

## **Emerging technologies – preserving and growing value over multiple innovation timelines**

Dr Valerie Lynch FIoD FRSA CDir

[Valerie.lynch@andtr.com](mailto:Valerie.lynch@andtr.com)

IFM University of Cambridge, AND Technology Research Ltd

### **Abstract**

Innovation involving emerging technologies typically involves higher risk than innovation using established technologies. The rewards can be higher, but the time-line to receipt of rewards can be long. Multiple innovation projects may be required to produce a marketable product.

This paper presents a process through which value could be identified at each innovation stage, preserved and grown over that time-line. Companies following such a process could benefit from a better understanding of value created and help guide investment decisions that need to be made.

Specific terms, implicit value, explicit value, enrichments and headstarts are introduced. The fit between the process proposed and the ability of companies to undertake the process is examined through interviews with 18 companies, all of whom were introduced to the value process. Data collected shows that although many companies have processes to identify value, they do not appear to have mechanisms to communicate how they can preserve and grow value over multiple time lines.

Work on the development of new process which could possibly assist companies is ongoing.

## **Emerging technologies – preserving and growing value over multiple innovation timelines**

Dr Valerie Lynch FIOD FRSA CDir

[Valerie.lynch@andtr.com](mailto:Valerie.lynch@andtr.com)

IFM University of Cambridge, AND Technology Research Ltd

**Fiod FRSA CDir**

### **Identification of the need for study on this topic**

Study of values gained from investment in emerging technologies is useful to R&D managers as technology emerging at the right time may result in a market winner. But what if the time is not right? Does this mean that work undertaken has no value? Unlikely, but what is that value?

Fast changing industries breed new technologies, and disruption in a market place will occur when the market and the technology come together [1]. To survive disruptions companies can invest in new product and services; but in what, and when, requires strategy [1].

Different approaches are taken. Value creation from the development of emerging technologies is risky and investment in portfolios of technology which hedge outcomes [2] is one approach. Managers can develop strategies to support balancing portfolios and assist investment choices made [5]. But, despite best efforts, ongoing R&D work can deliver outputs that do not match market conditions. Markets can be volatile and influenced by external factors outside of the control of the company [10,11]. In addition, the market for emerging technologies may itself be emerging. It may not be possible therefore to capture value from work when projects are completed [1,3,4,6] and the outputs may therefore appear to have little value.

Opportunities, however may arise in the future when, for example, a new market emerges, or if an alternative market area is identified, but this often requires investment in the technology over multiple innovation times lines [2,3,4,7]. Time lag therefore between value generation and value capture can be considerable and decisions to preserve and maintain value already generated need to be taken. Information about what is valuable and why, is required if decisions taken are not to be misguided [4,6,9].

Performance indicators guide companies when making decision, and these are often focused on financial rather than broader measures [4,7]; sales achieved and return on investment (ROI) are examples of financial measures [4,7,9]. Financial measures however do not reflect the overall value created by the work undertaken [4,7]. In particular, for work involving emerging technologies and for which market maturity is yet to be reached, financial indicators may not even be available. Alternative measures are therefore required for guiding decisions. [4,5,7,9].

Value is a broad term which differs in meaning according to context [4]. Value from a sale, for example, can be measured through revenues received by a company as it reflects a value judgement in the market place, i.e. the price. In the context of investment, costs and funds provided to produce or develop the market offering alongside percentage returns required, can be taken as a measure for determining value required in a market place. Linking development work to the market place can however often be difficult or meaningless when emerging technologies are involved [4,5,7]. Despite this there is clearly still a need for companies to assess their use of funds, not least for providing robust company governance [8]. This therefore involves assessing the value any particular piece of work has achieved. What to measure and how to measure it is an issue [16].

An example of the difficulties faced by companies is illustrated in the Mazda case study described by Nonaka in [7]. This case reports on development that required multiple innovation timelines before the technology was employed in a marketable product. At the end of each innovation stage value needed to be established but using non-financial measures. The point is made that if financial indicators had been the sole criteria for continued investment, the project would most likely have been stopped. The case describes how commitment to strategic purpose, set by the company, acted as a driver for continued investment. The knowledge and know-how created was used as the value measure in the early stages before explicit market estimations and revenues were obtained. Alignment of the area in which the knowledge was created to strategic aims gave the measure credence within the company.

Nonaka [7] highlights that knowledge is a key resource within a company, and how, through valuing knowledge, competitive advantage can be both maintained and gained. Nonaka identifies the existence of tacit knowledge, and suggests that companies that recognise and

utilise explicit and tacit knowledge appear to be more successful than those that don't. Explicit knowledge he explains is that which is recorded and shared. In contrast tacit knowledge is held by project team members, for example, within actions taken, and is not fully articulated. Note that it is not just that knowledge is important. Measures to inform the decision makers about the knowledge are also important. Furthermore the point is made that companies should look to measure assets that are not always obvious. Explicit knowledge is readily identifiable, tacit knowledge is not.

Performance Indicators, of which knowledge and strategic alignment of two examples, allow companies to assess their operations in areas other than financial [10]. Companies set their own indicators depending on what is to be measured and why [5], but operational efficiency, quality, customer satisfaction and social/environmental impact are often addressed through the use of indicators [4,7,8]. Assessment of value and determining whether or not continued development of emerging technology should be pursued [5] can be addressed in this way.

Evaluation using performance indicators as opposed to valuation using financial indicators is a distinction commonly used when considering company performance [4,8], but the two types of indicators are not necessarily independent [8]. Financial indicators of value are plentiful [9], some such as revenue are lagging indicators, i.e. after the event, and some such as market size are leading, i.e. before the event. Estimation of value expectation from sales is a leading financial indicator [9]. Companies use the indicators for accounting and governance. Companies communicate the information to stakeholders via reports and statements. Operations, resourcing, R&D spend and customer service levels are often described, as well as ways in which the company address their responsibilities for legal adherence and social / environment benefit. Stakeholder relations and the extent to which the company strategy and objectives have been achieved are also included. The audience for such reports will vary according to company type and the purpose. For example, potential and existing investors, will look to reports when making their investment decisions [8] and companies wishing to attract investors should take that into account. Financial data alongside narrative is often used in order to clarify the position of the company so that the report articulates a view of the company at that specific point in time.

The financial data can include both lagging and leading information and from this two views of the company value can be formed as shown in figure 1.

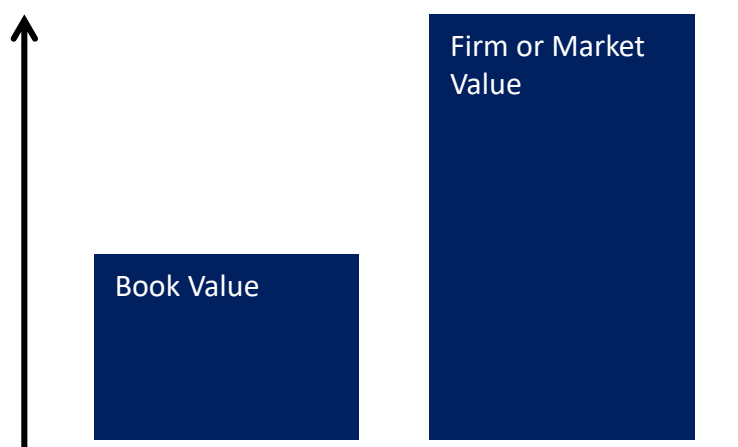


Figure 1: Two views of company value company

The Book Value represents the equity or assets held and accounted for by the company. It is based on lagging financial indicators. The Firm or Market Value represents the owners or other stakeholders view of the company and its potential for the future. Leading financial indicators are used. For example, estimations of the potential value from exploitation of company assets can be used to create the Firm Value. For publically traded companies a Market Value using capitalisation of shareholding can be calculated using the current share price. As the share price reflects confidence of investors in the company, this value is a leading indicator. Book Value (lagging) and the Firm/Market Value (leading) are both important to analysis undertaken by potential investors [8,9]. Some indicators combine the two. The Market to Book Value (MBV - (a ratio of the two) and Market Value Added (MVA - difference of the two) can be calculated for use in judging the potential of the company [9]. Higher ratios and larger differences, respectively, when compared to norms or other companies in the market place, provide an indication that the company is perhaps using its resources more efficiently, providing high levels of returns on investment, or operating in an area of growth and opportunity.

Understanding the potential for the company to use its assets and create value is important not only for investors but for all stakeholders and the company itself. And for companies utilising emerging technologies, for whom the time lag between investment and achieving revenues is likely to involve multiple projects over extended time periods, it is particularly

important. One possibility for examining company potential is through estimating how much investment would be needed to create the impact required for achieving a superior value. A simple relationship between investment, impact and value is illustrated in figure 2.

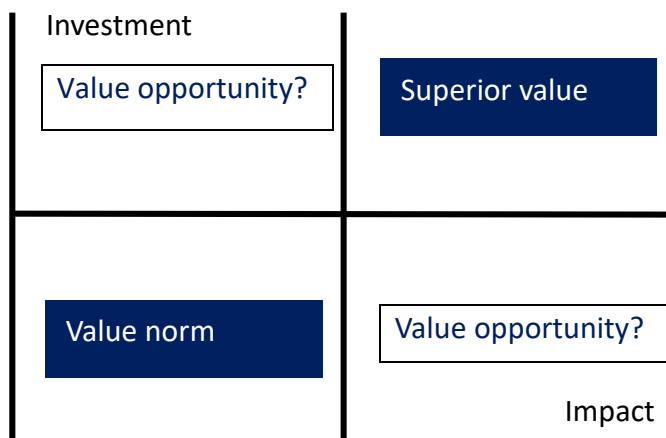


Figure 2: Impact of investment on value

Figure 2<sup>1</sup> illustrates that investment can result in generation of superior value but that it may not. The value opportunity may be unknown. The role of the decision maker is to assess the viability of a project in terms of the impact the investment is having on the value created and for this they need information. Lagging indicators can show whether or not value creation has been achieved, but leading indicators are required for deciding whether or not it is likely to be achievable.

Assessing the viability of value creation for a set level of input is difficult and made more so when, as illustrated in the Mazda example [7], emerging technology is involved. Financial indicators are generally not readily available making communication of value difficult [7,8,9,16]. Misguided decisions [8] and loss of value can result if the indicators used within the assessment do not reflect the value created. Choice of indicators, measures and the way in which the measures are communicated are therefore important [12, 16] if decision makers are to be best informed.

Narrative to articulate the outputs achieved and intended direction of work on emerging technologies goes some way to providing context for how value can be created during any

<sup>1</sup> This paper is concerned with the existence of a relationship between investment and impact and not with level of investment required to achieve an impact.

one innovation cycle. However, it seems reasonable that, to support preservation and growth of value through multiple innovation cycles, decision makers will require some evidence of positive impact on the company value. This can be achieved through linking innovation to company strategy [7], or adherence to legislative or social objectives. Whatever indicators are chosen, governance dictates that evidence of good use of resources is required. Impact on finances therefore needs to be considered even if indicators chosen are not financial.

Studies on the impact of different types of indicators have shown that, for example, high levels of customer satisfaction can be linked to a raised Market Value [8, 15]. A similar link is reported in a study of the impact of investment on Market Value [14], and R&D spend has been linked to opportunity for obtaining superior value [13]. Despite the fact that performance indicators are not be financial measures, it would appear that they could be viewed as leading indicators for financial performance [8]. The Tobin 'q' ratio, compares Market Value plus debt to a total asset value [9]. This indicator was developed by James Tobin (1969) to assess impact on Market Value of investment into new assets. A raised 'q' indicates that the company has a higher market value despite a likely decrease in underlying profits due to the investment. Study and comparison of company 'q' values has shown that companies developing assets within immature markets, or utilising immature technologies, have a higher 'q' than other like companies [15]. The 'q' ratio, alongside relevant performance indicators, can therefore be used to assess the impact on Market Value of investment in emerging technology.

Given therefore that it is possible to assess the impact of investment on company value, this research looks at how companies identify the value of outputs from the work undertaken and, in addition, how they can preserve and grow this value over the multiple innovation cycles.

### **Design of the research**

The Strategic Technology & Innovation Management (STIM) programme<sup>2</sup> brings together companies from different industries through the vehicle of a membership consortium. The programme provides opportunity for company members to engage with research into topics

---

<sup>2</sup> <http://www.ifm.eng.cam.ac.uk/research/ctm/stim/> last accessed 31/1/2016

of interest. STIM members and others attend research days and network days and information on the current status of the research can be presented to them at workshops sessions. Discussion with STIM companies during these sessions led to research engagement with 16 companies. Semi-structured interviews with these companies plus two non-STIM companies has provides the data analysed in this research. Semi-structured interview is used as the data collection method as it provides a framework through which data analysis can be undertaken but allows for open discussion. Differing contexts within which the companies operate are accommodated. Data collected is verified with company representatives at the end of each interview.

This research is exploratory and therefore benefits from breadth of input rather than depth of analysis. As the STIM consortium membership is, by design, cross industry, it is possible to collect multiple data points from which generalisations can be made. However in order to check that phenomena identified is not limited to organisations inspired to join the STIM consortium, research has also been undertaken with two non-STIM organisations. In addition AND Technology Research Ltd provides a pilot site where the research process and methods are trailed. A list of the companies that have taken part in the research is provided in Appendix A and information about AND Technology Research Ltd is provided in Appendix B.

### **Background and aim of the research**

Prior work [3,4,16] identified that companies find it difficult to communicate value created during innovation. Financial indicators are often meaningless or not readily available. Value is therefore likely to be lost. Retrospective study of a series of projects that developed technology over multiple timelines, demonstrated that value generated can be measured and growth tracked [3]. However instances of value that has been destroyed or where a ‘wheel has been twice invented’ are not difficult to identify [4,7]. Many companies simply do not have processes in place to capture such data even if they are minded to do so. Team members often recognise that value is being generated through the work they do, but mechanisms to record this value are not readily available. Value is therefore not communicated [4]. Further research highlighted that a lack of common language is a major barrier. It is difficult even to discuss what is valuable [16].



Knowledge and know-how generated through work on innovation projects can be articulated if there is the will and the process in place to do so [7]. However value can only be gained if care is taken over the capture and preservation of the knowledge and know-how created. But a problem exists in that knowledge acquired through activity can be difficult to articulate and therefore is often not captured. Value can be lost. Explicit and tacit knowledge are terms used to differentiate between the two situations [7]. The importance of capturing tacit knowledge has been highlighted through the study of Japanese companies where it was shown that tacit knowledge shared between team members is instrumental in achieving good outcomes from work in innovation. The point remains however that the existence of this knowledge is difficult to identify [7] and therefore measure.

Other outputs from innovation such as software codes and the creation and use of specific tools to add quality and aid efficiency, can also add to the value created [4]. But similar to knowledge, these assets need to be identified, measured and preserved over multiple innovation cycles if value is to grow. It is reasonable to assume therefore that outputs from work undertaken on emerging technologies can easily be discarded.

Study into the willingness of companies to engage with identifying potentially valuable assets show that they are willing, but find it difficult to undertake [16]. Methods and processes are required to help them do this. Distinguishing between explicit and implicit value can assist [16]. This distinction is based on the point that companies find it easier to communicate value in terms of financial indicators [3,4,16]. Explicit value therefore is that which can be articulated through impact on financial indicators. Implicit cannot be articulated in this way and must be described using alternatives such as narrative and impact [16]. The problem facing companies is that without language to describe how to identify implicit value it is difficult to identify it and impossible to measure it [16]. The terms explicit and implicit value has been introduced to companies and are found to be helpful in the identification of implicit value [16]. The terms enrichments and headstarts have also been introduced and these will be described in more detail in the next section.

This research builds upon the previous work but is focused on the development of a value process to assist companies in the capture of value from innovation work. In particular the process is formed so that value can be preserved and allowed to grow over multiple time-

lines. The aim of this research is to understand the fit between the value process developed to date and the ability of companies to follow the process.

The research is in two stages. The first stage presents the value process to the companies. The process is clarified and the language and terminology explained.

The second stage is a semi-structured interview with one or more representatives from the company. Information captured during the interview is firstly verified and then analysed against 10 key points. The aim of the analysis is to understand which parts of the process (if any) a company would struggle to complete. Each question addresses a different element of the process and a score of either 1 or 0 is given. A score of 0 means that the company would struggle to complete that part.

The following sections describe the process in more detail. A table showing the questions asked, the scores and the criteria for scoring is included. An analysis of the results and conclusions complete the research.

### The value matrix

Figure 3 below, a value matrix, has been developed in order to provide a framework and language to assist companies in identifying value.

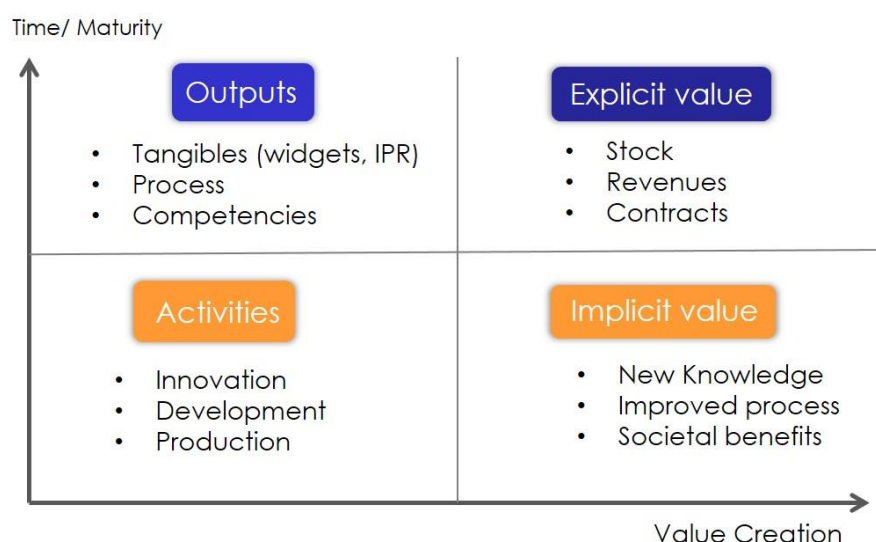


Figure 3: Value matrix

The leftmost quadrants of the matrix illustrates that activities undertaken over time will mature and, assuming a successful project completion, produce planned outputs<sup>3</sup>. The maturation process may occur during one project cycle or it may require multiple cycles. The rightmost quadrants are concerned with value capture. The matrix illustrates that value can also mature over time. Sales of products for example will accumulate during the product lifecycle and as shown in the top right quadrant, explicit value can be captured. The bottom left quadrant shows implicit value. This is value that is recognised but that cannot be measured directly through a financial indicator.

Tacit knowledge is an example of an asset that has implicit value. This type of knowledge, or similar know-how, may possibly be used in subsequent innovation cycles and may eventually be captured as explicit value but when it is generated it is not possible to value the knowledge explicitly. The term enrichment has been coined to help companies identify outputs that fall into this category.

### **The value process**

The following paragraphs describe a process that has been developed in order to assist companies in the identification and capture of implicit value. The process starts with the identification of enrichments and finishes with the capture of value from the use of headstarts.

The term headstarts has been coined to help companies capture value from enrichments generated. Tacit knowledge, an enrichment from one project, may be employed on the next project. Time saving and efficiency from such knowledge will mean a project team in possession of such knowledge would have a headstart over teams that did not. Tools available to the team, re-usable components and skill, (know-how), as well as knowledge, are all examples of headstarts. Financial estimations of headstarts is possible in terms of time saved and efficiencies and the point to note is that when an enrichment is used as a headstart, value impact from that enrichment can be captured.

---

<sup>3</sup> Planned outputs are those that have been identified as part of the work planning/ business case.

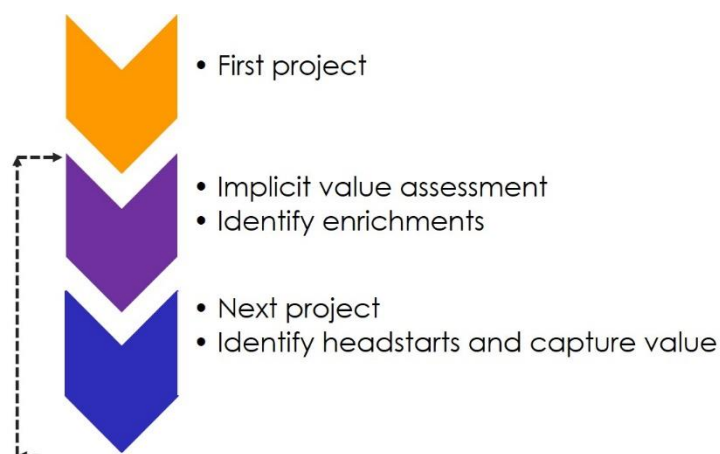


Figure 4: Value capture process

### *Identification and assessment of implicit assets - enrichments*

As described in the first section of this paper, performance indicators can be used to measure assets that have been identified. Identification of enrichments therefore forms part of the process of capturing value. Enrichments can take any form. Tacit knowledge as mentioned above, is one example, but any outputs from the project that are not directly captured as explicit value can be expressed in this way. Project outputs however need to be assessed to ensure that they have value potential before they can be categorised as an enrichment. A new process developed during the innovation cycle may be an enrichment, but if, for example, the process is not aligned to the strategy and could not impact the value of the company, it would not be an enrichment. The term enrichment is chosen because it reflects the need for value.

Determination of potential value can, as described in the first section above, be made through assessing the impact of a performance indicator on the market value. This however is not easy to achieve. Private companies for whom a market value is not readily available have particular problems. All companies however can look to opportunities they may wish to address in the future. The impact any one enrichment is likely to have on that opportunity can be assessed instead [16].

Customer satisfaction, societal and environmental values can also be assessed when considering the value of enrichments. Potential impact on company brand and as a result the company value can be assessed [16].

### *Capture value over multiple projects – headstarts*

Development of innovation requires, for example, skill, knowledge, tools and possibly pre-existing components. Together these can be thought of as forming a pool of resources that are available for use within the work. The way in which resources are used can have a significant impact on the outcomes of work undertaken [4]. In particular, for work that involves emerging technology, knowledge and know-how invested in human resource can be essential for the timely outcomes. Skill and knowledge are built up over time, across innovation cycles, and can be classed as enrichments. Assessment of the impact that enrichments held within the resource pool will have on, for example, the efficiency, time required or level of innovation achievable, can be undertaken at the start of each new or subsequent innovation work. Doing so means that enrichments become headstarts and value is captured.

### *Cyclic process to support preservation of value and growth.*

The value process ensures that implicit value in the form of an enrichment can be identified. The use of a resource pool of enrichments is suggested in the preceding paragraph in order to support the preservation of value. Categories have been suggested above as examples, but these are not prescribed. It is thought that such detail will vary according to company context.

The cyclic nature of the process means that an enrichment can be used multiple times and in addition can be combined with complementary enrichments. As described in [7] evidence from industry shows that value can grow over time. This value process describes a mechanism to capture it.

### **Value process audit**

An important aspect of a process is that it is easy to operate. This research therefore investigates the ability of companies to follow the process and undertake the steps required to identify and capture value. A value process audit has therefore been undertaken.

Open questions were posed to each company, responses were recorded and scored according to set criteria. Table 1 details the questions and the criteria.

<b>Question</b>	<b>Value Process Audit question</b>	<b>Analysis scoring criteria</b>
1	Please describe drivers of value within the company	Score is value drivers are described
2	Please provide a description of value that is important to the company or impacts the company	Score if value or its impact described
3	Please describe how the company evaluates outputs from work undertaken? Is there a process?	Score if any one evaluation method is described, or a process is described
4	Please describe methods used to identify value created during work undertaken? Is there a process?	Score if any one evaluation method is described, or a process is described
5	Please describe methods used to measure value created? Is there a process?	Score if any one evaluation method is described, or a process is described
6	Please describe methods used to identify implicit and non-planned assets created during work undertaken. Is there a process?	Score if any one evaluation method is described, or a process is described
7	Please describe what is communicated either internally or externally regarding value created.	Score if value created from work done is communicated in reports. Don't score if the communication is merely for project management
8	Does it communication include information that could be used to measure the growth of value over multiple innovations projects.	Score if the communication includes information that is passed on to subsequent projects AND it includes how it will be used in a subsequent project
9	Describe your understanding the terms explicit and implicit value	Score if the description conveys understanding AND is thought to be helpful
10	Describe your understanding the terms enrichments and headstarts	Score if the description conveys understanding AND is thought to be helpful

Table 1: Value process audit and data analysis criteria

The questions were designed so that they cover all aspects of the value process. The ability of companies to identify enrichments and value them is tested. Communication of value has also been addressed as this is the area most commonly cited by companies as difficult during previous research [16]. The questions were piloted within AND Technology Research Ltd to ensure that data collected covers the research areas of interest and to develop the scoring criteria. Figure 4 shows the results of the data analysis and scoring.

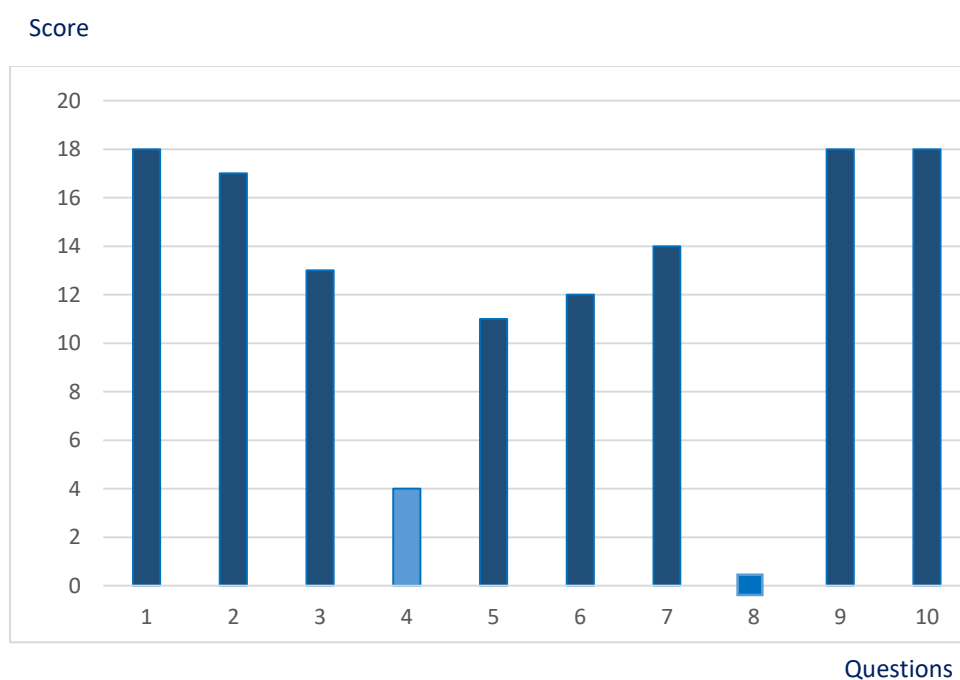


Figure 4: Results of value process audits

The answer to each question was scored with 1 or 0 by assessing the information provided by the company against the scoring criteria. The totals for each question across all 18 companies were calculated.

The results show that that 8 out of the 10 questions scored 61% or above and that 3 questions scored 100%. The two lowest scores are highlighted in light blue.

The specific terms coined for use in the process and tested in questions 9 and 10 appear to have gained acceptance and all companies were able to describe value drivers. Most companies, 88%, could articulate views on how value impacts their company. The ability to assess the impact implicit value has on the company is important for deciding whether or

not an enrichment is valuable. The results indicate that companies feel they would be able undertake this assessment.

Questions 3 to 6 are focused on process and it is encouraging to see that with one exception the majority of the companies appear to have processes in place to capture data which will enable to the identification and assessment of value. Question 4 highlights that companies may however be having difficulty implementing a process to identify value as work is ongoing. Possibly companies may just not have considered but more investigation is clearly needed in this area.

Questions 7 and 8 related to communication. The results show that although the majority of companies report work progress, none of the companies appear to communicate the preservation and growth of value. This may indicate that although companies are identifying and capturing data, they are yet to employ the cyclic process needed for capturing value over innovation cycles. The reasons for this are unknown and further research is required.

### **Evaluation and conclusions**

Given that companies face significant challenges when attempting to justify the investments in emerging technologies, this work provides insight into how value created during the development journey can be articulated.

This research addresses a small part of a very broad and complex area, the communication of value. It is recognised that the research is limited in scope. However, in order to articulate value, companies must be able to follow a simple process to capture data during and across innovation cycles. This research has investigated a process developed to achieve that aim and has reported on outcomes.

In conclusion, it appears that companies are keen to engage with a process that will help them identify value. Terminology introduced for use in communicating value is well understood and it can be seen that most parts of the process could be followed. The research has highlighted areas within the process that companies appear to be struggling with and these areas, question 4 and question 8 are the focus for on-going work.

Case study work which investigates, in detail, the implementation of the value process within companies is also on-going.



- [1] M. Christensen, Clayton & Suarez, Fernando & Fernando, Fumagalli & Utterback, James & M, James. (1996). Strategies for Survival in Fast-Changing Industries. *Management Science*. 44. 10.1287/mnsc.44.12.S207.
- [2] W.D. Sheasley. (2000). Taking an Options Approach to New Technology Development. *Research Technology Management*. Nov-Dec 2000.
- [3] V. Thorn, F. Hunt, R. Mitchell, D. Probert & R Phaal (2011). Internal technology valuation: real world issues. *Int. J. Technology Management*, Vol. 53, Nos. 2/3/4, 2011.
- [4] V. Lynch (2013). An investigation into the value of embedded software. University of Cambridge PhD Thesis. Feb. 2013.
- [5] R.Mitchell, R. Phaal, N.Athanassopoulou (2018). Scoring methods for evaluating and selecting early stage technology and innovation projects. Centre for Technology Management working paper series ISSN 2058-8887, No. 2 March 2018.
- [6] I. Chandrasekar. (Nov. 2018). DRIVING DISRUPTION:Catching the Next Wave of Growth in Electric Vehicles. <https://www.christenseninstitute.org/publications/driving-disruption>. Last accessed 17/02/2019.
- [7] I. Nonaka. (1991) Knowledge Creating Company. *Harvard Business Review*, July-August 2007.
- [8] C. D. ITTNER, D. F. LARCKE. (1998). Are Nonfinancial Measures Leading Indicators of Financial Performance? An Analysis of Customer Satisfaction. *Journal of Accounting Research* Vol. 36 Supplement 19.
- [9] E. M. Al-Matari, A. K. Al-Swidi, F H Bt Fadzil. (June 2014). The Measurements of Firm Performance's Dimensions. *Asian Journal of Finance & Accounting* ISSN 1946-052X 2014, Vol. 6, No. 1
- [10] Porter, M., (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. The Free Press.
- [11] Porter, M. (1979). How Competitive Forces Shape Strategy. *Harvard Business Review* , 57 (2 March-April),pp.137-145.
- [12] Grundy, T. (2006). Rethinking and reinventing Michael Porter's five forces model. *Strategic Change*,15(5), pp.213-229.
- [13] Pindado, J., de Queiroz, V., de la Torre, C., (2010 ). How Do Firm Characteristics Influence the relationship between R&D and Firm Value. *Financial Management*,pp.757-783
- [14] Sorescu, A., Spanjol, J., (2008). Innovation's Effect on Firm Value and Risk: Insights from Consumer Packaged Goods. *Journal of Marketing*,72 (March),pp.114-132.
- [15] Srinivasan, S., Hanssens, D., (2009). Marketing and Firm Value: Metrics, Methods, Findings, and Future Directions. *Journal of Marketing*, 46(3),pp.293-312.
- [16] Lynch, V. (2016). Is value created during NPD identified?. RADMA conference paper. Presented June 2016.

## Appendix A – Company participants in the research

Companies that have taken part in this research during their association with the STIM consortium are listed in the following table. Thanks are extended to the companies for their valuable input.

Company name	Description
TWI	Member organisation supplying expertise on welding and materials
Swisscom	Telecommunications
Petronas	Oil and gas
Johnson Matthey	Science and chemical company
Walters	Engineering
Airbus	Aviation
BP	Oil and gas
Lego	Toy manufacture
Grundfos	Pump manufacture
GSK	Pharmaceuticals
Maxam	Mining
SKF	Bearing and seal manufacturer
Syngenta	Agriculture
NDA	Organisation with responsibility to decommission nuclear installations
Thales	Engineering
Mars	Confectionery, snacks, drinks and pet food manufacturer

In addition the following 2 organisations have provided input and thanks is also extended to these companies.

Durham Rose	Jewellery manufacturer
ESC	Organisation with responsibility to drive change within the energy sector.

**Appendix B – AND Technology Research Ltd.**

And Technology Research Ltd (ANDtr) is a technology development company with a mission to “Innovate with Purpose”. The company partners with global organizations, research institutions, start-up’s and entrepreneurs to transform ideas and innovation into successful market-ready products. The team at ANDtr consists of multi-disciplinary engineers covering software, user interface design, data analytics, testing and customer support. The company has been operating for over 39 years and have completed more than 300 projects.

Valerie Lynch (author of this paper) is CEO of ANDtr uses her expertise in R&D to develop tools to assist in Value Capture and Value Communications for use within the company. The tools are developed as a result of academic research undertaken within University of Cambridge IFM STIM consortium. AND Technology research is not a member of the STIM consortium but is a member of the IFM SME community. Pilot trials of the research methods described in this paper were undertaken with ANDtr. The results of the pilot are not included within the results listed to avoid researcher bias. Thanks however are extended to all staff who have assisted in the research.