		18:00	3	Cost making	1	5	
690	16/07/2012	3	16:00	16:02		18:00	4	AK	3	5	
691	16/07/2012	3	16:00	16:02		18:00	5	NBO	3	5	
692	16/07/2012	3	16:00	16:02		18:00	6	Affordable	1	5	
693											
694	16/07/2012	3	18:00	18:00		18:00	1	Sufficient	1	5	
695	16/07/2012	3	18:00	18:00		18:00	2	Metrology	3	5	
696	16/07/2012	3	18:00	18:00		18:00	3	Cost making	1	5	
697	16/07/2012	3	18:00	18:00		18:00	4	AK	3	5	
698	16/07/2012	3	18:00	18:00		18:00	5	NBO	3	5	
699	16/07/2012	3	18:00	18:00		18:00	6	Affordable	1	5	
700	16/07/2012	3	18:00	18:00		18:00	7	Design	2	5	

Appendix 4: Workshop 2 Top Ten Post-it Database

35	Workshop	Post it	Votes	Pre Populated comment	Cluster (at time of voting)	Initials	Words	Layer (1,2,3)	Timeline (S1,M2,L3)	Post it Date	Landscape End date	Linkages	Max Linkages per layer	Total Layers	Total votes per person per layer
36	16/07/2012	1	9	n	n	MDS	6	2	1	2014	2025+	4	7	3	5
37	16/07/2012	2	9	n	n	RW	7	2	1	2018	2025+	0	7	3	5
38	16/07/2012	3	9	n	n	NBO	10	2	1	2025	2025+	5	7	3	5
39	16/07/2012	4	8	n	n	PGM	6	1	2	2020	2025+	na	0	3	5
40	16/07/2012	5	8	n	n	RW	14	2	1	2013	2025+	6	7	3	5
41	16/07/2012	6	8	n	n		3	3	1	2017	2025+	3	4	3	5
42	16/07/2012	7	7	n	n	DEW	8	3	1	2015	2025+	2	4	3	5
43	16/07/2012	8	7	n	n	IEC	5	1	1	2012	2025+	na	0	3	5
44	16/07/2012	9	7	n	n	PGM	11	1	2	2017-20	2025+	na	0	3	5
45	16/07/2012	10	7	n	n	JK	8	1	2	2020	2025+	na	0	3	5

Appendix 6: Research Feedback Questionnaire

Research Feedback Questionnaire

Thank you for taking the time to fill out this feedback questionnaire. Please answer as honestly and accurately as possible. All answers you provide will be kept confidential and treated as a group result.

1. During the landscape voting, how did you decide to place your votes?

2. Of those below, to what extent would you say the following influenced your voting choices?

Post-it Timeline e.g. short term:

0 1 2 3 4 5 6

No Influence Great Influence

Highlight arrow on post-it (if applicable):

0 1 2 3 4 5 6

No Influence Great Influence

Linkages on the post-it:

0 1 2 3 4 5 6

No Influence Great Influence

Post-it being a part of a cluster (if applicable):

0 1 2 3 4 5 6

No Influence Great Influence

Voting for my own post-it:

0 1 2 3 4 5 6

No Influence Great Influence

Amount of votes already placed:

0 1 2 3 4 5 6

No Influence Great Influence

Author of the post-it:

0 1 2 3 4 5 6

No Influence Great Influence

Amount of words on a post-it:

0 1 2 3 4 5 6

No Influence Great Influence

3. If any additional factors influenced your voting choice please state below...

5. Would you have any suggestions to improve the voting process?

6. Any additional comments?

Appendix 7: Workshop 2 Research Feedback Questionnaire Database

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1				Voting Influence 0-6										
2	Workshop	Delegate No.	During the landscape voting, how did you decide to place your votes?	Post-it timline	Highlight arrow	Linkages	Cluster	Voting for one's self	Amount of votes already	Author of the post-it	Amount of words	Which, if any additional factors influenced your voting choice please state below	Do you have any suggestions to improve the voting process?	Any additional comments?
42	16/07/2012	1	(Generally) I chose subjects that were relevant to my industry and the work I am currently involved in	2	4	2	2	2	4	2	2			Maybe some quick "work through examples" for each of the three main sections of brainstorming
43	16/07/2012	2	By looking for the 'stand out' ideas relative to the topic in hand	2	1	3	4	2	3	0	1	Pre-existing personal knowledge	Try not to 'stack' post-it's on top of each other	
44	16/07/2012	3	Review all post-it's, apply stickets to preferred topics	3	2	1	2	2	3	0	1		Bigger piece of paper so you can more easily see all post-it's	
45	16/07/2012	4	Topic	5	5	5	5	4	4	2	2			
46	16/07/2012	5	Observed the different comments which ones were most relevant to my needs/environment/job	1		3	4	4	4	3	2	Having voted when majority of people had already votes possbily made an impact on voting trend	The method of improving this process to makre more independent would impact timeline of process so as long as various variables are considerent then current process is fine	
47	16/07/2012	6	Look for 'hookline' on post-it that attracts attention	3	4	3	4	3	3	2	2	Knowledge of subject area	Blind voting- not see other votes cast	
48	16/07/2012	7	Topics interesting to me- and those with good potential to be implemented or develop	0	0	0	0	0	0	0	0		No it's a great concept that seems to work well	
49	16/07/2012	8	Relevance to my companies technology and areas I feel are important	0	0	0	0	2	0	0	0			Some post-it's were hidden and didn't get the same attention
50	16/07/2012	9	I chose items I understood were relvant and seemed realistic. Potential to help my business.	4	0	3	3	4	3	5	3	The legibility of the post-it. Handwriting neatness	Have you considered the 'turning point' electronic voting system? Very interactive. Google it.	
51	16/07/2012	10		2	0	0	3	1	3	1	2	Ability to see the post-it it was busy around the chart so I could not see them all		
52	16/07/2012	11	I reviewed sollutions against my business needs	3	2	3	2	2	2	2	2	Good debate around post-it's as they were placed had a degree of influence		
53	16/07/2012	12	Importance, interest (self and intellectual)	0	0	2	1	2	3	2	0			
54	16/07/2012	13	Can't remember	1	2	2	3	4	3	1	1	Discussions with others	More room for post-it's on poster	
55	17/07/2012	14	I tried not to vote for my own post-its unless I couldn't see a better suggestion. I looked for suggestions that would have the most influence on my business	2	0	2	3	3	3	0	2			
56	18/07/2012	15	Spending time to read through the post-its and asking questions if something needed clarification	0	0	4	1	0	1	0	2			
57	19/07/2012	16	Requirements/ interests/ views	2		1		4	0	0	2	Some post-its were really difficult to see	Larger area for both post-it sticking and viewing	Very well conducted- informative brainstorming
58	20/07/2012	17	Read all the post-its and considered my responce. Open minded.	0	1	0	3	0	1	0	4			
59	21/07/2012	18	What is interesting. What touched my topic	2	4	3	1	4	3	1	3	Readability	Collect all suggestions and give them anonymously	
60	22/07/2012	19	Review the points and what was most relevant to my knowledge and experience	4	2	4		5	5	2	2		None it was very structured	
61	Total:			36	27	41	41	48	48	23	33			
62														

Appendix 8: Debriefing Form

A Psychological Insight Into Voting Behaviour

Thank you for taking part today. I am currently in the process of implementing a research project to contribute a psychological insight into selected aspects of the Institute of Manufacturing's roadmapping workshop methodology.

The aim of this observation is to gain a deeper understanding of the way individuals use their voting dots during the roadmap formulation.

After data has been collected a report will be written addressing the findings of the observations and the practical implications of these results. Input will be provided to the project facilitators in terms of process development and to organisations as to the conclusions of the research.

Any individual results will be kept confidential to the observer and all results will be displayed anonymously as group data.

If you have any further questions regarding the research or the conduct of the observation please contact Georgina McKenzie (Observer): georgina.o.mckenzie@gmail.com

In addition if you have any complaints or concerns about the research you may contact Rob Phaal (Institute of Manufacturing): rp108@cam.ac.uk

Your participation in this observation is greatly appreciated.