

4. Maximising value from technology in sport

4.1 Tools to foster suitable technology adoption

4.1.1 Pre-utility Checklist

To this point of the course a number of aspects for consideration prior to utility or development of a given technology have been identified. Here, three specific activities are detailed, which should ideally be carried out prior to development or implementation of a technology: evaluate technology quality, clearly establish the aims of the technology, and conduct a 'pre-mortem' exercise.

1. *Evaluate technology quality:* The first of these three activities fundamentally corresponds to the formal consideration of the quality items outlined in Module 2. Under such an activity, the respective technology would be evaluated against all relevant criteria included in the module. Examples of how this checklist could work is shown in Figure 4.1.1.a, with respect to the evaluation of a GPS-based electronic player tracking system.

Characteristic	How assessed	Results	Comments
Validity	☒ Internally ☒ Literature ☐ N/A	Concurrent validity of $r = 0.85$ Predictive validity of 0.2 m/s root mean square error	Deemed suitable for use with all levels of competition
Reliability	☐ Internally ☒ Literature ☐ N/A	Reliability of 0.1 m/s	Important to conduct own internal investigation to confirm the findings reported in the literature
Responsiveness	☐ Internally ☐ Literature ☐ N/A	None reported	Not yet assessed
Complexity	☒ Internally ☐ Literature ☐ N/A	Easy to set up and has integration with the organisational athlete management system	One of the more user-friendly options available on the market
Cost	☒ Internally ☒ Literature ☐ N/A	One of the more expensive options (90th percentile). If high number of units discounts apply	Recommend acquiring large number that can be used across men's, women's and youth teams
Training required	☒ Internally ☐ Literature ☐ N/A	High level of training provided by manufacturer. Provided at no additional cost.	One of only a handful of manufacturer's that provide specific training free of charge
Interpretability	☒ Internally ☐ Literature ☐ N/A	Rated of a suitable level of understanding by >80% of relevant stakeholders	Software output shows good flexibility. No issues in understanding output from coaches

Figure 4.1.1.a. Example of a completed pre-utility checklist relating to the evaluation of the quality of a technology (GPS-based electronic player tracking system) in sport

The quality characteristics discussed earlier in the course are each shown within the first column of the figure; the user can then determine whether the characteristic has been assessed by themselves internally, by external researchers (i.e., in the form of a scientific article), or it may not be applicable for consideration, or left blank if it has not been evaluated. In the next column, the specific results relating to the characteristic can be added, for example, specific data collected from a validity trial (i.e., correlation between data collected from a system against a gold standard.) The final column is used to detail any comment on whether the technology reaches an 'acceptable' level on the particular characteristic. This determination of acceptability could be informed based on benchmarks from the industry (where available), standardised statistical methods such as effect sizes, or a subjective judgement from relevant stakeholders.

The collective information can then be collated to make a determination as to whether the technology is a) of an insufficient quality to be used for its intended purpose, b) of an unknown quality in one or more areas and thus requiring more evaluation, or c) ready for implementation. Of course, a question may relate to how this overall evaluation is reached; however, this may differ depending on the organisation. For instance, a well-resourced professional sporting club may require all of the characteristics to be examined prior to utilising the technology. The exercise may particularly be difficult in the case of new technologies, where

no suitable comparisons can be made. This is where the second activity to be undertaken prior to utility of the technology, holds even further importance.

2. *Clearly establish the aims of the technology:* This serves to facilitate the eventual overall evaluation of the success of the technology implementation. Without stating clear aims and expectations ex-ante, any decision to cease the use of a given system, or carry on using an insufficient one can often eventuate based on a hunch and with a lack of objectivity. Key questions to include when establishing the aims could include the following:
 - *What is/are the main purpose(s) of the technology?* Is it to improve an existing practice? Or provide new data or insights not currently available? Are there multiple purposes? If the technology is going to be implemented across multiple stakeholders, is there agreement on the purpose?
 - *What are the minimum levels of quality that can be accepted in order to justify implementation of the technology?* This can be difficult to answer for new types of technologies, but easier for those that can be compared against current practice. Utility of the above checklist can feature here.
 - *What is the expected time course of the technology?* What is the realistic duration that the organisation believes it will utilise the technology before it becomes redundant, needs updating or replacement altogether? Theme 4.1.4 below deals more specifically with the structured evaluation of technology longitudinally.
 - *What is the cost-benefit scenario?* Can a direct return on investment be quantified? If the technology reaches a point whereby it is no longer viable for elite level sport, can it be utilised with other cohorts?
3. *Conduct a 'pre-mortem' exercise:* this activity may not be essential in all cases, but it will particularly be useful if the technology requires considerable investment by an organisation, or provides a service on which the organisation may become heavily reliant on. It may also be useful to conduct in other non-technological projects of which technology plays some part in.

Unlike pre-mortems, post-mortems are a concept that will already be familiar to most readers. Following the death of an individual, they are sometimes used by medical and health professionals to determine the underlying reasons. This facilitates both learnings for the professionals and some comfort for the family. With a pre-mortem, by moving the 'autopsy' to the start of a process rather than to the end, a team can consider what actually went wrong, rather than what potentially could go wrong (i.e., troubleshooting.) Pre-mortems have groundings in work relating to a concept called 'prospective hindsight', which refers to the formal generation of an explanation for a future event as though it has already

occurred (Mitchell, et al., 1989). In essence, the user goes forward in time firstly – and then goes back in time.

Although more typically used prior to commencement of new projects, pre-mortems are equally useful to conduct for operational processes such as deciding to invest time or resource into a given technology. This is particularly important due to two factors. First, implementation or development of technologies in sport either fail or are used sub-optimally at a spectacularly high rate. Some of the many reasons for this have been discussed throughout this course to date. However, an additional reason that has yet to be discussed relates to one of a simple human team dynamic: sometimes people either are not consulted or decide not to speak up about their concerns, ideas and reservations relating to something new prior to its implementation. The pre-mortem provides an opportunity in which to do this. A second factor relating to their importance is that the method has actually been shown to improve outcomes. Examples of the method's efficacy include an increased ability to identify reasons for future outcomes by 30% (Mitchell, et al., 1989). The method has also been used in a variety of management applications in areas such as medicine (Mills & McKimm, 2017) and engineering (Eckert, 2015).

So how do they work? Pre-mortems start by conducting a briefing with a team of individuals on the intended project or intentions to implement or develop the technology (Klein, 2007). A designated leader commences the activity by informing the team that implementation or development of the technology has failed dramatically within the organisation. Subsequently, each individual team member is given an allotment of time to independently identify as many reasons as they can, which would explain why the failure occurred, however outlandish the reason can be. These could include the technology failing tomorrow, through to a timeframe much further on in the future. The leader then facilitates a session by which all of the individuals involved in the exercise can verbally communicate each item on their list to the rest of the group. The technology manager or team can then strengthen the implementation or development based on the collective feedback.

Of course, when an exercise such as a pre-mortem is undertaken in sport, many obvious reasons for a failure will likely be identified. For example, a new technology may fail because a new similar device is created shortly after its implementation, and, thus, the technology may become quickly redundant and replaceable. However, often in the pre-mortem exercise, human factors are also identified. For instance, in a sporting team a change in club manager may lead to differences in philosophy with respect to engagement with the given technology. In order to achieve the best outcomes, individuals should be involved in the team that has an ability to focus on the future, particularly if the failure of the technology is hypothesised as occurring later into the

future. This has some overlap with the future scenarios exercise, discussed later in Theme 4.1.4.

Obviously, some caveats exist with respect to ensuring the efficacy of the method. Careful articulation of the technology at the commencement of the pre-mortem is essential; otherwise, team members may be providing insights into an incorrect or incomplete scenario. Further, it is important to gather all relevant team members (and potentially those outside the team.) An overly homogenous perspective on the technology may lead to creating similarity in responses. Carried out appropriately, the exercise can cause team members to feel valued for their expertise and also sensitise them to any early signs of problems once the project commences. Thus, more often than not it represents a must run exercise prior to development or implementation of a new innovation.

4.1.2 Innovation Stocktake

Broadly speaking, innovation in technology refers to a new idea, creative thought or initiative that can take the form of either a device or method. The major drivers of innovation can be categorised as *challenges* (i.e., in response to a threat, or scarcity of something) or *facilitators* (i.e., funding, creative environments, relevant infrastructure and support for risk-taking.) With respect to the latter, it is worth noting that sometimes simply the removal of legal, administrative, or cultural barriers to innovation can also be facilitators. In sporting contexts, much of this driving or facilitating occurs within the sports industry or ecosystem itself. Often this includes various sporting leagues, institutions and governing bodies but can also extend to coaches, scientists, technology experts and even the athletes themselves. Universities also have a role to play, as do technology manufacturers, with the start-up community representing a more recent addition to this space.

In the previous module, the importance of decision-support systems in sports organisations was discussed. For stakeholders working within sports organisations, one of the major benefits of such systems is a concomitant improvement in work efficiency, which ultimately results in greater time availability for stakeholders. Ideally, some of this saved time can be spent by these stakeholders on identifying and implementing new and innovative initiatives. Elite sporting clubs have long turned to innovation in order to obtain new insights and gain an advantage over their competitors. But how does one decide as to which innovation areas to focus on? To help guide the process, a range of factors should be considered. For instance, does the initiative have the potential to meaningfully improve outcomes for the organisation? Similar to cases in the evaluation of technology quality, how much does it need to do so, in order for it to be

considered a success? Is the initiative likely to experience ongoing adoption by stakeholders? What are the risks not only of action, but inaction?

Considering existing questions and processes within an organisation on a 'priority continuum' can identify those areas most appropriate to target for innovation (Figure 4.1.2.a).

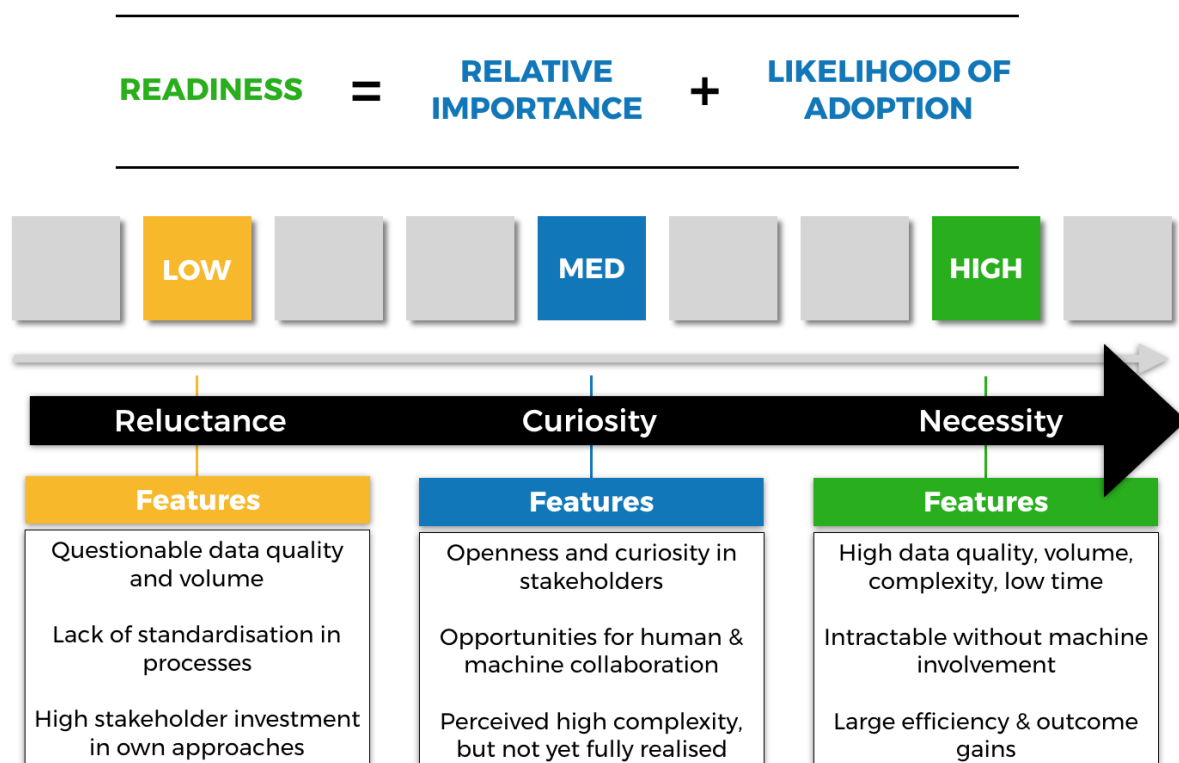


Figure 4.1.2.a. Innovation priority continuum. Questions and processes being carried out within an organisation can each be evaluated and placed at a point along the continuum

The continuum can be used to sort various questions and processes that may be considered as requiring innovation within a sports organisation. Typically, those which feature at the Reluctance end of the priority continuum experience high exposure to many of the constraints discussed earlier in the course. Examples may include limited access to high quality data, or high investment by stakeholders in their own subjectively-informed decisions, thus resulting in a reluctance to alter existing practice. They may feature no standardised method of data collection or reporting, which can lead to the possibility of perceived conflicting/contradictory conclusions being drawn, or result in a lack of sustainability of any developed innovation, irrespective of how impactful it may be. Thus, although such scenarios may benefit greatly from innovation,

their likely lack of success within an organisation means that the time and efforts of those initiating and driving the innovation are best spent elsewhere.

Questions or processes featuring near the Curiosity mid-point of the continuum are typically characterised by a level of openness and willingness to explore on behalf of the organisation, manifested by some provision of support and removal of barriers in order to support the innovation. A number of these questions also tend to facilitate opportunities for a comparison of human vs. machine recommendations. Often these areas are pervasive in sport, and thus, they are being addressed by many organisations, which is why a range of potential solutions exist.

Questions and processes at the Necessity point of the continuum are typically complex and work to overcome the challenges stated earlier, rather than emphasise incremental gains. They may drastically improve performance, save time, improve efficiency or overcome a barrier that has emerged to a sport; therefore, innovation may potentially be required by necessity in order to prevent an unwanted outcome or simply keep pace with competitors. Sometimes, obtaining solutions to these questions can result in meaningful gains to organisations by indirectly improving outcomes through obtaining insights not available to competitors.

In the event that multiple potential innovation areas emerge out of this activity, further examination of each may be required in order to select one, or a smaller number, to progress. To do so, other characteristics of the innovation may require consideration. Figure 4.1.2.b shows how the decision as to which innovation(s) to progress can be made simpler by also comparing between how feasible the innovation is expected to be implemented, to the resourcing required.

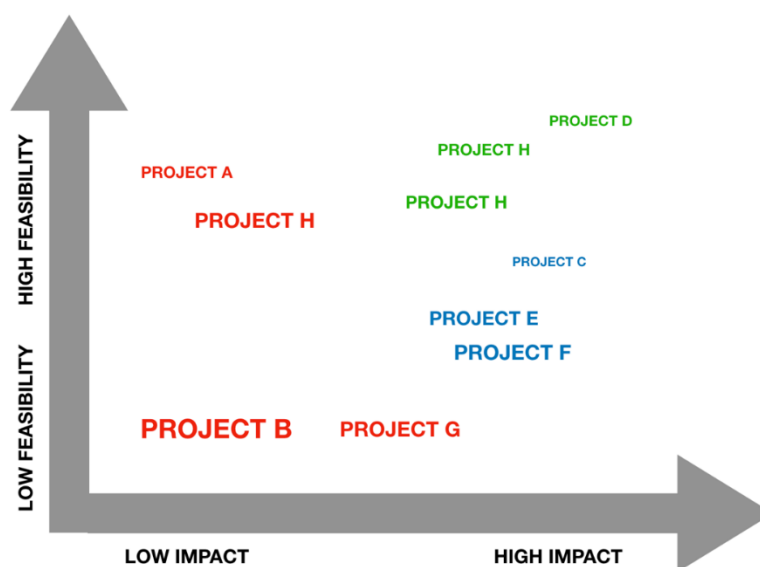


Figure 4.1.2.b. Characterising various innovation opportunities within an organisation based on their feasibility and impact. Larger font indicates greater resources required, whereas the colour corresponds to the same scheme as shown in Figure 4.1.2.a.

4.1.3 Innovation Adoption Checklist

Once an innovation area(s) has/have been determined as requiring priority attention, a series of steps typically follow. This process can remain relatively similar, irrespective of whether the next step required is to actually generate the new innovation (i.e., a new device or process) or simply adopt it. These steps are as follows (Damanpour & Schneider, 2006; Wolfe, 1994):

- *Identify the current or future potential problems or performance gaps:* This stage of the process would include the rating of problems on the innovation priority continuum that was discussed in the previous Theme 4.1.2. However, the process should also extend to problems that have not yet been identified through a careful examination of the business or organisation. This may require some future planning or projections (this process is explained later in this module.) The entire process should be undertaken in a formal manner and involve multiple stakeholders.
- *Undertake research on the problem:* An important component of innovation is networking and knowledge exchange. Having both the philosophy of and ability to share across various leagues and sports, and indeed other industries, has the potential to reap rewards at this stage of the process. This might also include speaking with vendors or commercial providers; in such cases, it is important to start from a place of scepticism and critically evaluate claims, whilst also being able to differentiate short term trends from innovations that can truly add value to the organisation. Universities also present useful sources of both knowledge and advice.
- *Develop or adopt the innovation:* This stage could take multiple forms depending on the nature of the innovation, but they should all include a clear timeline and goals as per the guidelines outlined above in Theme 4.1.1.
- *Establish and test the solution:* Many of the qualities of a technology that should be evaluated (as discussed in Module 2) are also relevant here. The overall quality of the technology should be evaluated across the entirety of the contexts and environments that it is likely to experience post implementation.
- *Implement support mechanisms:* These refer to the drivers and facilitators outlined in the previous Theme 4.1.2. These may not only include the establishment of support mechanisms for the innovation but also the removal of potential barriers to its success.
- *Expand and scale the innovation:* For sporting organisations, this may be ensuring that the innovation becomes available to participants across the sports pathway. For manufacturers looking to sell the innovation, it will be essential in ensuring it constitutes an economically viable pursuit. Cross-functional collaboration

represents one such way that this can be explored. This refers to the discovery of new sources for application of the innovation, some of which may be in areas not immediately obvious. For sports organisations, the exercise helps to ensure that there is shared value in the innovation across the sport. One simple way of conducting the exercise could be to create a simple table stating information that relates to the organisation, such as the key stakeholders, contexts and features of the innovation that may render it useful in other scenarios. The contents of the table can be as broad or specific as the organisation desires, but the more comprehensive it is, the more likely it is to see the greatest overall value for the entire organisation. The table works in practice by it being formally consulted every time a new innovation is developed, at which time different combinations of stakeholders and contexts and activities relating to the organisation are considered with respect to potential value gain from the innovation. For instance, a governing body that may not see value in a particular innovation for use in elite-level competition may see feasible and viable value for it in amateur training settings. Or a particular device that may be of an insufficient resolution to be used to improve athlete performance may still hold some value for media and broadcast. In some cases, the table could include stakeholders external to the organisation. For instance, carbon-fibre technology from formula racing has been used to improve Bocce players, whilst car seat manufacturers have helped to improve the maneuverability of the wheelchairs of Paralympic basketballers.

Another important benefit of this stage is that it allows for organisations to plan for scale and growth. Many innovations that receive immense and rapid uptake are simply not ready to extend their practice, or increase manufacturing volume of a particular device that is required – or at least not without potential drops in quality control. Here, the benefits of partnering becomes important so that organisations can evolve and develop together. For instance, some manufacturers or start-ups in technology simply need access to an opportunity or participants in order to progress to the next level. Similarly, many sports organisations may not see technology development as their core business; therefore, partnering is a mutually beneficial arrangement.

4.1.4 Monitoring Technology Longitudinally

Two main activities are essential for consideration with respect to longitudinal monitoring of technology. The first relates to the ongoing evaluation of existing technology at various time points, whereas the second relates to the monitoring of the industry for sector-wide developments.

With respect to the former, once a technology is developed, implemented and eventually evaluated, it is easy to fall into the trap of ending the process of adoption there. However, as we have seen earlier in the course with respect to both devices and decision support systems, assuming that the performance of a technology will remain a constant longitudinally can be folly. With respect to the function of a device, this may be because it may degrade in its performance over time. Even simply maintenance of the status quo can result in a relative reduction of performance in some environments, as a result of competitor improvements creating a more challenging marketplace. For instance, a manufacturer that was once considered a market leader, years down the track may fall behind (such is the case of Kodak with cameras), or a new device altogether may render an existing solution redundant (such is the case of EPTS tracking removing the need for measuring of distances with trundle wheels.) In terms of decision support systems, if they are not designed to ingest and systematically incorporate this new and improved (and likely more voluminous) information, they too will suffer from performance decrements.

A further reason as to why following post-implementation, technology and innovation should continue to be measured at multiple points longitudinally corresponds to human bias. Humans tend to value or recall outcomes that provide immediate benefit more highly when comparing with those that deliver outcomes in the longer term, or through incrementally slow improvements over time (see Smith, et al., 2009, for a sport example.) Thus, subjective evaluation is unlikely to be a sufficiently valid method of monitoring technology value or performance longitudinally. However, any process of objective evaluation may also need adjustment. For instance, if a technology is implemented to a process or question in an organisation that is already of a quite poor standing as a starting point, it may be easy to make substantial gains rapidly. Therefore, it may also be unreasonable to view the same technology in a harsher manner if these gains are not felt in an ongoing capacity.

Monitoring the sector for change can be an overwhelming task that is often left to too few within sports organisations, such as staff dedicated to technology or innovation (if the organisation is fortunate enough to have such roles.) Disruptive and transformative technology can emerge from a wide variety of areas, thus all staff should have an awareness that is a joint responsibility. The benefits of third party arrangements, discussed earlier in the course, are again of use here. Contemporary universities are not typically known for their innovation, but they do cover a broad range of topic areas. Maintaining close links with the start-up and technology entrepreneurial communities is also recommended. Besides, as developments occur and potentially changes to the types of technologies utilised are realised, different skill sets may be required with respect to the personnel involved in the governance. Further, governance overall may become more complex. For instance, more sophisticated data may mean more sophisticated security requirements, whereas more voluminous data may require governance personnel with expertise in data storage.

4.2 Future scenarios

4.2.1 What are Future Scenarios?

Making decisions for the future forms some part of most individual's roles within sports organisations. To date this course has discussed how, given that technology is developing at rates never seen before, it is impossible to keep up to date with all of these progressions. Furthermore, existing technology needs to be updated and iterated on a regular basis in order to avoid redundancy. From a future perspective, if the rate of technology development continues, data from the past is going to be even less useful when aiming to make predictions about the future. Besides, if the situations and contexts faced in the present are not the same as they will be when the outcomes of the decisions are realised, how can we plan confidently for the future in the face of such uncertainty?

Future scenarios planning is a tool that can help to navigate likely uncertain landscapes by making assumptions on how the future is expected to be. Importantly, it can also help to determine what implications this future will have for an organisation and thus help it to anticipate, prepare and strategise accordingly. This is exceedingly important in a busy world, as it forces organisations to think about matters they would otherwise either ignore or prioritise at a lower level, comparative to matters relating to the day-to-day. Future scenarios planning works by designing a various set of alternate realities of what the future may look like, as it pertains to a specific organisation or question. These scenarios should not only have beginnings and ends, but also details in the middle.

Figure 4.2.1.a shows an example of the 'futures cone', which is commonly used in future scenarios exercises (Voros, 2003). Here, the wider the circumference of the circle, the less certain about the outcomes we can be; the longer the cone extends across the page, the greater the time course being referred to is. The circle of the present day is represented by a small dot, since we have the greatest amount of certainty about what will come today, comparative to the distance future. The small 'probable' circle represents future scenarios that we can approach with some level of confidence, due to access to historical data or trends. The further we move across the page and away from our starting point, the less confident we become. Take, for instance, the cases of forecasting an approximate winning time in a swimming event at an Olympic Games two years away, or the number of people in attendance at a World Championships event. Whilst forecasting probable outcomes are useful, it is unlikely to facilitate outlandish or innovative perspectives of a sporting future. The large outer possible cone focuses on imagination and extending the mind to just about any conceivable solution

to a problem or question. Some of these possibilities may struggle for credibility and may be met with some cynicism; however, this cone is also often where true innovation lies. The plausible cone sits somewhere between the probable cone and the possible; thus, it is often the one most emphasised by organisations in future scenarios exercises. By incorporating a mix of both creativity and evidence-base, it also tends to be the most palatable option for sports organisations.

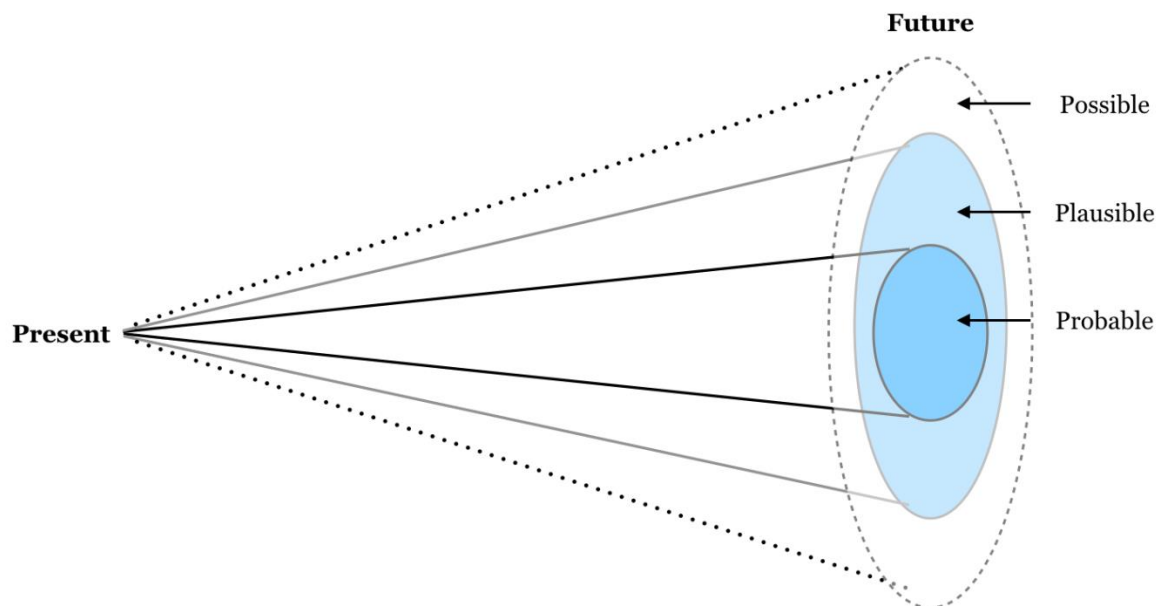


Figure 4.2.1.a. The futures cone. “A generic foresight process framework,” by J. Voros, 2003, *Foresight*, 5(3). Adapted with permission.

Future scenarios exercises are easy to overlook the importance of this. They can seem such a simple process that its value is underestimated. Further, its impact is often not felt in the short term, or is hard to directly measure, which sometimes can cause organisations to undervalue it. However, the risks of not conducting such exercises in a rapidly changing environment are very real. At best, missed opportunities could occur through a lack of readiness for what lies ahead. At worst, organisations could face increased costs, risks and losing out to the competition.

4.2.2 How to Conduct a Future Scenarios Exercise

Multiple frameworks exist by which to guide the future scenarios exercise. A summary of the typically accepted important steps are as follows (Ogilvy, 2015):

1. *Identify a predominant issue:* This may be an issue already identified by the organisation, or one that is expected to be experienced in the future. This could be a very specific question, such as ‘how should our technology look in the future?’, or it could be broader, such as ‘how do we ensure our organisation

remains a leader in our given sport?', or 'what are the key surprises that will loom as a threat to our current position in future?' Only one issue should be focused on per future scenarios exercise.

2. *Identify the key drivers:* This corresponds to identifying the major changes expected not just in technology but also the sport industry, as they pertain to your organisation. They could be obvious drivers that would normally be addressed in a business plan, such as the changing demand for the technology, or anticipated competitors and barriers. It is not uncommon for 30-50 drivers to be identified at this step; one of the advantages of future scenarios is that these can be represented in text form or as figures or sketchings. Thus, both this step and step number 3 consist of considerable brainstorming. Once the most obvious drivers are recorded, the focus should shift to those that are more radical and have the ability to transform the industry (i.e., the plausible funnel of the futures cone.) During this stage, it is important to try and focus on 10+ years ahead, rather than the shorter term, otherwise participants tend to simply extrapolate existing activities rather than truly think of the 'future.'
3. *Identify external forces:* This relates to the larger forces outside the sport industry that have the ability to significantly affect the landscape in which the technology will be existing. These could refer to changes of the political and economic climate, as well as social and cultural preferences from one sport to another (such as the rise of e-sports to draw resources away from traditional sports.). For example, climate change may impact global sporting competitions by restricting the amount of air travel teams can undertake, or reduced air quality may mean some sports now are required to be conducted indoors. These types of forces can often be hard to focus on without specific expertise involved in the process; however, due to their potential massive influence, they must be discussed. It is also important during this step to not be overly optimistic: not all changes in the future will be positive for the given questions or problem at hand.
4. *Develop a framework:* Focus on a small sub-section of these drivers, which can be termed 'critical uncertainties', for they are arrived at based on a) how important the drivers are deemed to be by those involved in the exercise, and b) how uncertain their future appears to be. As a rough guide, these should account for approximately 20% of the starting number of drivers; anymore and participants can lose focus or become confused.
5. *Create a critical uncertainties matrix:* This process involves selecting two of the abovementioned critical uncertainties. For a technology manufacturer, one could relate to a) the cost of developing and selling a particular technology, and the other b) the level of overall participation in a given sport of priority for their company. If these two critical uncertainties are plotted on a matrix (Figure 4.2.2.a), the likely overall outcomes associated with these uncertainties can be visualised in a succinct manner. For instance, a low cost, high participation scenario may be most favourable for the organisation, whereas a high cost, low

participation one could present a variety of challenges. This step helps to guard against the organisation going headlong entirely into one scenario, where in fact a number of other plausible ones exist. In the event that more than two critical uncertainties exist, the matrix can be repeated using various combinations.

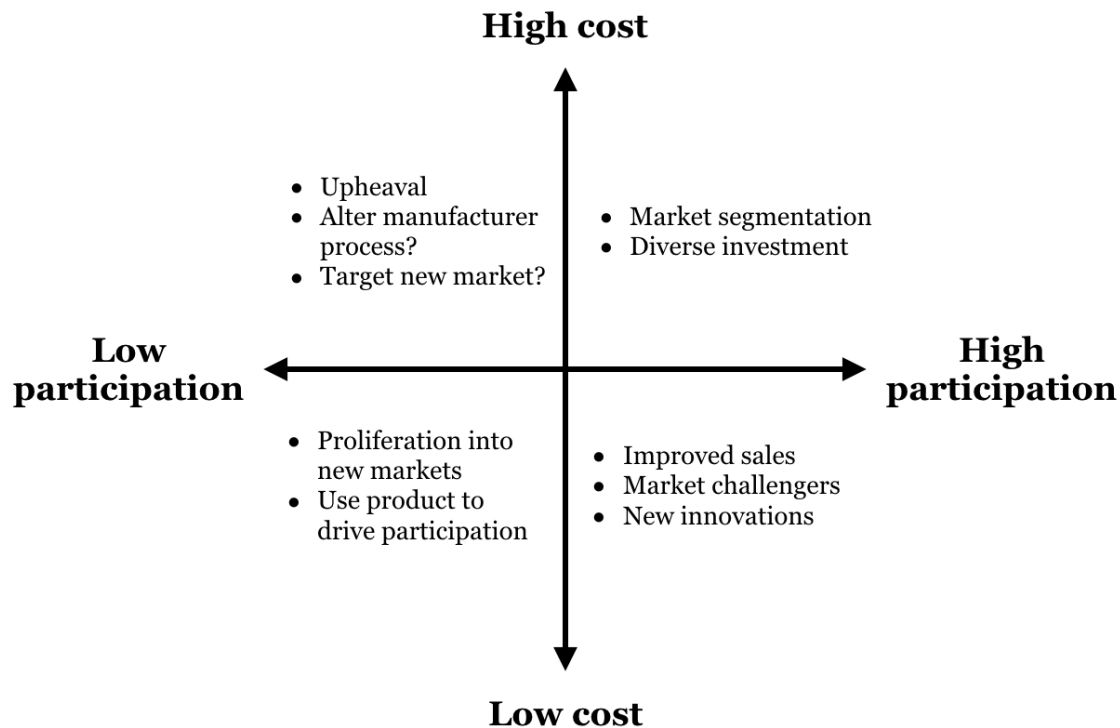


Figure 4.2.2.a. Critical uncertainties matrix for a future scenarios exercise. Adapted from *Forbes*, by J. Ogilvy, 2015, <https://www.forbes.com/sites/stratfor/2015/01/08/scenario-planning-and-strategic-forecasting/#3c65fa25411a>

6. *Develop the scenarios:* This involves actually creating detailed narratives around each of the two (or more) critical uncertainties stated in the previous step. The process should involve multiple stakeholders, typically be conducted initially in a workshop-type format and utilise a large number of post-it notes! Participants independently create narratives, one-off outcomes or any other thought that occurs to them, which can then be added as a post-it note to the matrix. Later they can be compiled by a team leader to form a specific narrative, based on the collection of information. It is worth noting that this process may need repeating over a number of weeks or months, in order to further refine narratives produced or involve a variety of different stakeholders in the process.
7. *Discuss the implications:* At a follow-up session, typically conducted approximately a month after the scenarios development, a second workshop is conducted focusing on just one of the developed scenarios. The narrative is played out in full by the team leader and presented to the members. The most commonly-noted strategic actions recommended in the responses by

participants from the initial workshops are then presented recommended for immediate priority.

8. *Early indications:* Once indications are observed or noticeable in one particular direction as mapped out in the exercise, the corresponding scenario can move from this stage to strategy. It is worth noting at this point that this entire process can still hold value in situations whereby an organisational strategy already exists. Often these are developed by executive teams within organisations, rather than the wider workforce. Thus, the future scenarios exercise acts as an 'insurance policy' and as a way of double checking the existing strategy.

It is important to note that future scenarios exercises are not future scenarios exercises without their criticisms and limitations. For instance, above in Step 4, the process details removing potentially key drivers from the forefront of thinking. Earlier in this course the features of complex systems were described; unpredictability was stated as one of the key characteristics. Thus, removing variables should not be a trivial process here, as it could arbitrarily reduce complexity. However, it is nonetheless important in order for the exercise to work practically. Furthermore, it is also not always obvious as to whether the right scenarios have been identified (as they essentially cannot be validated), or the steps from scenario identification to decision-making is reached.

Other key guidelines of the future scenarios exercise include the following courses of actions:

- Do not become paralysed by the number of possibilities that could occur throughout the process, it is better to start simple and let the more outlandish ideas come later.
- Do not focus too much on the short term. Think about the far right-hand side of the futures cone – whilst it is easier to think about what might happen next month or a year from now, the true value will be forecasting decades into the future.
- Although it might seem somewhat archaic, post-it notes are the best method to assist in recording all of the relevant information when developing the scenarios. If participants want to change their mind, or move their idea to a different position, in the scenario they can do it easily.
- Use fun to stimulate creativity. The future scenarios exercise should be enjoyable for participants; it actually also serves as a great way of bring staff within an organisation together in a more stimulating way than comparable methods such as SWOT analysis or Delphi exercises. It also can be used as a way of incentivising innovation in staff, something that many organisations are still grappling with how to do.

4.2.3 Examples of Future Scenarios in Sport

In the previous theme, we took a step-by-step walkthrough of the process of conducting a future scenarios exercise. Rather than conduct a specific exemplar for one sport or type of technology, a broad overview of some of the critical uncertainties that technology in sport will face in the coming years, as it pertains to different stakeholders is provided:

The overall sport industry:

- Which new sports will be developed predominantly as a result of technological advancement (i.e., extreme sports such as free-falling from space)? Will some be augmented versions of existing sports (i.e., 3v3 basketball or fan-driven decision-making of plays)? Will some existing sports die out completely (i.e., Five day test cricket being replaced by the 20/20 format)?
- The structure of competitions: Will rapid transfer of information and increased ease of long-haul travel facilitate global leagues across continents and potentially even multi-sport? Will there be a rise of gender fluid and transgender competition? How will artificially enhanced athletes be differentiated from 'natural' athletes for the purposes of classification in competition? Will we see non-human, robot-based competitions for extreme sports where the danger is high to human participants?
- The growth of e-sports: Will this manifest as a threat to existing sports or target a new market altogether? Is it a threat to existing sport or an opportunity for partnerships (i.e., active e-sports)?
- Sponsors and commercial partner fund distribution: Will investment shift from traditional sports?
- Adjudication & governance: Will we see a move towards complete automation of refereeing and adjudication based on technology? Governance becomes increasingly challenge in the face of multiple, dynamic and interacting components of sport.

The athlete:

- Human or machine?: Implants, sensors, genetic engineering and artificial body parts have implications for what 'human' competition looks like. How much of this is acceptable to occur in existing competition and leagues (remember the earlier principles from the course of 'do no harm' and 'equal access' of technology)?
- The athlete as a commodity: Athletes will sell shares in themselves or access to data generated through wearable sensors. Decisions on their future will be made by the shareholders. Extended length of careers will take place due to improved health.
- Pushing the boundaries: Athletes will continue to find ways to make small but influential improvements to their performance. The major gains in the short term

are likely to come from artificial intelligence, improved data from wearables, virtual and augmented reality, improved understanding of the mental side of training and competition as well as strategy, teamwork and character.

The sports organisation:

- More and new job types: There will be an increased size and diversification of staff skill sets, a range of tasks offloaded to automated decision support systems, a change in value of skill sets in workers (i.e., creativity, storytelling, problem solving, collaborators.)
- New growth markets exist around the globe for both live and virtual fan experiences.
- There will be commercial companies owning and running entire sporting competitions and leagues.

The venue:

- Multi-purpose: How will the size and functions of venues have to adjust for the impending changes in society (i.e., reduced need for parking, increased urban sprawl and density, changed economic conditions)?
- Increased tiers of service provision: There will be availability of ultra-high cost options providing unprecedented levels of access for fans to competitions.
- Mixed reality viewing options: Fans will have the ability to immerse themselves in augmented or virtual reality versions of the live match.

The media & broadcaster:

- Fantasy sport integration: There will be concurrent fantasy competition coverage and broadcast during competition.
- Exclusive content provision: It will be possible to view the play from the perspective of the athlete, distinctly different coverage by commercial provider.
- Timing of events to suit time-poor individuals, and the emergence of the 24-hour work day and 7-day work week will take place.
- There will be specific tailoring of content to suit viewer demographic, particularly as human lifespan increases.

The fan:

- Varying levels of access: There will be short attention spans, plug in and out of digital experiences.
- Monetisation of content by fans – a development of new content far exceeding that of commercial providers in terms of volume will occur.
- There will be danger of pirating of content.
- Ensuring engagement in time-poor individuals will be carried out. Finding ways to leverage non-organised sport and physical activity will be necessary.

4.2.4 Course Summary

This course has considered the role of technology in sport, predominantly with respect to how it interacts with the performance of athletes and practitioners in practice. It addresses the development and application of technology from both a theoretical and philosophical perspective; consequently, the skills cultivated by the student in the course should extend beyond technology in sport alone. Further, the importance of these developed aptitudes is not likely to be reduced to a function of trends and fads experienced within the sports industry. Thus, such expertise will continue to remain relevant even as the sporting workplace of the future continues to change at an astounding rate.

To recap, in Module 1, the origins of technology were discussed along with its importance as both an aide in decision-making, and as a vehicle to gain new understandings of the sporting environment. In an age of such significant technological advancements, it is important that we continue to ensure that these developments conform to suit the human mind and the environments in which it works, rather than the other way around. Two relevant theories for the technology developer and adopter to be aware of are covered, in complex adaptive systems and bounded rationality.

In Module 2, the importance of basic concepts, such as measurement theory and operational compatibility, are applied to technology development and utility. Such concepts have long been recognised as the backbone of good applied tools in any scientific endeavour, and sport is no different. Specifically, knowledge of the key factors that should be considered in evaluating the quality, feasibility and overall value of technology in a sports context is explained.

In Module 3, a specific type of technology – the decision support system – is covered in detail. These systems are given such a large emphasis in the course predominantly for two reasons. First, their use in sporting organisations will continue to grow in response to increased data generation in sport, thus making them one of the most widespread technologies in practice. Despite this, very little information exists with respect to their specific use in sporting contexts. Second, in a sense, they represent a unifying vehicle for all (or at least, most) technologies that are utilised within an organisation; thus, when implemented appropriately, they have the ability to transform an organisation in terms of both effectiveness and efficiency. The student should exit the module with an appreciation for the value of such systems to the sport organisation, as well as and ability to develop and use them.

In Module 4, a series of practical tools are presented to the student with respect to evaluating and operationalizing technology in sports organisations. The importance of innovation comes to the forefront, with students acquiring skills relating to creativity, future planning and future preparedness.

Upon completion of this course, the graduate should now possess preparedness for impending rapid changes to sports technology and its impact on the industry, both in the immediate term and in the future. With respect to the future, they should be equipped with the knowledge of how technology can be utilised as a disruptor and stimulus for innovation.

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