# SIGNALS: A design tool to encourage future thinking in problem identification

**Ross Brisco*[1] and Ann Davidson[2]**

[1] Design, Manufacturing and Engineering Management, University of Strathclyde, UK
[2] The Entrepreneurship Centre, Judge Business School, University of Cambridge, UK

**Abstract:** In the Discover phase of a design project, students can focus unjustly on current implementations of products and services and current societal norms. Future thinking aims to encourage users to consider the next generation, the products and services they will use in the future and the societal norms that will govern what would become a successful innovation. Signals is a tool that highlights current trends away from the norm, why these trends are significant and why they will become more critical in the future. Signals are currently being used as part of the Scottish Institute for Enterprise, Scottish Innovative Student Award (SISA) programme, where students from across Scotland are invited to attend innovation workshops to develop entrepreneurship skills. Signals are the starting point of these workshops to consider future solutions suitable for tomorrow's society. This paper will discuss the use of Signals with Design students and the benefits observed in the design process.

*Keywords; future thinking, design activity, design process, design methods, early design phase*

**Correspondence to: Ross Brisco, DMEM, University of Strathclyde, United Kingdom. E-mail: Ross.Brisco@strath.ac.uk*

## 1. INTRODUCTION

Engineering design students can get distracted by the here and now. Iterative product design can encourage this mentality by focusing on small improvements to optimise a product for current market demands. Future thinking can support innovative thinking towards new product development (Sommerville, 2004).

To better understand future problems, a design team can execute a future-thinking activity to understand society's future and the products they might use (Henning Buehring and Liedtka, 2018). Future thinking encourages a designer or a design team to consider future problems and establish a roadmap through iterative accepted solutions (Evans, 2010). For example, the progress from the corded phone to the smartphone was a massive jump in isolation. However, it is more rational when considered with the steppingstones of; mobile phones enabling constant contact, touchscreens enabling customisable interaction, personal music devices and portable games consoles enabling acceptance of caring additional devices and the increased dependency on internet connectivity amongst other technological changes.

If a future scenario can be identified and the steps required for customer acceptance planned, the next iteration of a product or service can be identified and included in the product development process (Randt, 2015). Students benefit from future thinking within a design curriculum by visualising their solutions within a wider context, identifying new solutions, and developing creativity and innovation skills, as discussed in Ringvold and Digranes (2017).

To overcome the challenge of students focusing on the here and now, a future-thinking method was taught to students with help from the Scottish Institute for Enterprise (SIE). In this paper, the Signals tool is introduced as an indication of future society. This is a formalised design activity conducted by a design team, enabling them to share their opinions about future product use to influence the product development process. As part of future thinking, Signals indicate the next step of society to become more accepting of new products and services or can be used to roadmap into the future. The tool was developed by SIE who have an abundance of experience in delivering workshops to different disciplines of students. Signals was developed with a business/entrepreneurial context focus and was proven to be successful in students education, the workshops detailed in this paper describes the tool as a design activity within an engineering design environment. The changes required to be made in delivering the tool were minimal. Where business/entrepreneurial students may employ the use of Signals to identify potential business value propositions, engineering design students use the tool to develop product ideas. Other engineering students and educators will find use in developing solutions to existing/future problems, integration of new technologies/techniques or building understanding of cultural issues.

At the Department of Design, Manufacturing and Engineering Management (DMEM), University of Strathclyde, students tend to focus on observable problems in today's society in the discovery design phases. They are very unlikely to explore future societal problems. It is essential to explore future problems as part of creative endeavours described by Byrne et al. (2010) and forecasting is arguably critical to this creative process be defining a future state. However, achieving this can be difficult. Methods of conducting forecasting contribute to additional cognitive load, which a holistic approach to forecasting can alleviate. In addition, "specifically divergent thinking and intelligence, influence the extensiveness and effectiveness of forecasts" (Byrne et al., 2010).

Germany and Lund (2019) identify this as a growing trend in design education stating, "the problem of future framing and designing for experiences that have not yet materialised is something that educators are beginning to introduce into regular design and engineering curriculum". This led to the focus of the research detailed in this paper, which encourages future thinking in engineering design education.

## 2. WHAT ARE SIGNALS?

A Signal, as the name suggests, is a transmission of information. In the context of future-thinking, it is an indication of what might be. Signals are all around us. They drive change in our society. A Signal, if appropriately exploited, has the potential to impact the lives of many by disrupting the status quo. Signals can be small or large indications in nature and can be informal and formal. Formal Signals differ from informal Signals in the source of the information and the intent of searching. To identify Signals formally requires active searching of news articles and social media posts. Active searching can be looking with a purpose and a topic in mind or scrolling through articles and posts for inspiration. Signals can impact the ideation process, however, only formal Signals can be scheduled as a design activity with reliable tangible outcomes. A template of a signal is included as Figure 1. Examples of Signals are included as Figure 2.

A signal has five parts:

- The title
    - This can be the original title supplied in the news article or social media post, or can be created by the designer to represent the signal better

    - The title should be succinct and should focus on the implication for product development than the current status.
- A description of the signal
    - The description of the signal explains what the current indicator is.
- A description of the significance of the signal
    - The description of the significance explains why it has been identified as a signal .
- A reference to the source and an image to quickly remind the designer of the signal.
    - The source enables the designer to revisit the source. This is usually a URL link to an original article.
- An Image
    - The image can be taken from the original article or social media post, can be another image that better represents the signal or could be a drawing by the designer.

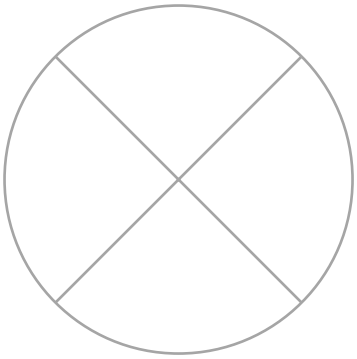
| | |
|---|---|
| Title: | Image |
| Description: What is it? |  |
| Significance: Why is it important? | |
| Source: | |

**Figure 1 A blank template of a signal**

*2.1 Signals and the Design Process*

Angheloiu et al. (2018) proposed a design methodology for divergent and convergent future thinking in a similar style to the Double's Diamond Design methodology divergent and convergent nature (Design Council, 2005). The design activities associated with this methodology included "signals of change" to identify a "positive future in 2050". Although there is little described of this method or tool, it appears similar to Signals in its intention.

This indicates that Signals as a future-thinking activity belongs in the early design stages, which makes logical sense as the first divergent stage of the Double Diamond Design methodology including primary research and secondary research towards unstructured research findings AKA "Insight into the problem". However, there may also be scope within the Define stage of the Double Diamond Design methodology which includes synthesis of ideas around insights, themes, and opportunity areas AKA "The area to focus on".

Signals have the potential to support approaches to designing such as Cradle to Cradle when considering the current product and its future potential. This is especially relevant when considering situations where society will be more eco-conscious.

Signals can influence many design tools. The obvious one is personas to contextualise future customers based on Signals. But also, customer journey mapping, trend analysis and storyboarding all centre around the need to contextualise the customer to understand better and represent their needs. Personas may use the future thinking identifications to forecast how a future user/consumer may act react to a product solution. Customer Journey mapping may require considerations of situations that currently don't exist. Trend analysis can be clarified from identifications of early Signals into future trends. And storyboarding can be used for imaginative scenarios.

One example of how students used the signal activity within the wider design activity was in the context of a high street shopping project. Students identified a future state as 'the high street shopping experience - in space', Signals were identified including Space tourism from companies SpaceX and Virgin Galactic, space deliveries identified by companies such as Amazon and SpaceX, and fashion for weightlessness - a book published in 2019 named Space Wear displaying potential future fashion trends. Students identified Space as a future state, personas of the types of people who might be space tourists, and customer journey maps and storyboards of how the experience might be for these customers. This lead to the identifications of interventions in high street of simulating how a fabric reacts in zero gravity, but also other environments, hot and cold temperatures for example. And the creation of the conceptual design for a mirror/AR simulator that can display your purchase in different environments.

| | |
|---|---|
| Title: *Museo Della Merda* |  |
| Description: A*n Italian Farmer is creating an alternative radical resource in cow dung. Bricks and plaster are created as building materials and a self fertilising plant pot.* | |
| Significance: *Resources which were once regarded as waste can, become safe to handle and made into attractive products. A supply chain is being created for future products.* | |
| Source: *museodellamerda.org* | |

| | |
|---|---|
| Title: Sustainable materials for fast fashion |  |
| Description: *A German designer and sustainable material manufacturer are collaborating on the design of a shoe as a fast fashion alternative with a coconut fibre material which resembles leather.* | |
| Significance: *Fast fashion and fast products are becoming increasing problems for future society. Designers and manufacturers can come together to explore alternative sources.* | |
| Source: *craftingplastics.com* | |

**Figure 2 Examples of completed Signals**

## 3. WORKSHOPS

Three workshops were conceived to trial the use of Signals in a Design Classroom. The first workshop took place with students of the Design 2 class at DMEM, University of Strathclyde in 2018 and the second and third took place with students of the DM305 Module on Design Management at DMEM, University of Strathclyde 2018 and 2019 respectively. These students are second and third year Product Design Engineering, Sport Engineering or Production Management Meng and BEng students and Design Innovation MSci and BSci students. Both sets of students have taken part in the Design 1 class intending to deliver foundational knowledge in the design process and design methods. These methods include observations, surveys, the post-it note method, Product Design Specification and morphological chart. Students in the third workshops had previously taken part in the first workshop, and the decision for this was to see if there were any changes in the use of Signals after students were already familiar with the design technique. Teams were made up of four or five students. Two teaching staff delivered the class on Signals.

### *3.1 Methodology*

The workshop format was a short presentation on Signals and how to use them, then a short activity using premade Signals on a relevant topic to the student's design project work. The workshop delivered the knowledge to conduct a Signals design activity, and the students had 'homework' to go away and try to find some relevant Signals for the following weeks class.
Slides were created to communicate:

- What is Future Thinking?
- How Signals support Future Thinking?
- What is a Signal?
- How to find Signals?

Workshop attendees were given example Signals on the project topic of the class. Students of Design 2 were conducting projects on transporting children, and the Signals chosen as examples were related to childcare, such as the addition of nursery facilities on Norwegian trains. Furthermore, students of Design Management were conducting projects on invigorating the high street. Examples were given, such as an AR-enabled mirror within a clothes shop that allowed the user to try different clothes in AR and share videos and photos online.

The example Signals acted as a database in which the students, in teams, considered and selected any relevant to their projects. The primary learning outcome was to highlight that indicators of change in culture and product use are out there. Students need to formalise these Signals and use them as a rationale for design decisions. These Signals can then lead to solutions to Future Thinking problems and opportunities for product development.

### *3.2. Outcomes*

Workshop 1 indicated that the prepared material on Future Thinking and identifying Signals was adequate for the workshop. Students were able to use the provided Signals and identify those which were relevant to their own projects. Student submissions later in the year, evidence of the use of Signals in submitted coursework and rationale of the experience demonstrated that Signals were used to justify design decisions.

One outcome of the workshop was using SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) in conjunction with Signals. SWOT acted as a familiar framework for students to discuss each of the Signals and relate them to their project ideas. Students completed the SWOT analysis on the back of the Signal card to keep the information together. This introduced another

aspect of the use of Signals in inspiring new product ideas to solve problems and improving product ideas during the iterative product development design phase.

It was interesting to discuss with the students the value of Signals to their design processes. One prominent comment was the use of Signals in the here and now. There did not seem to be an explicit connection to Future Thinking as the Signals, and SWOT activities could be used on current problems. This informed the need to ensure. Future thinking was a larger part of further workshops.

Workshop 2 was a success in ensuring the lecture material was relevant to more experienced design students. A more structured approach was delivered. First, students were introduced to shifts in technology and the small changes required for society to accept more considerable changes. These smaller changes could be opportunities for new products or iterative products to solve the right problem at the right time.

Following this explanation, students were introduced to Signals to explore current problems and future solutions. Students were handed example Signals and asked to discuss in their groups any which might be relevant to the problems they were exploring. Students were also given the task of finding new Signals over the following week using social media and news websites. When students returned to the class the following week, they shared what they had found with their fellow students.

The number of Signals the students were exposed to was much larger than if they were asked to use their own existing knowledge or observe the physical world. While both of these are relevant to design problem exploration, the Signals offered more stimulus to consider problems for a larger section of the population and future societal changes.

Workshops 3 had few changes from workshop 2. The students were aware of Signals from taking part in workshop 1 and therefore had some limited experience of using Signals as a tool. When reintroduced to Signals with a wider scope for development, the students were able to differentiate the use of Signals within the context of SWOT analysis, and the use of Signals as a separate activity leading to the analysis of shifts in society introduced in workshop 2. This indicated that Signals as a concept could have greater reach than a single design activity and could be implemented at multiple points in the design process and in conjunction with multiple existing design tools.

One unexpected outcome of the third workshop was the reliance on Signals by students as the primary justification of the students' problems. Signals were intended to be one of the activities a student could engage with, and multiple Signals could justify a societal change to be explored. Signals were not intended as the only source of justification. Part of this could be the significance conveyed to students and the time spent on Signals as the workshop facilitators wanted to ensure the students understood how to find and use Signals. Perhaps if introduced as part of a larger foundational design class, the students would utilise Signals but not rely on them. Also, the timeframe for the students projects was over 11 weeks which often results in students skipping key design activities.

## 4. DISCUSSION

In a time where students cannot interact with the world due to COVID, Signals can be a relevant alternative to physical world observation and problem discovery. Students can be tasked with exploring future problems through others' opinions and smaller changes observed and reported by others. This design activity does not replace students' observations of the world but is a crucial

supplement. Signals do not replace the need to confirm understandings of the world through methods such as surveys and interviews. There is a need to clarify, understand and verify information which the designer believes to be true.

The Signals design activity's major outcome was the discussion student had around different Signals and the focus during these discussions on future problems and societal issues. When students have a shared experience or observation, it is easy for them to agree on the problem's issues. However, when one of the team holds the knowledge on the issue and shares it with the others, the entire team can learn about and explore the issue together, sharing their own viewpoints. In the workshops, there appeared to be greater discussion around the impact of the Signal and more suggestions of design solutions. Unfortunately, we have been unable to explore this quantitatively as part of the first workshops, but these are the next steps to understand better how Signals can impact the design process. The observations and reflections made within the discussion were discussed and agreed between both authors who delivered the workshops.

One unexpected observation which came from discussions with students was that Signals could be good or bad. A team member might find a signal which impacts upon society positively or negatively. The designer as part of a team might not like the Signal, but they have to be considered. If ignored, then opportunities might be missed for creative thought.

Signals found by students were mostly small changes in society or the next steps. Within the student's teams, they were encouraged to push the Signal's nature to the extreme. This aided students to observe big changes in our society. This was unexpected and perhaps brought about greater uncertainty when a Signal can be predicted based on an observable change. We would encourage the use of Signals to identify more considerable societal changes and exploration of small changes required to achieve the larger change primarily. Future case study exploration might help support the benefit of exploring smaller and larger changes for the design team.

Students who took part in Workshops 3 had previous experience with Signals in workshop 1. This brought about an exciting dynamic as these students had exposure to the method and a greater understanding of the method's benefits. In the third workshop, there was less of a need to explain the Signals methodology and instead attention could be made on the future thinking methodology. The greater focus on future thinking aided the students to consider the impact of their decisions towards generating concepts towards future society. There was more of a focus on projects that could help future society, including solving urbanisation and less garden space, or the trend towards ethical purchases. In both of these examples, student teams were able to identify multiple interventions of products that would support the move towards the future society, such as, indoor herb gardens and community gardens within car parking spaces, or messenger to allow customers to interact with shop owners and ask questions about the source of products they retail.

This links with the need to explore the forecasting of Signals. Are Signals acceptable changes? and when does morality impact the decision to act upon a Signal in the development of a product? There may be a diagram (4 box or otherwise) that can help students act upon Signals. The x-axis might be impact or potential from high to low, and the y axis might be risk or ethics from high to low. The Signals activity can play an important part in educating students on ethics in design, is society moving in an ethically positive or negative way and as designers and engineers is there a motivation or a responsibility to encourage a positive outcome. This can have an impact on the development of toolkits (Such as Engineering Professors Council and Product Design Scotland) to consider future thinking from an ethical standpoint. There is a need to explore some of the

Signals found by students and how they potentially might be used and misused by design teams to justify design decisions for future thinking.

## 5. CONCLUSIONS

In our exploration of Signals in a design education setting, we have identified a formal method that is valid for the early research stage of the design process. Design students were able to implement the Signals tool within class workshops, which contributed to greater exploration of Design problem and opportunities that could offer future societal solutions. Once Signals had been identified and discussed in teams, Signals acted as a central focus for design teams to generate ideas or contextualise solutions to problems. Also, Signals encouraged the Design teams to explore how their concepts could positively or negatively impact society. Future work would include determining quantitatively if teams benefited from using the Signals in a variety of measurements, including if there was an increase in the number of concepts generated or if there was an increase in the variety of problems considered.

## 6. ACKNOWLEDGEMENTS

Thanks to all students of DMEM who attended the level 1 SISA workshops. Thanks to all staff of SIE who supported the development of Signals and the SISA programme.

## 7. REFERENCES

Angheloiu, C., Chaudhuri, G. and Sheldrick, L. (2018), Alternative futures as a method for equipping the next generation of designers and engineers, DS 93: Proceedings of the 20th International Conference on Engineering and Product Design Education (E&PDE 2018), pp. 752–757.

Byrne, C.L., Shipman, A.S. and Mumford, M.D. (2010),"The effects of forecasting on creative problem-solving: An experimental study, Creativity Research Journal, Taylor & Francis, Vol. 22 No. 2, pp. 119–138. https://doi.org/10.1080/10400419.2010.481482

Design Council (2005), A study of the design process. Eleven lessons: Managing design in eleven global brands.

Evans, M. (2010). Design Futures : An Investigation into the Role of Futures Thinking in Design.

Germany, J.O. and Lund, J. (2019), Form Follows Story: An Approach to Designing for Commercial Space Travel, DS 95: Proceedings of the 21st International Conference on Engineering and Product Design Education (E&PDE 2019). https://doi.org/10.35199/epde2019.53

Henning Buehring, J., & Liedtka, J.M. (2018). Embracing systematic futures thinking at the intersection of Strategic Planning, Foresight and Design. Journal of Innovation Management.

Randt, N.P. (2015). An approach to product development with scenario planning: The case of aircraft design. Futures, 71, 11-28.

Ringvold, T.A. and Digranes, I. (2017), Future Scenarios in General Design Education and 21st Century Competencies, DS 88: Proceedings of the 19th International Conference on Engineering and Product Design Education (E&PDE17), Building Community: Design Education for a Sustainable Future, pp. 098–103.

Sommerville, S. (2004), Speculative Design Futures: Blue Sky Future Forecasting Within an Undergraduate Degree Programme, DS 33: Proceedings of E&PDE 2004, the 7th International Conference on Engineering and Product Design Education, Delft, the Netherlands, 02.-03.09. 2004.