Royal Academy of Engineering

Perspectivity
For the love of complexity

Inclusive leadership in engineering

Participatory systems mapping to explore the role of leadership in making the engineering industry more inclusive

October 2022

Contents

Context

The Royal Academy of Engineering (the Academy) aims to harness the power of engineering to build a sustainable society and an inclusive economy that works for everyone.

The Academy has initiated this participatory systems mapping process to explore how systems thinking can help us better understand the role of leadership in creating more inclusive cultures within the engineering industry.

This research, combined with other scoping research and consultations with stakeholders, will inform the Academy's new and ambitious inclusive leadership programme, which is being delivered as part of the Academy's commitment to support the engineering industry to become more inclusive.

Primary research objectives

1. **What does inclusive leadership look like in practice** in an engineering context and what inclusion challenges are specific to or particularly relevant to the engineering industry?
2. **What is the breadth of factors** that relate to inclusive leadership in engineering and how do they interconnect and influence one another?
3. **What evidence needs to be gathered** to support the case for inclusive leadership in an engineering context, including evidence of the impact of inclusive/non-inclusive leadership on individuals and organisations?
4. **Who is the most appropriate target audience(s)** for this programme and what support do they need to inform the type of intervention required?
5. **What are the enablers and blockers** to delivering a successful inclusive leadership initiative in the engineering industry?
6. **Where are the leverage points** that would enable engineering leadership to have the greatest impact on creating a more inclusive industry?
7. **How can we achieve and evidence** a lasting positive impact on culture?

Facilitators

The Academy commissioned Perspectivity to deliver this work. Perspectivity is a collective of facilitators of social systems' change in complexity. To foster collaboration and innovation, they facilitate dialogue processes with diverse stakeholders on shared challenges. Including a diversity in perspectives brings depth, generates new insights, and provides opportunities for strategic decision making and collective action.

Perspectivity designed and facilitated the participatory systems mapping process, elaborated the systems map, and wrote the final report. The recommendations contained within this report are Perspectivity's and will be considered alongside other inputs to inform next steps on the Academy's inclusive leadership work.

A participatory process

To better understand the complex dynamics of diversity and inclusion in the engineering industry, we engaged 64 key stakeholders from both industry and academia in two participatory systems mapping workshops. In addition, the Academy conducted 35 one-to-one interviews. The outputs of these conversations were used to create a comprehensive systems map, showing the relationships between the key variables in the system and indicating where in the system actors – with a focus on leadership – can intervene to realise a more diverse and inclusive engineering industry.

In this report you will find an overview of the process, the outcomes of the workshops, and the systems map and insights that emerged from this process. The findings will inform a new Academy programme, which will support engineering leaders in industry to create a more inclusive engineering culture for all.

Next steps

The findings from this report will be incorporated into the Academy's analysis of all the data collected from its scoping and consultation phase. That analysis and the resulting plans for the pilot of the Academy's Inclusive Leadership Programme will be published in a short report by the end of 2022.

The findings in this report will inform a new Academy programme, which will support engineering leaders in industry

Summary findings

The pipeline of engineers

The systems map that emerged from this participatory research process is based on the 'pipeline of engineers'. The map in **Figure 1** visualises how individuals navigate in, through, and sometimes out of the engineering industry. It helps us to understand the decision-making process of individuals along this stream, as well as the goals and questions at the level of an engineering company and at the level of society.

There are many reasons why individuals who are currently underrepresented in the engineering industry are less likely to choose to study, work, or stay in engineering. That is why their experiences, questions, and related decisions are the centre of the map. Inclusion is experienced and diversity is determined at the individual level.

To provide high quality engineering solutions for society, many engineering companies want to increase the diversity of their staff so they can draw on the diversity of perspectives, experiences, and ways of thinking that brings. To increase and fully benefit from that diversity, companies need to be able to hire and retain diverse talent, make everyone feel included, and provide conditions that allow everyone to perform at their best.

At the societal level, a more diverse and inclusive engineering industry can increase the ability to address big issues.

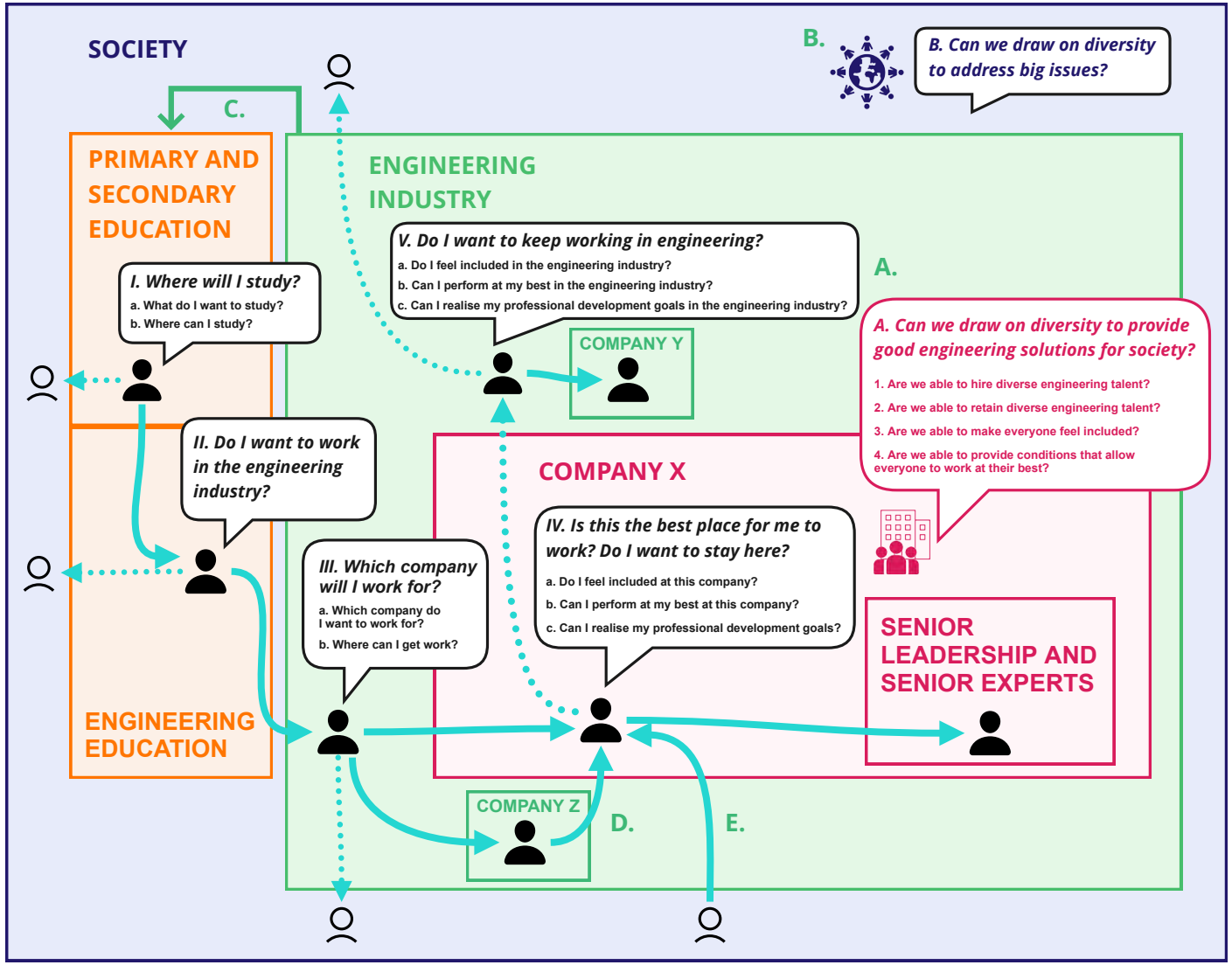

Figure 1: High level systems map with stakeholder questions

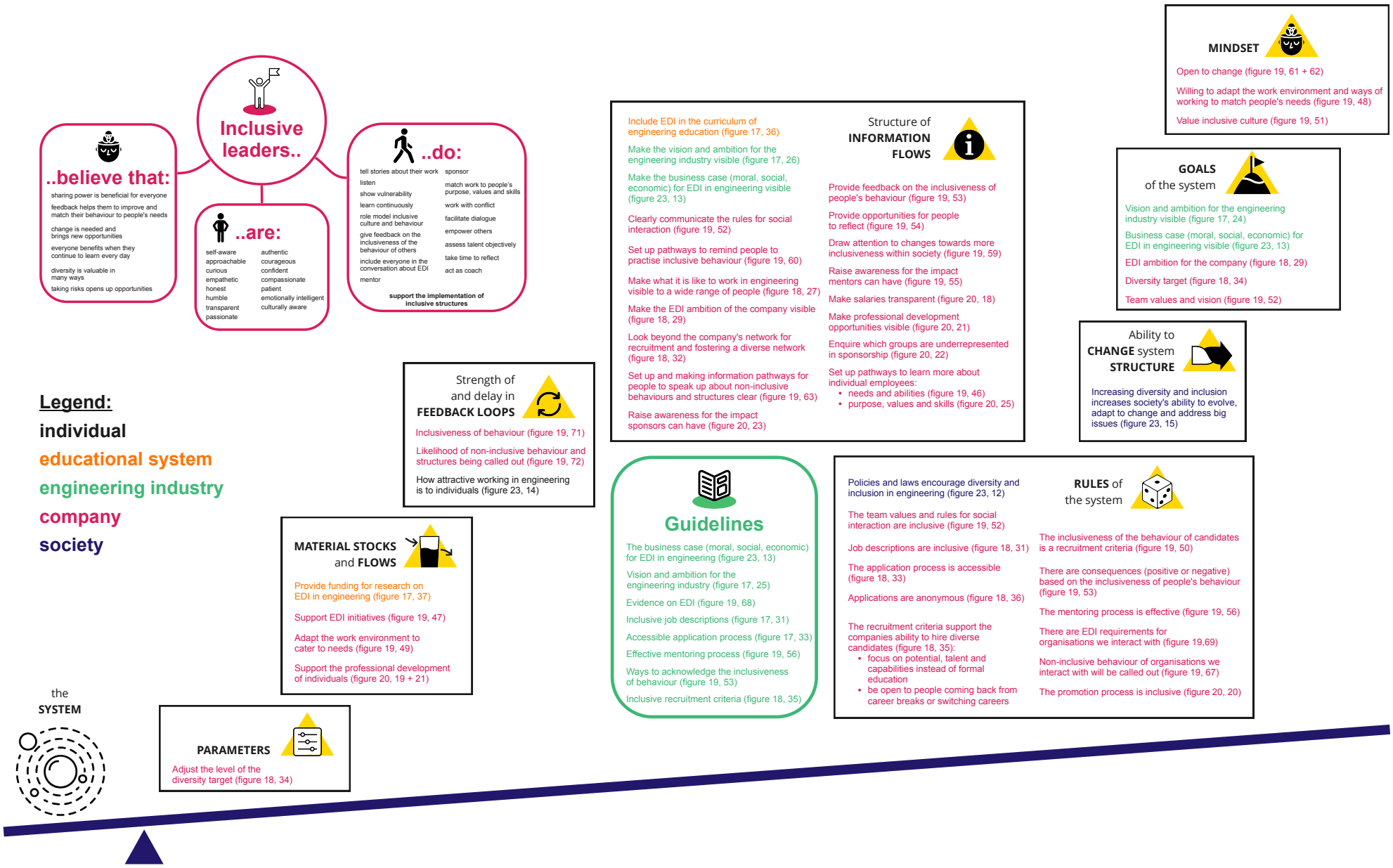

Figure 2: Overview of places to intervene in the engineering system and a summary of inclusive leadership mindsets, characteristics, and behaviours.

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Places to intervene and the implications for leadership

The current reality is that diversity is being lost at every decision-making point and it is difficult to re-enrich the stream further down the line. Some companies are able to attract diverse talent away from others, however that does not change the overall diversity within the industry.

The system contains multiple feedback loops (summarised in **Figure 2** above), which currently tend to reinforce low diversity and inclusiveness. A coordinated push of interventions in multiple places is needed now to change the direction of these loops.

> **It is crucial to make people and money available to get new initiatives off the ground**

This research process has revealed many of these potential places to intervene. Once this initial push has been given and the feedback loops move in the desired direction, this movement will reinforce itself and some interventions will no longer be needed.

What makes it challenging to achieve this in practice is that the reinforcing feedback loops and the forces that influence them span over many areas of influence, including outside of individual organisations. Therefore, it is important for leaders to start by implementing measures in their own companies, and from there look outside and consider how they can increase their area of influence.

While many of the interventions do not need to be executed by leaders themselves, they do require active commitment from senior leadership to ensure adequate resources. It is crucial to make people and money available to get new initiatives off the ground, and then to follow through to ensure sustainable implementation of the intervention.

Senior leaders are important role models and well positioned to make the business case for inclusive engineering explicit and appealing in order to take others along. Throughout this process we have identified the mindset, characteristics, and behaviours that increase the inclusiveness of leaders and have started to explore the knowledge and capabilities they need to develop these.

Participatory systems mapping

Participatory systems mapping offers a framework for dialogue to share and combine the experiences and perspectives of diverse stakeholders in a complex system. It enables a deeper understanding of the behaviour of the system by creating a visual depiction of that system, such as actors, trends, relationships, and feedback loops. The systems map helps to identify the most promising leverage points that can trigger change within a complex system.

A holistic view

Systemic insights are best obtained by having stakeholders in the system look at the system itself and the context it operates in. By exploring the situation together, new insights can emerge that no single actor could have come up with on its own.

We therefore chose a participatory approach to enable different stakeholders to see their role within the system, how their actions influence the system, and how they are influenced by it. This allowed participants to look beyond their own direct sphere of influence and gain a more holistic view of the system. Participatory systems mapping also supports the cooperation of diverse stakeholders in the system.

Process

Participants gathered in two interactive workshops. The first one was on 15 August for a half-day online, and the second one, on 5 September, in person at the Academy's office in London. Most people attended both workshops. Parallel to this a process of one-on-one interviews ran with stakeholders, most of who had not been able to attend the workshops.

The outcomes of both workshops and the interview process informed the systems map that you will find later in this report.

Dialogue

The workshops introduced the Chatham House rule and some dialogue guidelines (**Figure 3**) to foster a safe dialogue space that encourages open conversations and room for all diverse perspectives to be shared. Participants were asked to actively seek the minority voice, the voice of underrepresented, and sometimes vulnerable, groups, since those are the voices that are often not being heard (**Figure 4**).

Figure 3: Dialogue guidelines used in the workshops

Echoes

there is a timbre of voice
that comes from not being heard
and knowing
you are not being heard

which is noticed only by others
not being heard
for the same reason

[...]

– Audre Lorde

Figure 4: 'Echoes' poem by Audre Lorde

Participants

A diverse group of stakeholders were invited to take part in the workshops, from engineering leaders at different stages of their career; human resources (HR) and equality, diversity and inclusion (EDI) professionals; chairs of employee network groups in engineering companies; representatives of organisations that support underrepresented groups within engineering; and underrepresented groups in engineering with one or multiple protected characteristics.

Across the stakeholder groups we looked for a balance in:

- organisation size and type
- sector
- discipline
- based in UK or internationally
- region (UK only)
- career level
- diversity characteristics: gender, ethnicity, sexual orientation, religion/belief, and disability.

Workshop participants

- Olayide Akinsomi, Shell / Association for Black and Minority Ethnic Engineers UK
- Kirsty Akroyd-Wallis, MBDA UK
- Bims Alalade, Institution of Mechanical Engineers
- Deirdre Anderson, Cranfield University
- Cristina Blanco-Andujar, MediSieve Ltd.
- Dawn Bonfield FREng, Towards Vision
- John Bradbury, Eunomia / InterEngineering
- Martyn Bristow, Thermo Fisher
- Vanessa Burton, Mott MacDonald
- Amrit Chandan, Aceleron
- Mikela Chatzimichailidou, Arup
- Andrew Clark, Royal Academy of Engineering
- Tatham Crawford-Lennox, PwC
- Ibim Diri, Association for Black and Minority Ethnic Engineers UK
- Elizabeth Donnelly, Women's Engineering Society
- Caroline Eglinton, East West Railway Company
- Josh Ellis, University of Nottingham
- Anni Feng, Arup
- Jane Fenn, BAE Systems
- Ollie Folayan, Association for Black and Minority Ethnic Engineers UK
- Donovan Gill, AECOM
- Jane Grant, WSP Global
- Peter Guthrie FREng, University of Cambridge
- Lynne Hamilton, Mott MacDonald
- David Hull-Watters, Equality, Diversity and Inclusion Consultant
- David Jenkins, Atkins
- Jitinder Johal, Rolls-Royce Plc
- Pavneet Khurana, Unleashed
- Kristina Korsaks, Institution of Mechanical Engineers
- Claire Lucas, King's College London
- Rebecca Lunn FREng, University of Strathclyde
- Ivan Mactaggart, East West Railway Company
- Guru Madhavan, National Academy of Engineering
- Emanuela Maggioni, OW
- Davide Mattia, University of Bath
- Lisa Maule, Arup
- Justine McLennan, Microsoft
- Rhys Morgan, Royal Academy of Engineering
- Teresa Newell, British Academy
- Sharon Noble, Royal Academy of Engineering
- Karl Obszanski, Aston Vision Sciences
- Rebecca Ormond, PwC
- Folayo Osekita, Leonardo
- Zeba Kazi Osmani, Rolls-Royce Control Systems
- Jack Painter, WISE
- Brian Palmer, Tharsus Group
- Mike Percival, Rolls-Royce Plc
- Camila Ramos, Lloyd's Register
- Ian Ritchey FREng, Engineering Consultant
- Matthew Sinclair, BCG Digital Ventures
- Andrew Smith, Rolls-Royce Plc
- Neil Smith, HS2
- Siwan Smith, Arup
- Monica Stancu, Lloyd's of London
- Nick Starkey, Royal Academy of Engineering
- Greg Turner-Smart, Rolls-Royce SMR
- Claudia van der Salm, Google DeepMind
- Arun Verma, Royal Academy of Engineering
- Joanna Whiteman, Royal Academy of Engineering
- Polly Williams, Royal Academy of Engineering
- Kyle Wright, Cummins
- Maria Grazia Zedda, HS2

Academy organising team

- Shelley Stromdale
- Jessica Stevens
- Charlie Dalby

Perspectivity facilitators

- Petra de Boer
- Hannah Härtwich

Workshop 1

15 August 2022, half-day online

On 15 August, 48 participants gathered online for a broad exploration of the issue (**Figure 5**). The purpose of this first workshop was to identify key variables – actors and factors – that have an impact on inclusive leadership and to start exploring how these variables are interconnected and may influence each other.

Appreciative Inquiry

Participants were invited to share personal experiences with inclusivity in engineering. The set up for this workshop was inspired by the principles of Appreciative Inquiry, an approach that seeks what is "right" in an organisation, its success, its life-giving forces.

"We need to discover the root cause of success rather than the root cause of failure." – David Cooperrider, founder of Appreciative Inquiry at Western Case University.

Questions that were asked:
"Think about a moment where you felt particularly included as an engineering professional?"

Or: "Think about a situation where you felt you successfully included an underrepresented individual or group?"

After sharing personal stories in pairs, participants identified key factors that made the experience a success:
"What made this a positive and valuable experience for inclusive engineering?"

They also shared three wishes for the future of the engineering industry, and its leadership in particular, so that it is able to become truly inclusive:
"What are your three wishes for inclusive leadership in 2030?"

Finally, pairs joined in subgroups to share their stories and to plot the driving factors and wishes identified in a collective map. Through clustering they identified patterns and looked for relationships between the different elements (**Figure 6**).

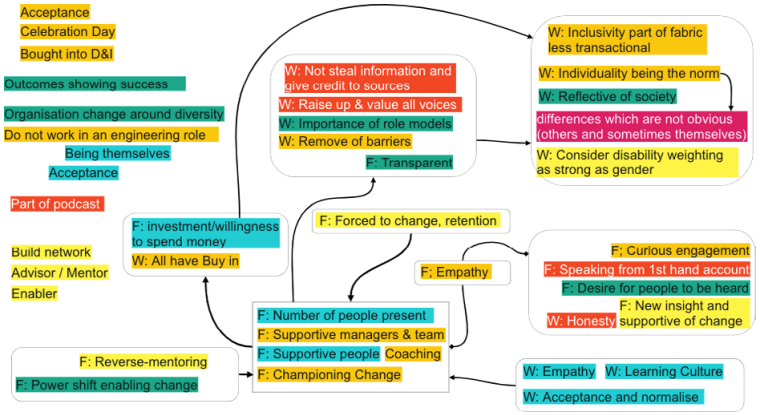


Figure 6: Example of a draft map produced by one of the subgroups

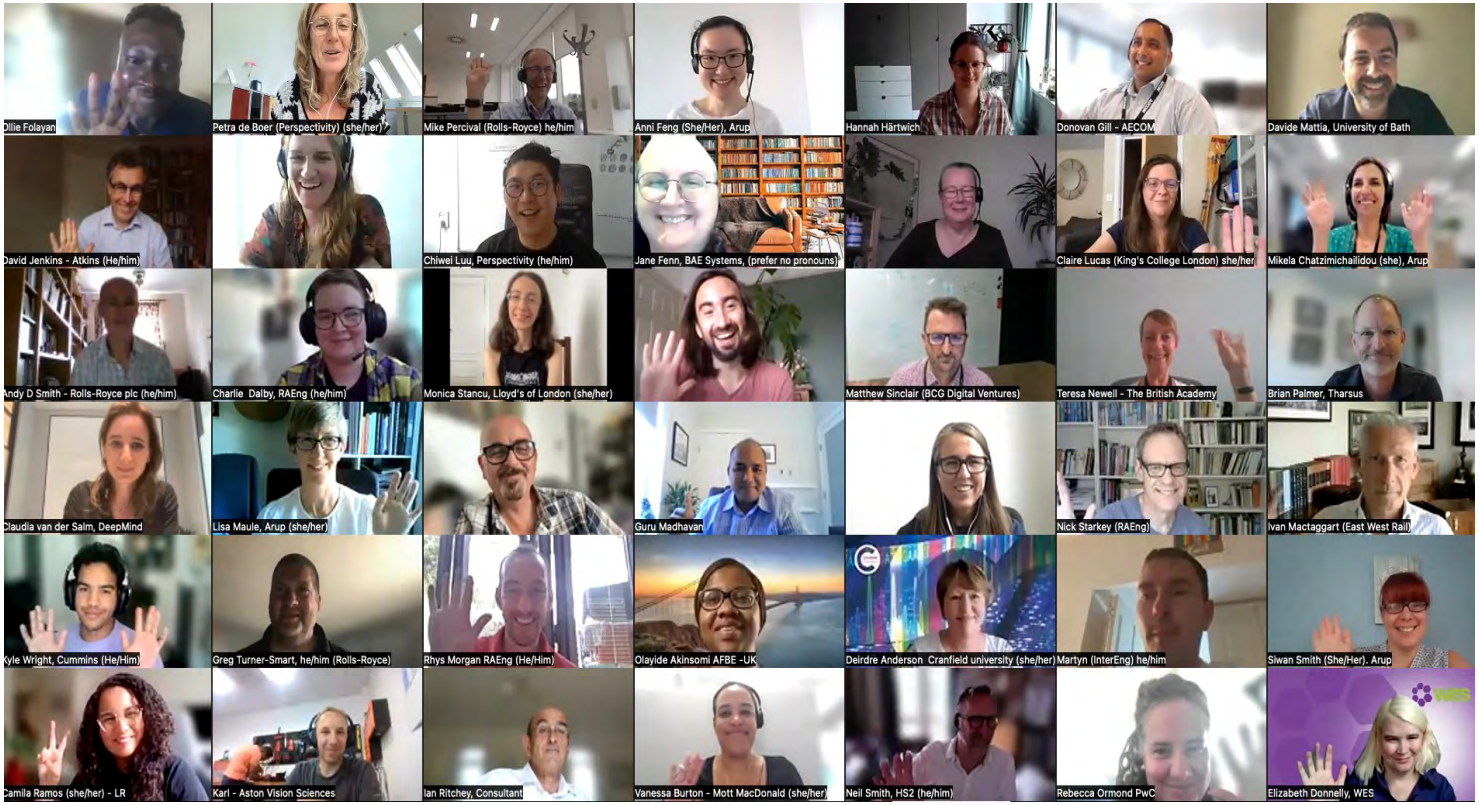


Figure 5: Screenshot of the online workshop (not all participants are pictured)

Interviews

July – August 2022 – online

The Academy held 35 interviews with the diverse set of stakeholders outlined above in addition to providers of inclusive leadership services. Interviewees will remain anonymous, however the Academy would like to thank everyone who contributed to the interview process.

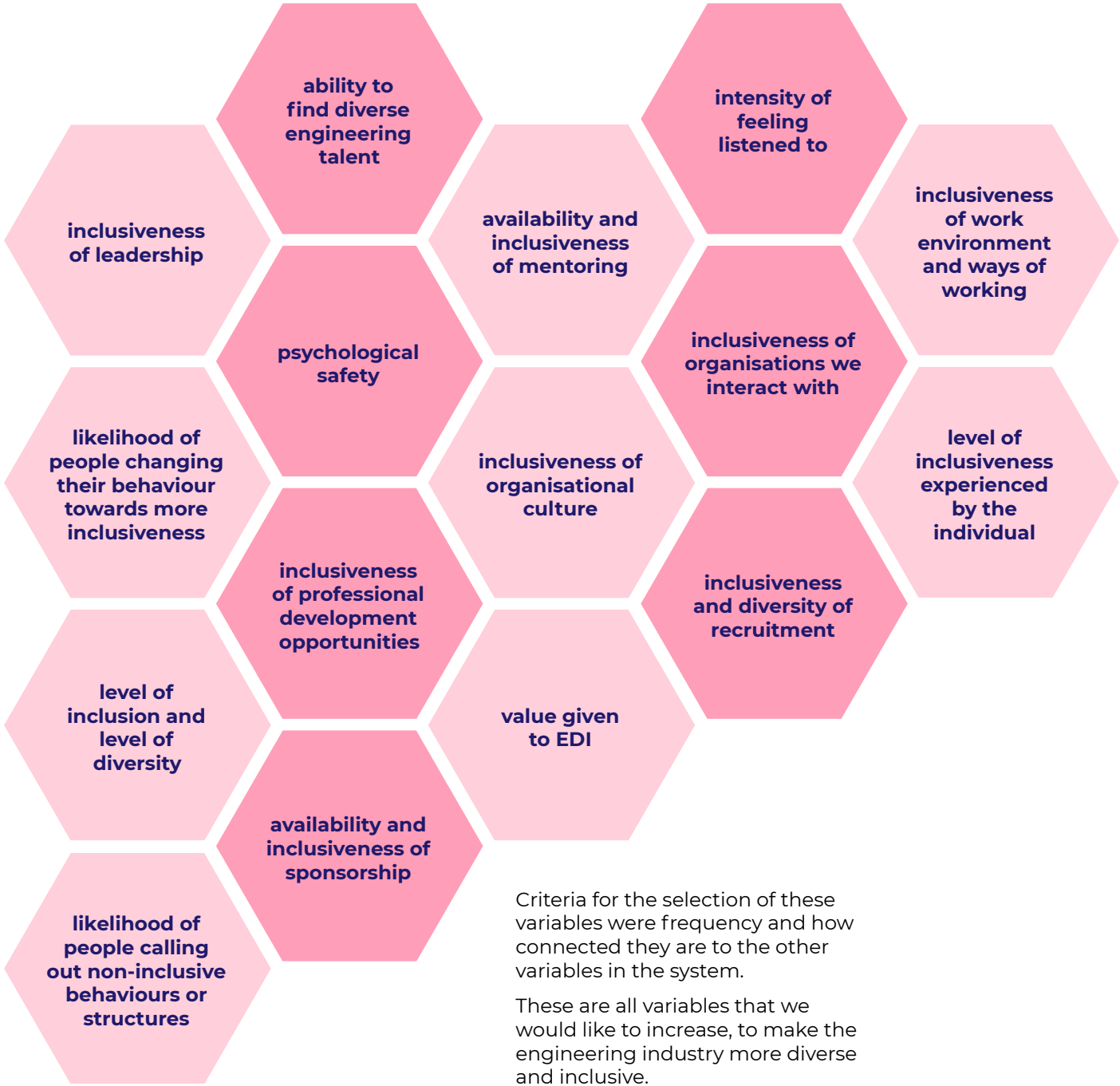
Questions

The interviews were conducted based on a semi-structured set of questions. For example: “Please describe a time where you experienced non-inclusive leadership and what was the impact?”

Because of the openness of interviewees, the interviews were incredibly rich and raised a broad range of inclusion challenges and opportunities within engineering. Some of the key themes raised in the interviews have been included in the process, both in the key variables that were identified after the first workshop and in the final systems map and recommendations contained within this report. The Academy is also undertaking its own internal analysis of the interviews to capture more specific details about content, format, and recommended delivery partners for this work. The information the Academy gathers through this process will be considered alongside Perspectivity’s recommendations to inform the design and delivery of the pilot programme.

Key variables

Based on the outputs of the online workshop and the interviews, we initially identified 16 key variables that influence diversity and inclusion in engineering, which are displayed in the hexagons to the right:



Criteria for the selection of these variables were frequency and how connected they are to the other variables in the system.

These are all variables that we would like to increase, to make the engineering industry more diverse and inclusive.

Workshop 2

5 September 2022 – in person

On 5 September, 42 stakeholders met at the Academy's Prince Philip House in London for the second workshop. Throughout the day participants 'played' with the key variables to produce their own system maps and to identify missing variables. They reflected on what came up and what this means for inclusive engineering. They then proceeded to identify eight key leverage points for increased inclusion in engineering. Finally, they explored what actions can be taken to access these leverage points and what is the specific role of leadership in this.

What follows is an overview of the steps that were taken as well as the outputs from each step.

Step 1: Mapping the system

In eight small groups, participants were invited to connect the initial 16 key variables (see previous page) into a systems map. Variables are things that can move up or down, that can increase or decrease. When variables are connected, they can influence each other in one of two ways. If the first variable increases or decreases, the second variable can move in the same direction or in opposite directions (**Figures 7 and 8**).

Key questions:
"How do the key variables influence each other? Which other variables can you add that are relevant for this system?"

After mapping in eight small subgroups, two subgroups compared notes and combined their maps into one, as far as possible (**Figure 9**). They then prepared a combined plenary presentation.

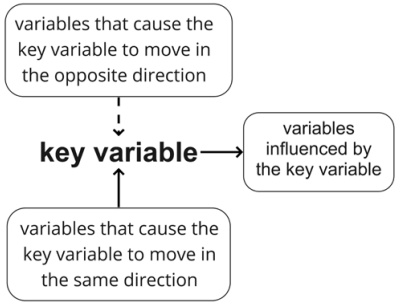


Figure 7: Variable format

Figure 8: Example variable

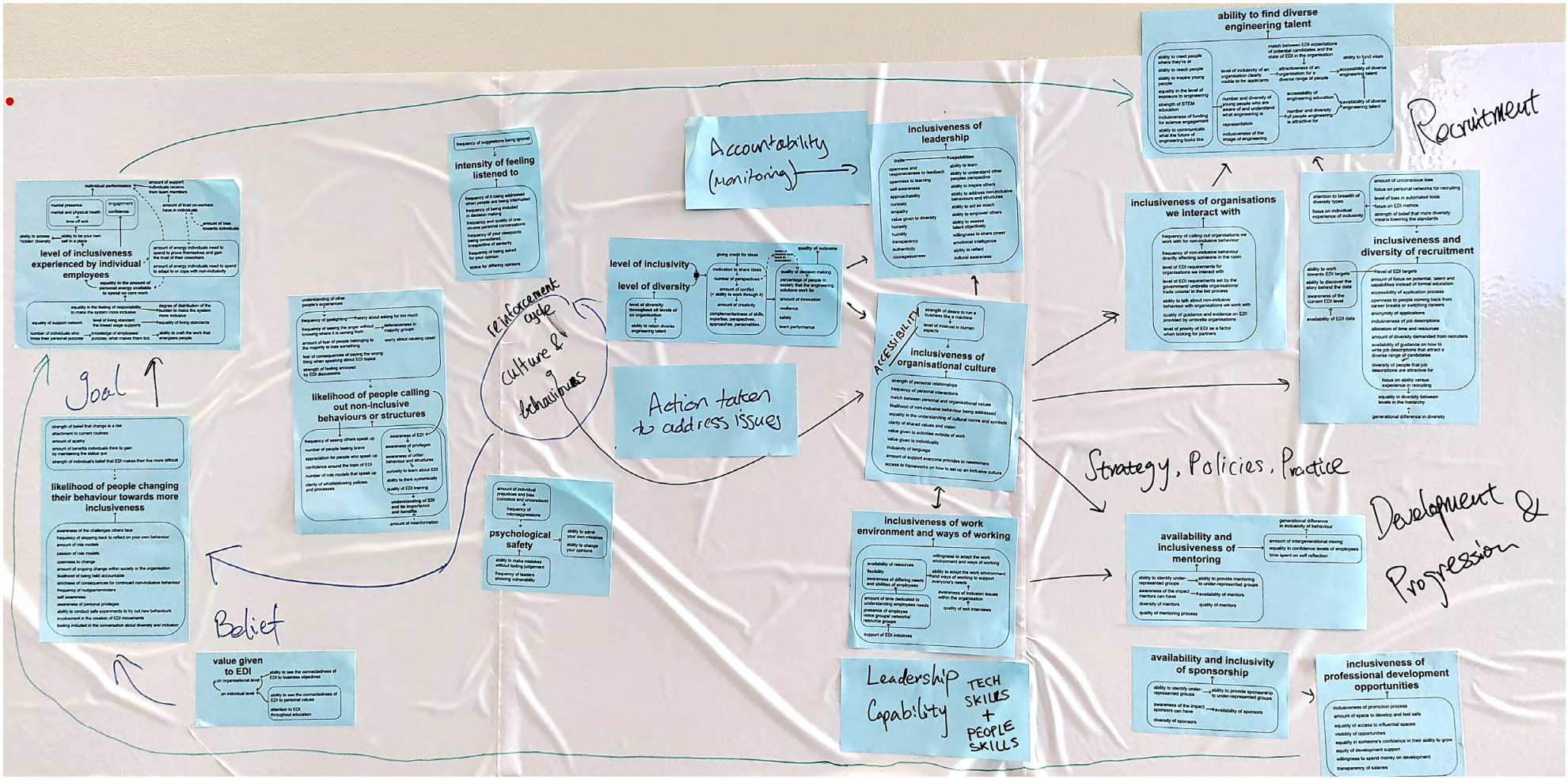


Figure 9: Sample systems map produced in step 1

Various perspectives

Each group presented their major insights as well as new variables that they felt also play a role. As anticipated, the resulting maps were a little different for each group. Complex systems are multi-dimensional, so they look different from different perspectives.

Below is a brief overview of the highlights presented.

Group one positioned leadership behaviour and capabilities (technical and people skills) as the central column in their map with two key areas next to that:

- Recruitment and development: How do we find and attract diverse people? How do people develop and progress through the organisation? Leadership has strategy, policies, and practice to mandate this.
- Culture and behaviour: These act as a reinforcing cycle within the organisation. This can be positive or negative, but in general is much harder to influence.

This group saw the increase in the level of inclusiveness experienced by individual colleagues as the overall goal. To achieve that, people need to want to change their behaviour. However, you cannot mandate behaviour change, you need to have this belief in people within the organisation to achieve that goal.

Group two stressed the importance of the application journey: When and where do you apply? What aspects are taken into consideration? There are a lot of misconceptions and stereotypes, for example, about polytechnic universities and what apprenticeship is. These are not only by potential applicants, but also by their families and in the communities where they live. Examples are: “Engineers coming through the apprenticeship route are less well trained than those that complete the university route”, or, “Polytechnic universities offer a lower quality education compared to Russell Group universities.” Misconceptions and stereotypes are further polarised in (social) media. The media is hard to control, but the engineering industry can influence its own media outreach.

This group also suggested that when people apply to work in engineering, we should show them the journey of an engineering product, not just the polished end-product. This shows that it is the journey that makes it interesting and provides opportunities for different types of people with varying skills.

This group also stressed the importance of culture in the workplace. Engagement with employees is something everyone can do at all levels in the organisation. How we do that is more difficult, for example, it is harder to be honest when there are issues between people.

> **Complex systems are multidimensional, so they look different from different perspectives**

Group three presented a roundabout of values and culture as a reinforcing system with, at the very centre, a feeling of belonging. This was described as a combination of factors including psychological safety, inclusive culture, and feeling listened to. The roundabout also had exit routes, such as professional development, sponsorship, (reverse) mentoring, and career opportunities.

This group pointed out the value of inclusion metrics for recruitment. A clear image of the numbers and targets to improve will drive the EDI need in the company and impact people who want to apply. They also noted that in the past, metrics – such as quotas – have sometimes been added for the wrong reasons, contradictory to creating a feeling of belonging.

Several groups also stressed the importance of accountability, monitoring, and KPI's in general.

Toxic culture was introduced as a negative driver, not just the opposite of an inclusive culture or the absence of inclusivity. A toxic culture works negatively against the actions that we could take.

The last group focused on the bigger picture. Why are we doing EDI? Why is it so important? What is the business case for EDI? There is a really strong link around social value and delivery – how engineers are responding to all the big issues of the current time, such as climate change, the energy crisis, productivity, connectivity, and social inclusion.

Culture drives both belonging and empowerment. People feel they belong to their organisation, and/or the engineering profession. Being empowered is a really important outcome of a more inclusive culture. An inclusive culture empowers engineers to speak up and challenge non-inclusive behaviours on the big issues of today.

This group also expressed that we need more emphasis on retention (not just recruitment). Research shows that we are losing underrepresented groups at a faster rate, not only from organisations, but also from the profession. We need to find out what we can do to retain that diverse talent. Inclusive culture and behaviours help diversity thrive.

Several remarks were made about the role of leadership: Is leadership driving this or is it just facilitating? Some say we cannot leave it to leadership. It is all about enabling the grass roots to be empowered to make a difference to speak up, so that leadership is not the key driver. Others argue that leadership is at the centre of change, after all, leaders can also destroy culture.

And finally, the question was asked: "Are there some benefits of exclusion? What is driving it?"

Plenary reflections

In plenary the group reflected on the output so far: "What stands out? What emerges out of all this? Is there anything that is missing?"

This also brought up many new questions, including:

- What is driving the lack of interest in coming into engineering? What do people see in or about engineering that is making them not come into it?
- What is the role of geography? Are we attracting people from the wide economic markets?
- Is engineering catching up with changes in workplace culture? Is it inevitable to do this?
- Where does the ownership of company values lie? Senior leadership, HR, employees?
- Inclusive culture is a very big topic. Not everyone outside this room is at the same level of why we are doing this. Engineers ask why EDI? What is the problem we are trying to solve? How do we bring people together to understand what we are trying to tackle?
- It is really difficult to change ingrained habits, that is, driving on the right or left side of the road. Processes and policies should make change the only option.
- Looking at the iceberg model (Figure 10 below) and at the history of where we are, have we gone far enough down to see what changes need to be made?
- We also need to consider external factors – policies and things happening all around us, such as Brexit.
- How do overlapping systems such as EDI, wellbeing, and safety interrelate?
- Can we move from overcoming barriers to removing barriers?
- How much time do we have? What can we do that can have an effect next year? What can we do to change policy next week?
- Are we providing the right resources and tools to help people become leaders and stay leaders?
- What can professions and functions do? What can individual employees do?
- How do you know what is right in a different culture? Different cultures have different mental models; what is considered "right"?
- It is very important for us to be ambassadors of engineering.
- Retention is quite difficult. We have to emphasise that there is a meritocratic element somewhere along the journey. When people find the ownership of skill, they tend to want to cultivate that.
- Allow the quality of processes and work to be equitable. What is the role of technology in terms of diversity?

Step 2: Identifying leverage points

The behaviour of complex systems results from their underlying structure. At the surface we can easily observe and experience events. In the first workshop we started to explore inclusive leadership at the events level, through sharing individual stories of actual experiences. We then identified key factors driving success, plotted them on a map, and observed patterns. For example, the more people are feeling listened to, the more engaged and confident they become. These patterns were made explicit in the concept systems maps by connecting (clusters of) key factors (see example in **Figure 9**).

In this step, we explored the structures and mental models that create these patterns. For example, because of the inherent mental model "I can trust people who are like me more than those who are different", people tend to be more likely to listen to and sponsor people that are similar to them.

This mental model perpetuates the existing composition at different levels within an organisation. Setting up structures that purposefully give underrepresented groups access to sponsoring can help change this pattern (**Figure 10**).

Where can we intervene in the system?

Leverage points are places in the system where a small change could lead to a large shift in behaviour. There are many different ways in which we can make changes to the system structure, to change the patterns it creates. Donella Meadows, a well-known systems thinker, identified different types of leverage points and sorted them by how effective she thought they were in causing a significant change (**Figure 11**).

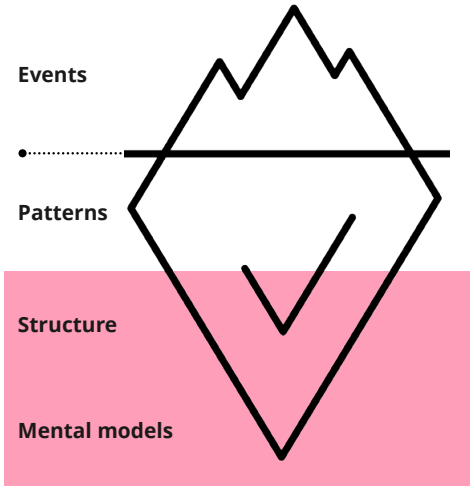


Figure 10: Underlying structure of a complex system

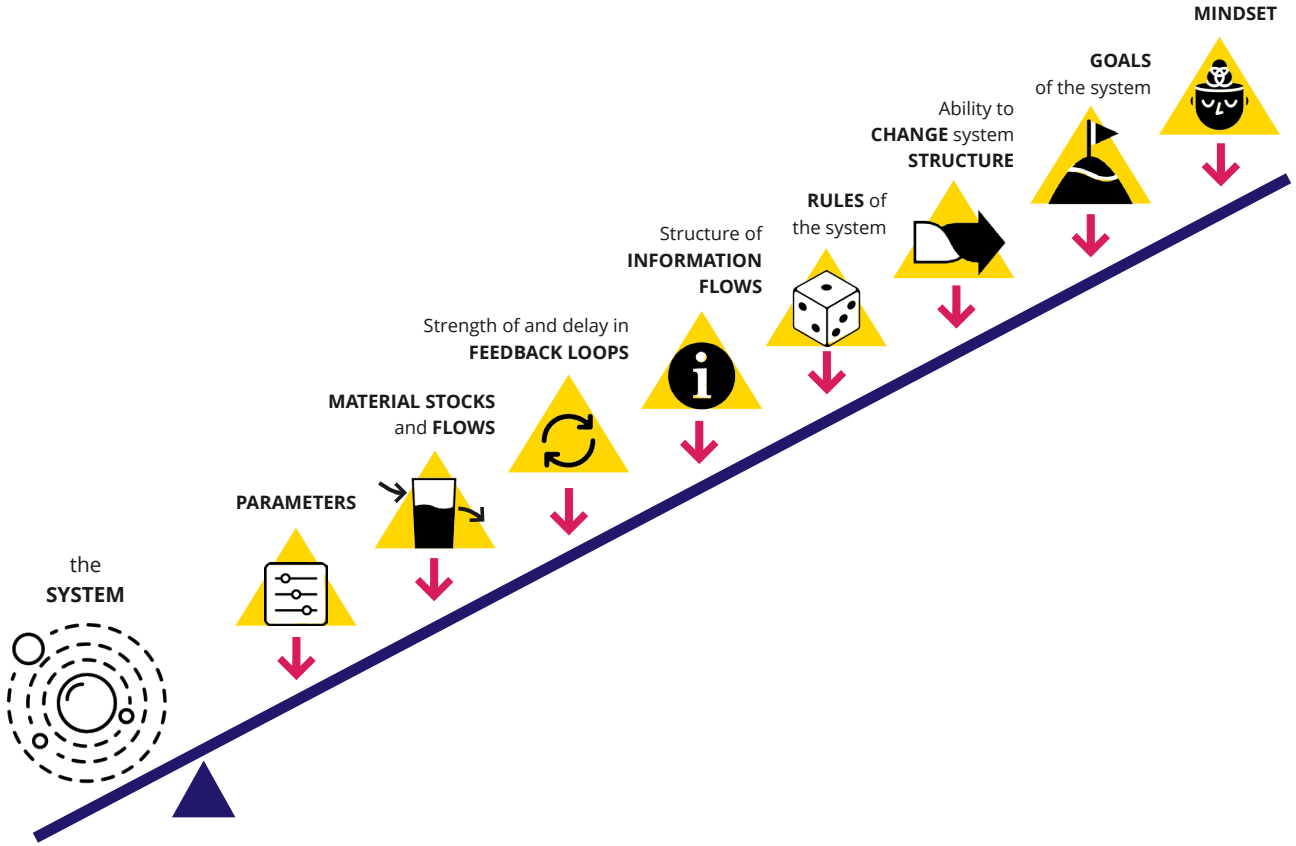


Figure 11: Leverage points: places to intervene in a system
Source: Thinking in System by Donella Meadows

Below is a brief explanation of the types of leverage points that were identified during this process, sorted by increasing effectiveness.

- **Parameters:** Constants such as the level of EDI targets.
- **Material stocks and flows:** The capacity of stocks and the flow of resources, such as the amount of resource available to adapt the work environment to people's needs.
- **Strength of and delay in feedback loops:** When variables are connected into loops, it results in balancing or reinforcing feedback. A thermostat balances room temperature around a stable level. Increasing diversity in the engineering industry attracts more diversity.
- **Structure of information flows:** How information flows through the system and who has access to what information, such as the transparency of salaries.
- **Rules of the system:** Rules, guidelines, and ways of working. For example, there are consequences (positive or negative) based on the inclusiveness of people's behaviour.
- **Ability to change system structure:** The power to add, change, or evolve system structure. For example, increasing diversity and inclusion increases society's ability to evolve and adapt to change.
- **Goals:** The purpose or function of the system. For example, if the entire industry would agree that the goal of the engineering system is to provide inclusive solutions to society, many changes to the structure of the system would follow.
- **Mindset:** The shared ideas in the minds of society and its actors. For example, taking risks opens up opportunities.

In new mixed subgroups, participants created a list of high-potential leverage points.

Key questions:
"Where can we intervene in the system to make the engineering industry more diverse and inclusive? Do you see a feedback loop that could be strengthened?"

In a plenary dialogue, reporters of all groups shared their top five leverage points and clustered them as they went along. This way the groups collectively identified eight topics they considered crucial to achieving inclusive leadership in engineering. Considering the pressure cooker in which the groups selected their top five, this list is certainly not exhaustive. However, given the frequency of most topics mentioned, this gives a good first indication of where in the system we could intervene and may expect relevant effects.

The eight leverage points identified during the workshop:

- The case for EDI in engineering
- Leadership transformation
- Organisation, structures, and networks
- Education
- Safe space
- Recognition and reward
- Measurement and monitoring
- Visibility and perception of engineering.

Step 3: Accessing leverage points

Next, self-formed subgroups around each topic explored ways to access the leverage points that were identified. The questions below guided their conversations. All groups were asked to particularly focus on the role of leadership in leveraging change. In addition, a small team of 'bumble bees' floated from one group to the next, to identify overlap between actions and potential for mutually reinforcing actions. Each group presented their ideas in plenary.

What follows is a brief recap of the output of these explorations, which has been used as input for the systems map later in this report (**Figure 12**).

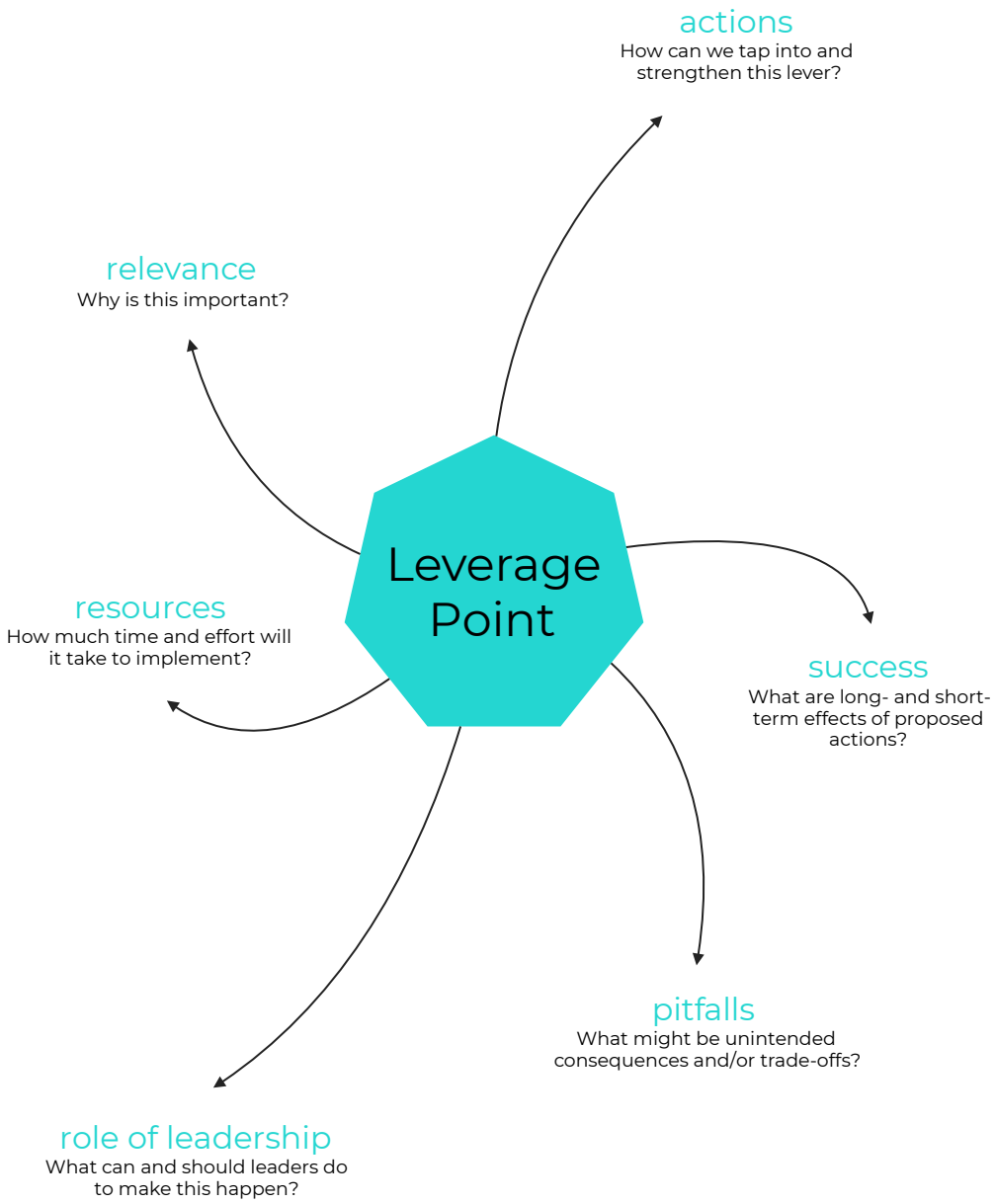


Figure 12: Guiding questions to explore ways to access a leverage point

The case for EDI in engineering

Relevance

We need to find better ways to express and articulate the importance of EDI for engineering. We are all convinced that EDI leads to better teamwork and that diverse teams produce better outcomes. We must find examples of ways to bring the end-user into the engineering design process.

Actions

- Update the business case to reflect the moral, legal, and economic aspects of EDI.
- Include the financial and social impact elements (for example, sustainability) of EDI.
- Tailor the EDI case to sectors and regions.
- Integrate environmental, social, and governance (ESG) factors in technological processes.

Success

Outcome: All engineers can articulate the business case and buy into it, not just leadership and HR.

Pitfalls

- Articulating the importance of EDI for engineering requires vulnerability and taking risks.
- The case for engineering may not be the same for corporates, professional engineering institutions, and SMEs.

The Academy action

Prepare a practical business case for EDI in engineering, tailored to different sectors, regions, and organisation sizes, with an emphasis on social impact.

> **We need to find better ways to express and articulate the importance of EDI for engineering**

Leadership transformation

Relevance

- Recognise that leadership sets direction for the industry and organisations, for example, the Academy sets the direction for all of engineering with great authority.
- Leaders can create the culture in an organisation.
- Lack of leadership is often why projects change or fail. If you do not get buy in from the leadership, you will fail.
- Leadership transformation is about changing the mindset.

Actions

- Design and implement a leadership values framework – What does good/inclusive behaviour (and non-inclusive behaviour) look like?
- Leadership should be exposed to wider thinking, for example, reverse mentoring, personal stories, and sponsoring staff networks.
- Leadership should be made accountable for setting EDI standards.
- A business case for EDI should be created: Why EDI is good for business.
- EDI is linked to the health and safety case to illustrate benefits (wellbeing/reduced sickness) and risks.
- EDI is embedded into leadership development programmes.
- EDI should be embedded into the selection process for leadership programmes.

Success

Long- and short-term outcomes include:

- a more diverse leadership team
- diversity in succession planning
- a more capable and inclusive leadership
- greater sense of belonging for the workforce, and for the board and senior management
- sense of progress in terms of retention and engagement scores in surveys and events.

Pitfalls

- Leadership transformation is not an easy quick fix – it takes time.
- Sometimes this is just a numbers game – box ticking.
- The process might switch people off, so they have the feeling “this is not about me”.
- The focus on EDI might distract from other initiatives and resources are limited.

> **Leadership transformation is not an easy quick fix – it takes time**

> **Inclusion should be embedded in business plans, strategic planning, and direction and accountability**

Organisation, structures, and networks

Leadership behaviours to drive change needs to focus on three things: involve, model, and embed. The role of leaders in each area is outlined below:

1. Involve all, including diverse voice

- The role of leaders is to involve everyone – including diverse voices – to set the culture and the values of the organisation and then hold people to these values. The organisation evolves around people and culture.
- Clear routes to raise issues should be created and promoted to enable safe spaces for people to call out non-inclusive behaviour.
- There is a need to understand what keeps or doesn't keep people in the organisation and to do something about it (for example, introduce inclusive policies and practices).

2. Model inclusive behaviour

- Dedicated resources should be allocated to support EDI. Leadership should be made accountable, but the responsibility and ownership should not be put on one person. Where does responsibility at senior level lie?
- Safe spaces need to be created for people to share experiences of inclusion.
- Leaders can role model openness and vulnerability by telling and sharing personal stories of inclusion.

3. Embed through planning

- Diversity and inclusion should be embedded in business plans, strategic planning, and direction and accountability.
- Employee resource groups and networks should be set up that leaders can support and join, both within the organisation and across the engineering industry.

Pitfalls

The majority can feel threatened, and you end up failing to bring them along as champions and allies.

Resources

Training should be provided for everyone at all levels, both for getting them on board and to embed new practices in the organisation.

Education

Relevance

Teaching inclusion in engineering education is important because it leads to:

- better engineered products
- consideration of whole lifecycle engineering on society, cultures, and communities
- building inclusive working practices in teams.

Actions

We believe it is already happening through:

- embedding EDI considerations in regulatory requirements and accreditation
- embedding EDI considerations in employer standards for apprenticeships, feeding into T-levels
- getting research councils to fund EDI, for example, Engineering and Physical Sciences Research Council (EPSRC) funding will embed EDI in higher education much more successfully
- developing resources and materials to support teaching (for example, toolkits, case studies).

Success

- Short term: Recent graduates will bring their inclusion knowledge and skills, which will change industry culture (similar to how digital natives have accelerated the digital transformation).
- Long term: Recent graduates have in general more value-driven needs and desires, which will embed long term systemic change in engineering.

Pitfalls

- The anti-woke agenda may cause a backlash against inclusion.
- Curriculums for engineering students are already too full, so if we include this, what are we going to drop?

Role of leadership

- Institution, regulatory, and research leaders need an inclusive way of thinking and approach.
- Wider support for funding needs to be leveraged as more resources are needed to support lecturers and to fund the development of case studies for teaching inclusion in engineering.
- This should start young by including inclusion in personal social and health education (PSHE) in schools as part of global responsibility.

> **Graduates will bring their inclusion knowledge and skills, which will change industry culture**

> **Success is recognising and rewarding the right things**

Recognition and reward

Success is recognising and rewarding the right things and not recognising and rewarding the bad things. That sounds very simple but is more difficult to put into practice.

Relevance

- Putting your money where your mouth is will influence the culture, it incentivises behaviour change, and it influences who is on your future senior leadership team.
- Seeing people promoted on appropriate criteria and through a more value-based system of recognition than most organisations have currently will demonstrate success in this.

Actions

- A handbook of ideas to guide organisations on how to put recognition and reward policies into practice should be produced. This can be used as a resource for the Academy's leadership programme.
- How these policies will be followed through and maintained, for example, through staff surveys, should be made explicit.
- Senior management goals and objectives are linked to bonuses and included in employment contracts.
- Metrics are reviewed regularly.
- Leaders role model good practice through openly sharing examples of failed inclusion and the associated lessons learned.
- Organisational recognition and celebration events should be facilitated.
- Use external recognition and validation to get engineering recognised as being creative.
- Actively look for other ways to embed inclusion and diversity in structures and processes.

Pitfalls

- We still need to make sure the best person gets the job.
- We need to be clear about what is happening in teams, beyond what is visible on the surface.
- Recognise that when non-inclusive behaviour is punished, you can't always share the details of what has happened.
- There can be a lack of actual consequences for 'poor' behaviour.

Role of leadership

Leadership is the common thread in all these leverage points. Without top-level leadership support, recognition and reward interventions would probably not be sustained.

Safe space

Safe space is about making it so that people feel comfortable to talk about anything.

Relevance

- Safe space can provide a feeling of inclusion and belonging.
- The bottom line is directly affected, because if you have the space to talk, then you get to address issues and embrace new ideas.
- It is good for employee mental health.

Actions

- Safe space connects all aspects of open culture – EDI, HSE, product, safety – via mental health.
- When someone speaks up, leadership listens and takes action (links to leadership transformation).
- Leaders show that they are ready and willing to listen (link to leadership transformation).
- It provides an independent route to speak up (including mentor, HR) (links to organisation, structures, and networks).
- It creates transparent processes so that people know how to speak up (links to organisation, structures, and networks).

Pitfalls

- People can lose focus on the big issues because organisations can be awash with small issues.
- There is a massive cultural variation in organisations, which makes different people behave differently.
- Misunderstanding or even abuse of the system can be used to create trouble, for example, when somebody doesn't get along with someone.

Role of leadership

- A training workshop on how to create safe spaces for CEOs and senior leadership should be created.
- Resources for educators should be produced (link to education).

> **Safe spaces need to be created for people to share experiences of inclusion**

> **Get data to compare and benchmark and continuously improve**

Measurement and monitoring

Sometimes measurement and monitoring are unfortunately still perceived as box ticking. Procurement is the entry point for getting diverse and inclusive teams working on our engineering projects.

Requirements

- Learn to ask the right EDI-related questions to gauge the inclusive behaviour of applicants. For example: “How have you engaged with the wider community in the procurement process?”
- The weighting associated with the EDI-related questions should be made non-negotiable.
- There should be an ongoing commitment to providing evidence (EDI data) leading to improved data.
- More diverse forms of reporting, for example, not just gender but different types of characteristics, should be encouraged.
- Processes to gather experiences from employees (internal) and from the communities that we design for (external) should be set up.
- Engineering standards should be improved by incrementing and influencing inclusive design in engineering settings. Data needs to be available to do the benchmarking against the standard of inclusion and diversity and to continuously improve.

Actions

- Share good practices in procurement, but also in design and so on.
- Promote leaders who are doing this really well.
- Provide a testbed or incubator for experimenting on EDI and get leaders involved.
- Get data to compare and benchmark and continuously improve.
- Get leaders involved, talk about it, inspire others, and influence the agenda.

Visibility and perception of engineering

Visibility of the engineering identity is about coming away from the stigma of apprenticeships, sometimes perceived as where you get your hands dirty or if you are not good enough for university, and the idea that engineering is about hard hats on construction sites.

Actions

- A social media campaign, *Day in the life of an engineer*, could be run.
- Aim to get influencers involved to promote EDI in engineering.
- STEM apps for children could be developed to raise awareness for academic career paths.
- STEM events that include parents to raise awareness of engineering careers could be organised.
- Look to develop engineering building kits and affordable engineering subscriptions for children.

Success

Visibility of engineering in practice will increase engagement from underrepresented groups in engineering. With more diverse skills we can develop new technologies and fix problems faster.

Pitfalls

Pitfalls include the costs of setting up apps and social media. There are also accessibility issues, for example, not everybody may have access to smartphones (elitism).

Role of leadership

- Social media managers should be appointed within companies to promote EDI through social media and marketing.
- Leadership should get involved in the wider community, especially with disadvantaged communities.
- Engineering advertising campaigns on EDI industry practices, for example, how to develop diverse talent should be launched.
- Leaders should be encouraged to lead by example, for example, Rolls-Royce CEO.

> **Visibility of engineering in practice will increase engagement from underrepresented groups**

> **Being able to have pride in failure and learning is crucial**

Overlaps and reinforcing actions

The bumble bees identified the overlaps and relationships between the different groups. This is what they identified:

- Recognition and reward links to measurement and monitoring. It is not just about box ticking, but about identifying genuine drivers for change. This prompts the question: “How do you remove bias?”
- Measuring outcomes to know where you are on the journey is crucial. Benchmarking and being able to articulate the business case feed into teaching.
- Using professional standards as a regular jumping off point, for example, a leadership value framework or handbook of inclusive practice to show people what inclusive leadership looks like is a key tool and needs to be taught too.
- In leadership transformation, making the business case for EDI must also be addressed.
- Winning hearts and minds for the business case needs a stronger emotional pull. The social impact side needs to be included and more grounded in social and environmental context, in other words, inclusion by design.
- Different forms of case studies, for example, role models sharing their stories can be used in teaching, leadership storytelling, raising visibility, both internally and externally.
- Communication skills of leaders came up a lot, including listening. While this sounds simple, a lot of people have not been taught how to listen effectively. Open communication with leadership is a reinforcing idea and leaders need to be able to listen well for people to talk to them and open up to them. Clear communication channels were also mentioned several times.
- The role of leadership skills and especially being able to have pride in failure and learning is crucial, for example, being able to talk about mistakes as well as about successes. This relates to safe space, leadership, and recognition.

Systems map

Development of the systems map

The systems map (**Figure 13** on the following page) visualises the ideas and perspectives that came up throughout the participatory systems mapping process. We started the mapping process by reading through the transcripts of the interviews and pulling out key elements. These elements were continuously clustered and connected, building up the systems map step by step (see **Figure 14**). The outputs from the first workshop, which took place during the interview phase, were also included in the mapping process.

In preparation for the second workshop, we identified 16 key variables based on the draft systems map. These variables were selected based on how often they were mentioned in the interviews and workshop and how connected they were in the draft systems map.

During the second workshop, participants worked in subgroups to arrange and connect these key variables into their own systems maps. Even though the resulting maps all looked different, a shared understanding of the structure and connectedness of the system started to emerge. We carried these concepts over into the layout of the systems map in this report. One of the key concepts is the 'pipeline of engineers' which we decided to use for the structure of the systems map.

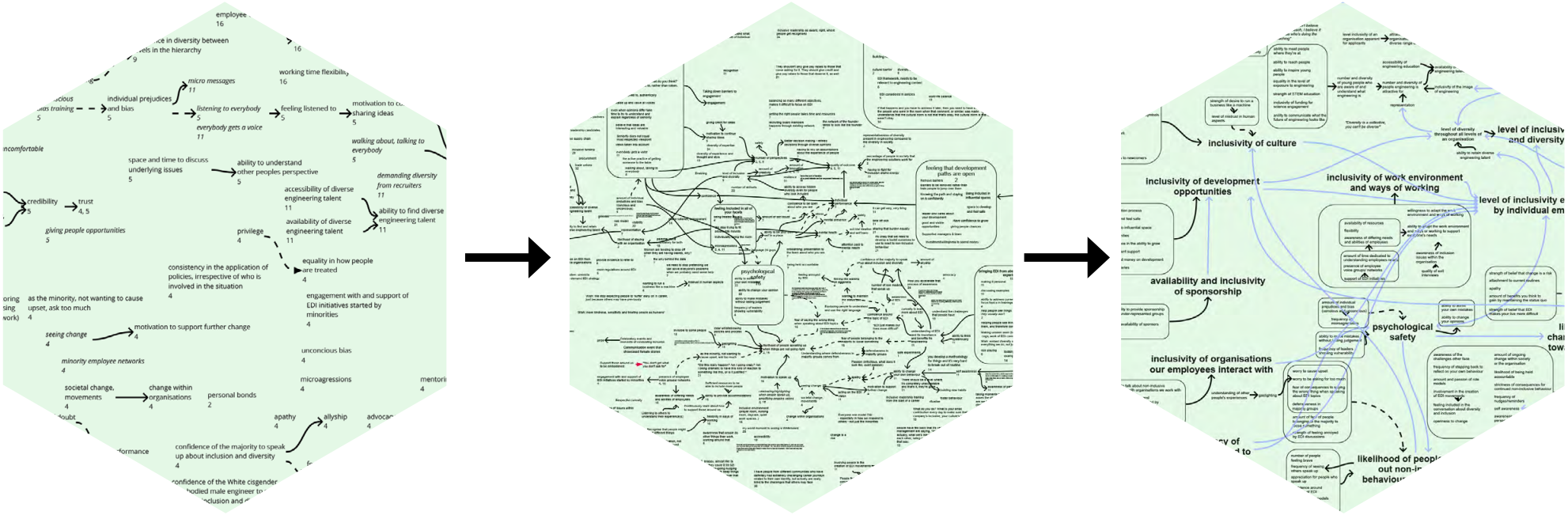


Figure 14: Steps in the development of the systems map

> **The systems map visualises how individuals navigate in, through, and sometimes out of the engineering industry**

© This is Engineering

Introduction to the systems map

Some participants referred to the movement of individuals through this system as the 'pipeline of engineers'. The systems map visualises how individuals navigate in, through, and sometimes out of the engineering industry and explores the variables that influence the decisions individuals make throughout their journey. These decisions determine the level of diversity in the engineering industry.

The systems map shows variables that are characteristics of five stakeholders in this system:

- society (**blue**)
- the education system (**orange**)
- the engineering industry (**green**)
- engineering companies (**pink**)
- individuals that navigate through this system (**black**).

For three of these stakeholders: society, companies, and individuals, we explore the diversity and inclusion related questions they ask themselves as well as the variables that determine the answers to these questions. There are many reasons why individuals who are currently underrepresented in the engineering industry are less likely to choose to study, work, and stay in engineering. That is why the experience, questions, and related decisions of individuals are at the centre of the map, because it is at this level that inclusion is being experienced and diversity is being determined.

Based on the exploration of these questions and the variables that determine their answers, we have identified many places in the system to intervene to increase diversity and inclusion in the engineering industry. This includes interventions that can be made throughout the system, points where the Academy can provide guidelines and intervention points that specifically relate to the mindset and behaviour of leaders. Finally, we indicate what capabilities leaders need to implement these actions successfully.

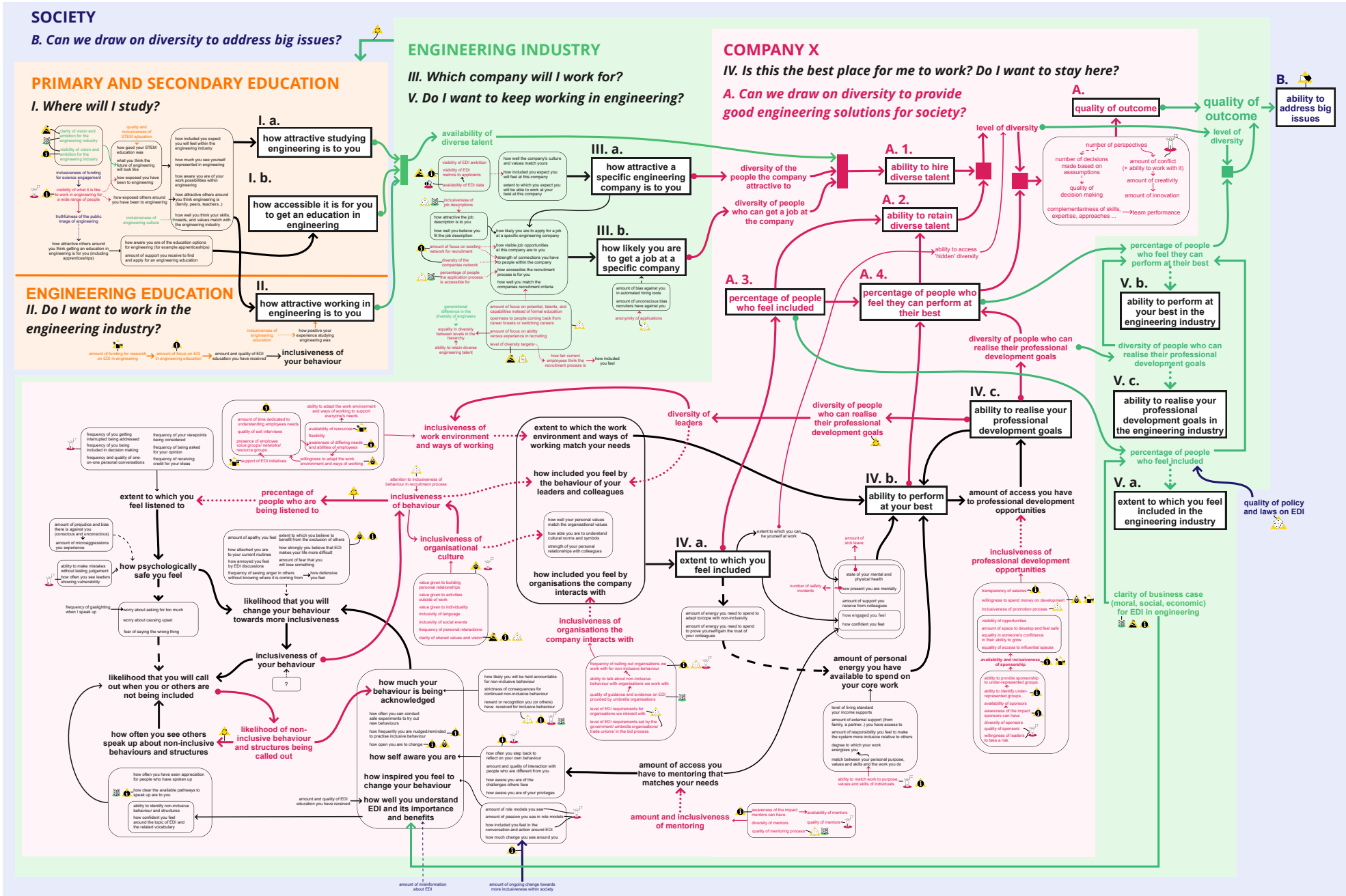


Figure 13: Full systems map

> **The current reality is that diversity is being lost at every decision-making point**

Stakeholder questions

The below text makes reference to **Figure 15** on the following page.

Engineering companies

A. Can we draw on diversity to provide good engineering solutions for society?

1. Are we able to hire diverse engineering talent?
2. Are we able to retain diverse engineering talent?
3. Are we able to make everyone feel included?
4. Are we able to provide conditions that allow everyone to work at their best?

Society

B. Can we draw on diversity to address big issues?

Individuals

At the end of their secondary education, individuals consider:

I. Where will I study?

- **a.** What do I want to study?
- **b.** Where can I study?

At the end of their engineering education, they consider:

II. Do I want to work in the engineering industry?

If individuals have decided they do want to work in the engineering industry, they then have to consider:

III. Which company will I work for?

- **a.** Which company do I want to work for?
- **b.** Where can I get work?

After having worked at an engineering company for a while, individuals will consider:

IV. Is this the best place for me to work? Do I want to stay here?

- **a.** Do I feel included at this company?
- **b.** Can I perform at my best at this company?
- **c.** Can I realise my professional development goals?

If they decide to leave their current company, they have to consider:

V. Do I want to keep working in engineering?

- **a.** Do I feel included in the engineering industry?
- **b.** Can I perform at my best in the engineering industry?
- **c.** Can I realise my professional development goals in the engineering industry?

The decision-making process of individuals is influenced by the context which they are navigating. There is a **reinforcing feedback loop**, where the conditions within the engineering industry influence the decisions people make, and the decisions people make influence the conditions within the engineering industry (C.).

The current reality is that diversity is being lost at every decision-making point and it is difficult to re-enrich the stream further down the line. There will be movement of people between engineering companies, with some companies being able to **attract diverse talent to them away from others** (D.), but that does not change the overall diversity within engineering. One option to increase the overall diversity further down the stream is to **hire people with a non-engineering background** (E.).

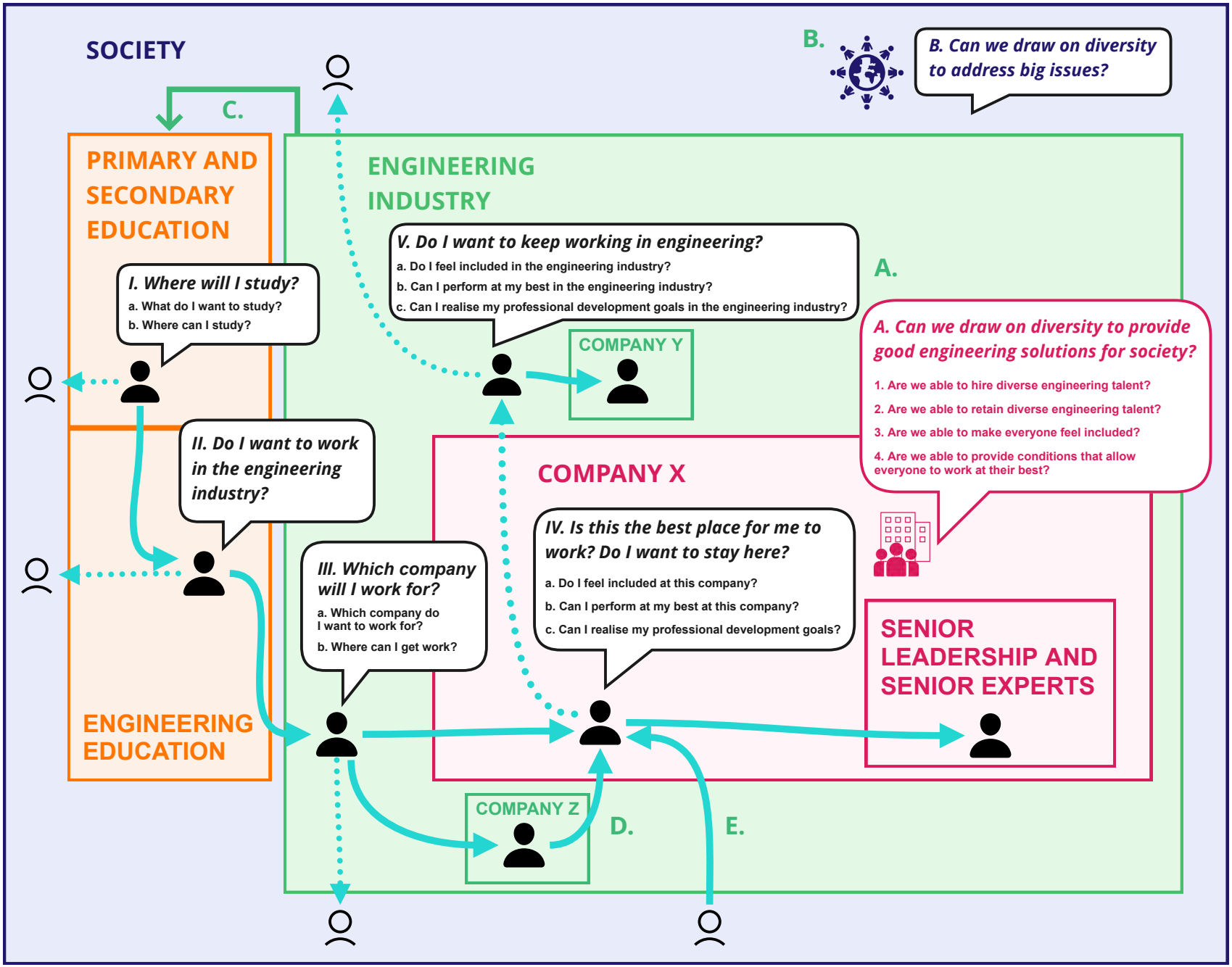


Figure 15: High level systems map

Systems map reading guide

To help you navigate through the full systems map (**Figure 13**), we have divided it into seven separate smaller maps (**Figures 17 through 23**). For each of these you will find a description of:

- the variables and their influence on the answers to the questions stakeholders ask themselves
- the influence on the diversity of the stream of engineers
- places to intervene to increase the diversity and inclusiveness of the engineering industry.

Figures 17 through 21 centre around the experience of the individual on their journey through the system. **Figure 22** focuses on the questions at the level of the company and **Figure 23** on the level of society.

You are invited to imagine going through this journey yourself. What decisions would you make? Are there other variables that influence your decision making that are not mentioned here yet or variables mentioned here that do not influence your decision? At the same time, imagine someone very different to yourself, how does the experience change?

Before you start, have a look at the systems map reading guide (**Figure 16**). While reading through the descriptions, we recommend looking at the corresponding figures. This will make it much easier to understand the connectedness of the entire system. Once you have read through the descriptions, we invite you to explore the full systems map again in your own way. This will allow you to gain extra insights, enriching it with your perspective and experiences, and applying it to your own context.

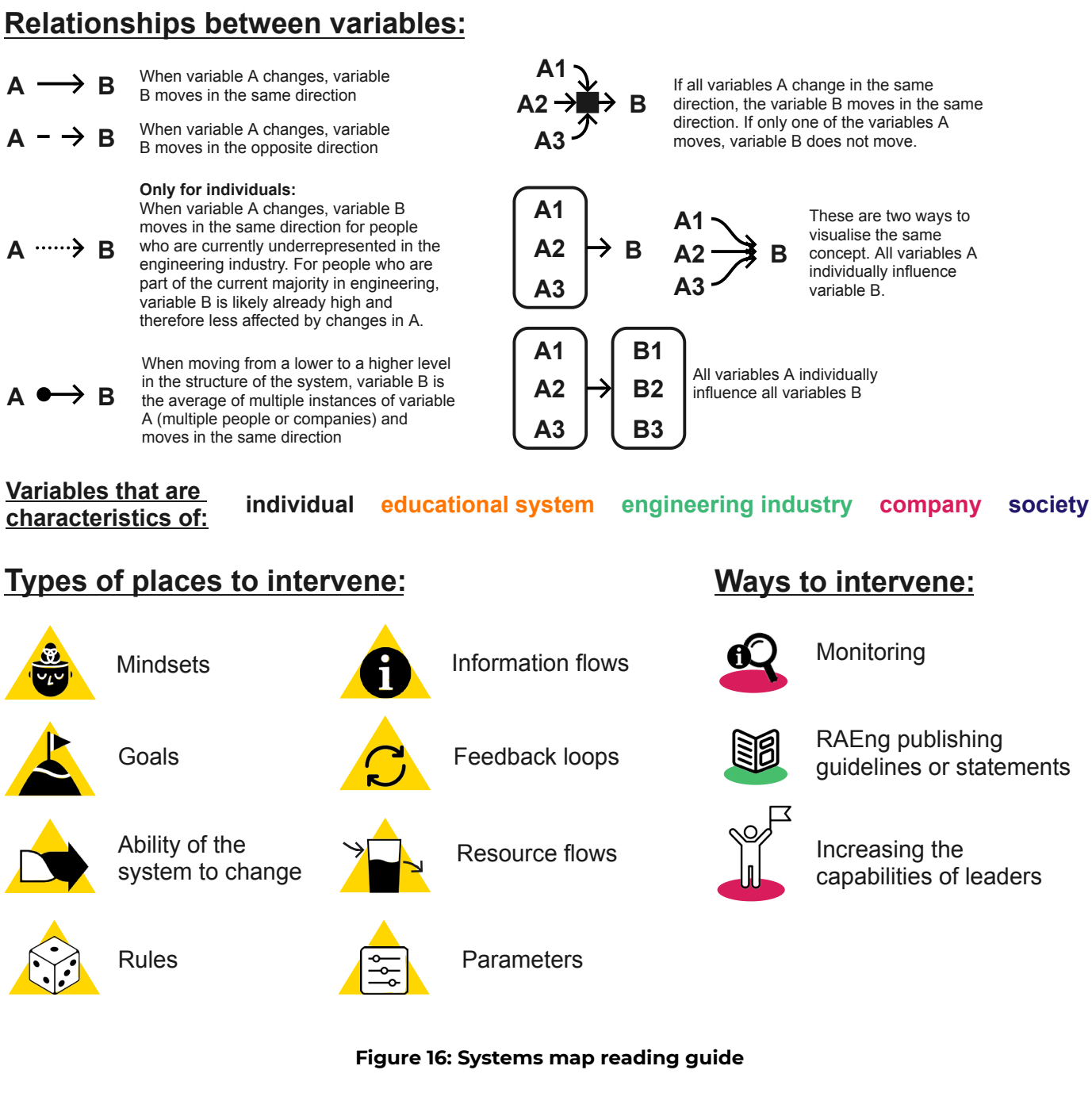


Figure 16: Systems map reading guide

I. Primary and secondary education

Where will I study?

Towards the end of your primary education, you are deciding where and what to study (**Figure 17**). You make this decision based on what is attractive for you to study (1) and which field is accessible to you (2).

How attractive studying engineering is to you (1) increases with (12):

- how included you expect you will feel within the engineering industry (3), which is influenced by the overall inclusiveness of the engineering industry (4)
- how much you see yourself represented in engineering (5), which is influenced by the overall diversity of the engineering industry (6)
- how aware you are of your work possibilities within engineering (7)
- how attractive others around you think engineering is (family, peers, teachers) (8), which increases with how exposed others around you have been to engineering (9)
- how well you think your skills, needs, and values match with the engineering industry (10), which is influenced by the inclusiveness of the overall engineering culture (11).

In turn, all the variables in box 12 described above increase with:

- how good your STEM education was (13), which is influenced by the overall quality and inclusiveness of STEM education (14)

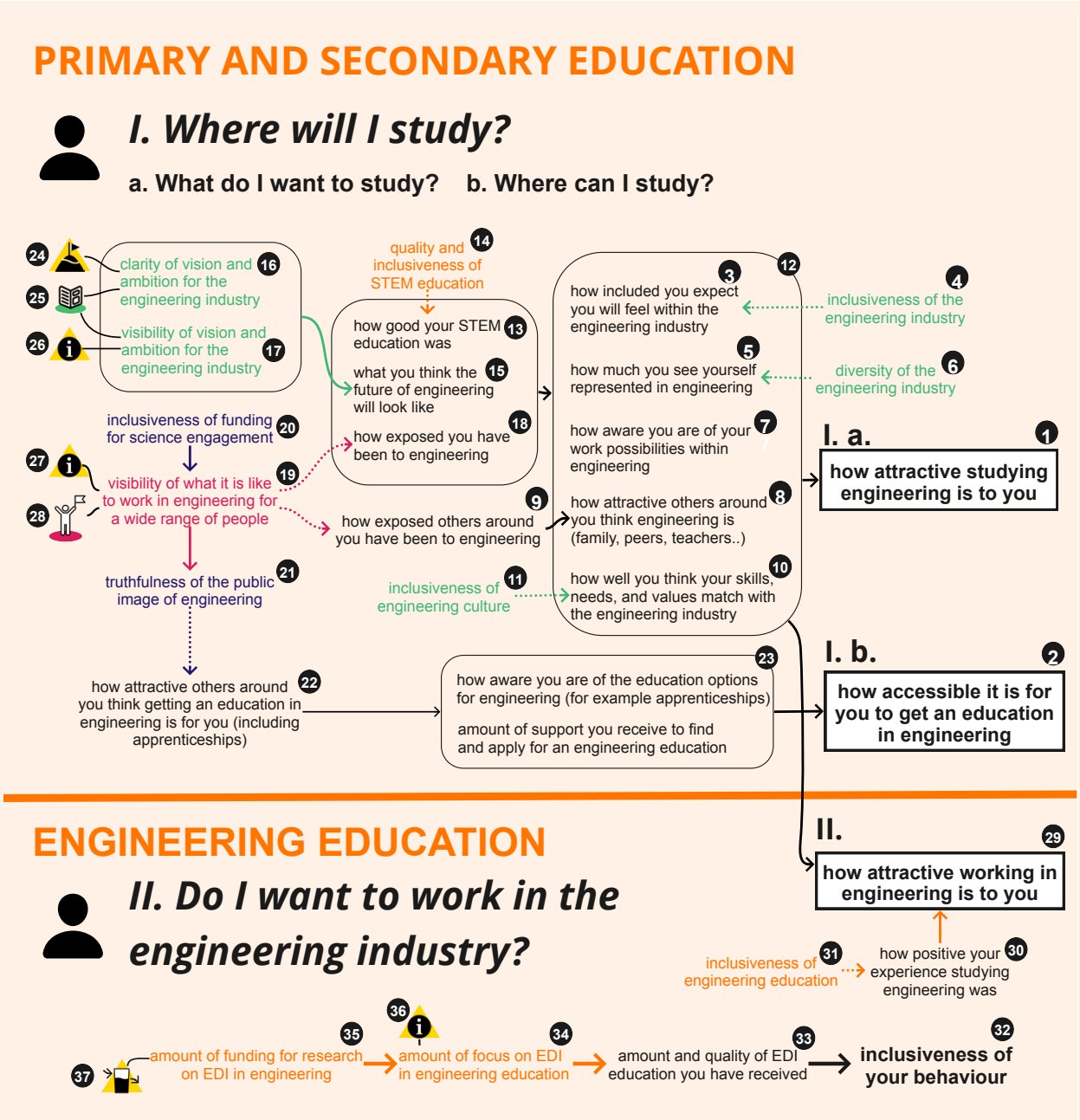


Figure 17: Choice of education

- what you think the future of engineering will look like (15), which is influenced by the clarity (16) and visibility of the vision and ambition for the engineering industry (17)
- how exposed you have been to engineering (18), which is influenced by the overall visibility of what it is like to work in engineering for a wide range of people (19). This, (19), also influences how exposed others around you have been to engineering (9) and increases with the inclusiveness of funding for science engagement (20).

When the visibility of what it is like to work in engineering for a wide range of people increases (19), the truthfulness of the public image of engineering increases (21), which influences how attractive others around you think getting an education in engineering is for you (including apprenticeships) (22). This in turn increases how aware you are of the education options for engineering (for example, apprenticeships) and the amount of support you receive to find and apply for an engineering education (box 23), which increases how accessible it is for you to get an education in engineering (2).

Influence on the diversity of the stream of engineers

How do you think this process has influenced the diversity of the stream of engineers?

Individuals who are currently underrepresented in the engineering industry are less likely to choose to study engineering than those who are part of the majority, for example:

- their expectation to feel included within the engineering industry (3) is low
- they rarely see themselves represented in engineering (5)
- they are less likely to have received a high-quality STEM education (13) and they and the people around them are less likely to have been exposed to engineering (18, 9), making them less aware of the work possibilities there are for them in engineering (7) and making it less likely that people around them will encourage them to choose this path
- they might not think that their skills, needs, and values match with the engineering industry (10)
- they are less likely to be aware of the education options there are for engineering and receive less support to find and apply for an engineering education (box 23).

Places to intervene

(24) Goals – Make the vision and ambition for the engineering industry clearer. **The Academy could bring people together to define and publish this vision for the future of engineering (25).**

(26) Information flows – Make the vision and ambition for the engineering industry more visible. **The Academy could bring people together to define and publish this vision for the future of engineering (25).**

(27) Information flows – Make what it is like to work in engineering more visible for a wide range of people. **Here leaders could play a role (28), by sharing stories about their day-to-day work on social media.**

II. Engineering education

Do I want to work in the engineering industry?

At the end of your secondary education, you are deciding if you want to work in the engineering industry. How attractive working in engineering is to you (29) depends on how positive your experience studying engineering was (30), which is influenced by the inclusiveness of engineering education (31), and the same variables in box 12 that made you choose to study engineering. Only now you have been more exposed to engineering (17) which might have altered how you relate to the variables in box 12.

Your experience throughout your education also influences the inclusiveness of your own behaviour (32), increasing with the amount and quality of EDI education you have received (33), which increases with the amount of focus on EDI in engineering education (34), which itself increases with the amount of funding for research on EDI in engineering (35).

Influence on the diversity of the stream of engineers

There are many reasons why individuals who are currently underrepresented in the engineering industry are less likely to choose to work in engineering than those who are part of the majority. For example, because the experience studying engineering is likely to have been more negative (30), as they felt less included, making working in engineering less attractive (29).

Places to intervene

(36) Information flows – Providing high quality EDI education increases the inclusiveness of the behaviour of individuals (32).

(37) Resource flows – To increase the amount of focus on EDI in engineering education (34), funding for research on EDI is needed.

III. Engineering industry

Which company will I work for?

Once you have decided that you want to work in the engineering industry, unless you are looking to start your own company, you will be looking to find a company you can work at (**Figure 18**). This decision will depend on how attractive a specific engineering company is to you (1) and how likely you are to get a job at a specific company (2).

How attractive a specific engineering company is to you increases with:

- how well the company's culture and values match yours (3)
- how included you expect you will feel at this company (4), which is influenced by the visibility of the EDI ambition of the company (5) and the visibility of EDI metrics to applicants (6), which depends on the availability of EDI data (7)
- the extent to which you expect you will be able to work at your best at this company (8).

The more attractive a specific engineering company is to you (1), the more likely you are to apply for a job at that company (9). This likelihood also increases with how attractive the job description is to you (10) and how well you believe you fit the job description (11). These are both influenced by the inclusiveness of the job description (12).

You can only get a job (2) if you apply for it (9). Additionally, how likely you are to get a job at a specific company (2) increases with:

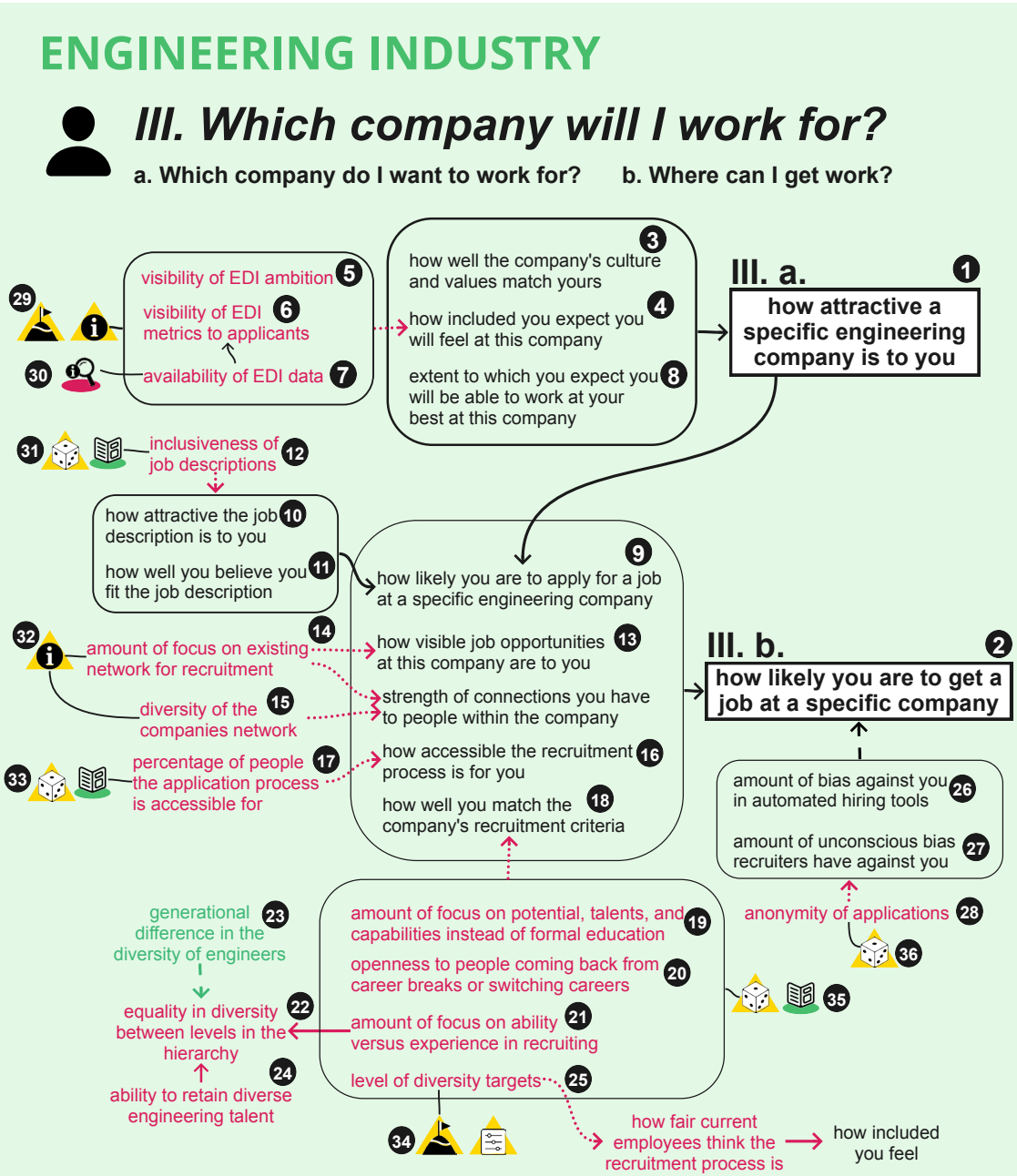


Figure 18: Choice of engineering company

- how visible job opportunities at this company are to you (13), which is influenced by how much recruiters for the company focus on existing networks (14). This, (14), also increases the importance of the strength of connections you have to people within the company, which is also influenced by the diversity of the company's network (15)
- how accessible the recruitment process is for you (16), which is influenced by the percentage of people the application process is accessible for (17). If you belong to the majority group of applicants, the recruitment process is more likely to be accessible for you.
- how well you match the company's recruitment criteria (18), which is influenced by:
  - amount of focus the company puts on potential, talent, and capabilities instead of formal education (19)
  - openness to people coming back from career breaks or switching careers (20)
  - amount of focus on ability versus experience in recruiting (21), which increases the equality in diversity between levels in the hierarchy (22). This, (22), also increases with a decrease in the generational difference in the diversity of engineers (23) and increases with the ability to retain diverse engineering talent (24)
- level of diversity targets (25).

How likely you are to get a job at a specific company (2) decreases, when the amount of bias against you in automated tools (26) increases and when the amount of unconscious bias recruiters have against you (27) increases, which reduces when the anonymity of applications (28) increases.

Influence on the diversity of the stream of engineers

Individuals who are currently underrepresented in the engineering industry are less likely to work for an engineering company than those who are part of the majority, for example:

- They are less likely to expect to feel included (4) and that they will be able to work at their best at this company (8).
- They are less likely to be attracted to (10) or believe that they fit the job (11), based on the job description and are therefore less likely to apply for the job (9).
- Job opportunities can be less visible to them (13), if the company focuses on their existing network for recruitment (14).
- The recruitment process is less likely to be accessible for them (16).
- There is likely to be more bias against them in automated hiring tools (26) and recruiters (27).
- They are less likely to match the recruitment criteria (18).

Places to intervene

(29) Information flows and Goals – Making the EDI ambition and metrics more visible to applicants will increase how included individuals who are underrepresented expect they will feel at the company, making it more attractive for them. To make this possible, EDI data needs to be collected (30) and an EDI ambition has to be developed for the company.

(31) Rules and Guidelines – Setting the rule that job descriptions need to be inclusive makes the job attractive for a more diverse range of people. **The Academy could create and publish guidelines on how to make job descriptions more inclusive.**

(32) Information flows – Reducing the focus on the company's existing network or making the network more diverse increases the diversity of the range of people for whom the job opportunity is visible.

(33) Rules and Guidelines – Setting the rule that the application process needs to be accessible makes the application process accessible for more people (16). **The Academy could create and publish guidelines on how to make the application process accessible to a more diverse range of people.**

(34) Goal or Parameter – Putting in place a diversity target adds a new goal, which can encourage changes in system structure order to reach this goal. For these changes to happen, the target needs to be backed up with the mindset in the company that diversity is valuable. Without this the diversity target is just an empty number and risks reducing how included individuals who are underrepresented feel, making them wonder if they are there just to fill a quota. This can trigger microaggressions from people who believe they do not 'deserve' to be there and that the recruitment standards have been lowered to reach diversity targets.

(35) Rules and Guidelines – Changing the recruitment criteria can make the range of people who match them more diverse. **The Academy could provide guidelines for inclusive recruitment criteria.**

(36) Rules – Making applications anonymous reduces the bias in automated tools and people. There tends to be more bias against people who are currently underrepresented, therefore this increases the diversity of the range of people who can get a job at the company.

IV. Company X

Is this the best place for me to work? Do I want to stay here?

After working at a specific engineering company for a while, you are likely to consider if this is the best place for you to work at and if you want to stay there (**Figure 19**). This decision is influenced by how included you feel at this company, your ability to perform at your best and your ability to realise your professional development goals.

Do I feel included at this company?

The extent to which you feel included (1) increases with:

- extent to which the work environment and ways of working match your needs (2), which is influenced by the inclusiveness of the work environment and ways of working (3)
- how included you feel by the behaviour of your leaders and colleagues (4), which is influenced by the overall inclusiveness of behaviour (5)
- variables (6) that are influenced by the inclusiveness of the organisational culture (7):
  - how well your personal values match the organisational values
  - how able you are to understand cultural norms and symbols
  - strength of your personal relationships with colleagues
- how included you feel by organisations the company interacts with (8), which is influenced by the inclusiveness of organisations the company interacts with (9).

The inclusiveness of organisational culture (7) increases the inclusiveness of behaviour (5) and vice versa.

The inclusiveness of behaviour (5) is part of a reinforcing feedback loop, where the overall behaviour of the collective influences the behaviour of individuals and vice versa:

- When the inclusiveness of behaviour increases (5), the percentage of people who are being listened to increases (10), which is likely to increase the extent to which you personally feel listened to (11), increasing how psychologically safe you feel (12), reducing your:
  - worry about asking for too much (13), which increases when others gaslight you when you speak up about your experience (14)
  - worry about causing upset (15)
  - fear of saying the wrong thing (16).

A decrease in these fears (13, 15, 16) in turn increases the likelihood that you will call out when you or others are not being included (17), increasing the overall likelihood of non-inclusive behaviour and structures being called out (18), which increases how much your own behaviour is being acknowledged (19), which increases the likelihood that you will change your behaviour towards more inclusiveness (20), which is further increased by an increase in psychological safety (12). Increasing the likelihood that you will change your behaviour towards more inclusiveness (20) over time increases the inclusiveness of your behaviour (21), which closes the loop by further increasing the overall inclusiveness of behaviour.

The likelihood that you will call out when you or others are not being included (17) is also part of a smaller reinforcing feedback loop: When the likelihood that you will call out when you or others are not being included (17) increases, it increases the overall likelihood of non-inclusive behaviour and structures being called out (18), which increases how often you see others speak up about non-inclusive behaviours and structures (22), which further increases the likelihood that you will call out when you or others are not being included.

It is important to remember that these reinforcing feedback loops can also spiral downwards, where a decrease in one of the variables leads to decreases in the others.

One detail in the first loop is that if the likelihood that you will change your behaviour towards more inclusiveness (20) decreases, it means that the inclusiveness of your behaviour (21) remains the same, not that it goes down. No variables that would reduce the inclusiveness of someone's behaviour (box 23) have been discussed throughout this process.

The likelihood that you will change your behaviour towards more inclusiveness (20) increases with:

- how much your behaviour is being acknowledged (19), which also increases with (box 24):
  - how likely you will be held accountable for non-inclusive behaviour
  - strictness of consequences for continued non-inclusive behaviour
  - reward or recognition you (or others) have received for inclusive behaviour
- how often you can conduct safe experiments to try out new behaviours (25)
- how frequently you are nudged/reminded to practise inclusive behaviour (26)
- how open you are to change (27)
- how self-aware you are (28), which increases with (box 29):
  - how often you step back to reflect on your own behaviour
  - amount and quality of interaction with people who are different from you
  - how aware you are of the challenges others face
  - how aware you are of your privileges
  - These four variables increase with the amount of access you have to mentoring (30), which is influenced by the overall amount and inclusiveness of mentoring at the company (31).

COMPANY X

IV. Is this the best place for me to work? Do I want to stay here?

a. Do I feel included at this company?

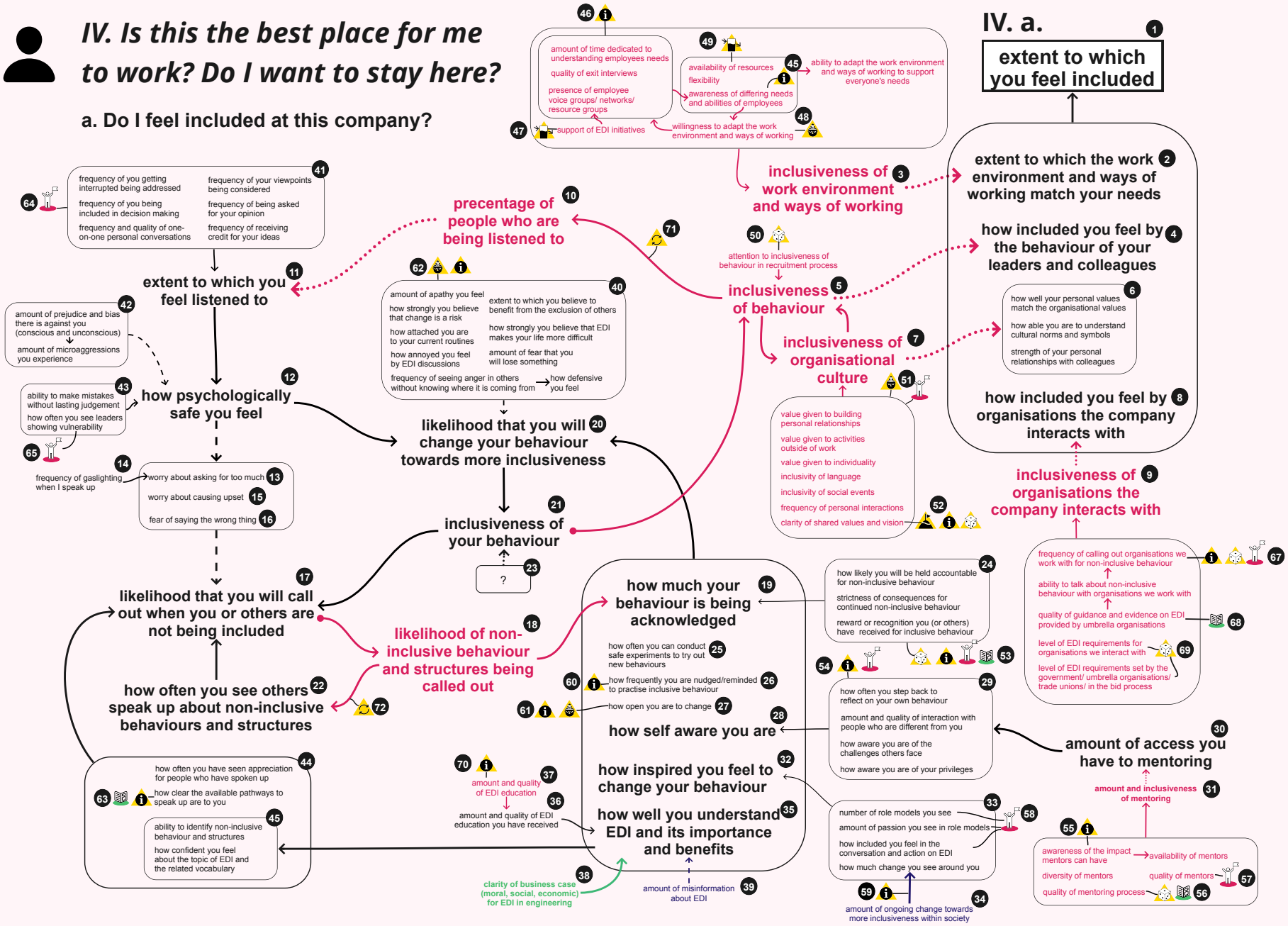


Figure 19: Experience of inclusiveness

- how inspired you feel to change your behaviour (32), which increases with (box 33):
  - number of role models you see
  - amount of passion you see in role models
  - how included you feel in the conversation and action on diversity and inclusion
  - how much change you see around you, which increases with the amount of ongoing change towards more inclusiveness within society (34)
- how well you understand EDI and its importance and benefits (35), which increases with:
  - amount and quality of EDI education you have received (36), which increases with the amount and quality of EDI education the company provides (37)
  - clarity of business case (moral, social, economic) for EDI in engineering (38)
  - and decreases with the amount of misinformation about EDI (39) that circulates in society.

The likelihood that you will change your behaviour towards more inclusiveness (20) decreases with an increase in (40):

- amount of apathy you feel
- how strongly you believe that change is a risk
- how attached you are to your current routines
- how annoyed you feel by EDI discussions
- extent to which you believe you will benefit from the exclusion of others
- how strongly you believe that EDI makes your life more difficult
- amount of fear that you will lose something, for example, privileges, opportunities, status
- frequency of seeing anger in others without knowing where it is coming from, which increases how defensive you feel.

The extent to which you feel listened to (11) also increases with (box 41):

- frequency of you getting interrupted being addressed
- frequency of you being included in decision making
- frequency and quality of one-on-one personal conversations
- frequency of your viewpoints being considered
- frequency of being asked for your opinion
- frequency of receiving credit for your ideas.

How psychologically safe you feel (12) decreases when the amount of prejudice and bias there is against you (conscious and unconscious) increases, which increases the amount of microaggressions you experience (box 42).

How psychologically safe you feel (12) increases with (box 43) the ability to make mistakes without lasting judgement and how often you see leaders showing vulnerability.

The likelihood that you will call out when you or others are not being included (17) also increases with (box 44):

- how often you have seen appreciation for people who have spoken up
- how clear the available pathways to speak up are to you
- how well you understand EDI and its importance and benefits (35) which increase (box 45) your ability to identify non-inclusive behaviour and structures and how confident you feel about the topic of EDI and the related vocabulary.

COMPANY X

IV. Is this the best place for me to work?
Do I want to stay here?

b. Can I perform at my best at this company?

c. Can I realise my professional development goals?

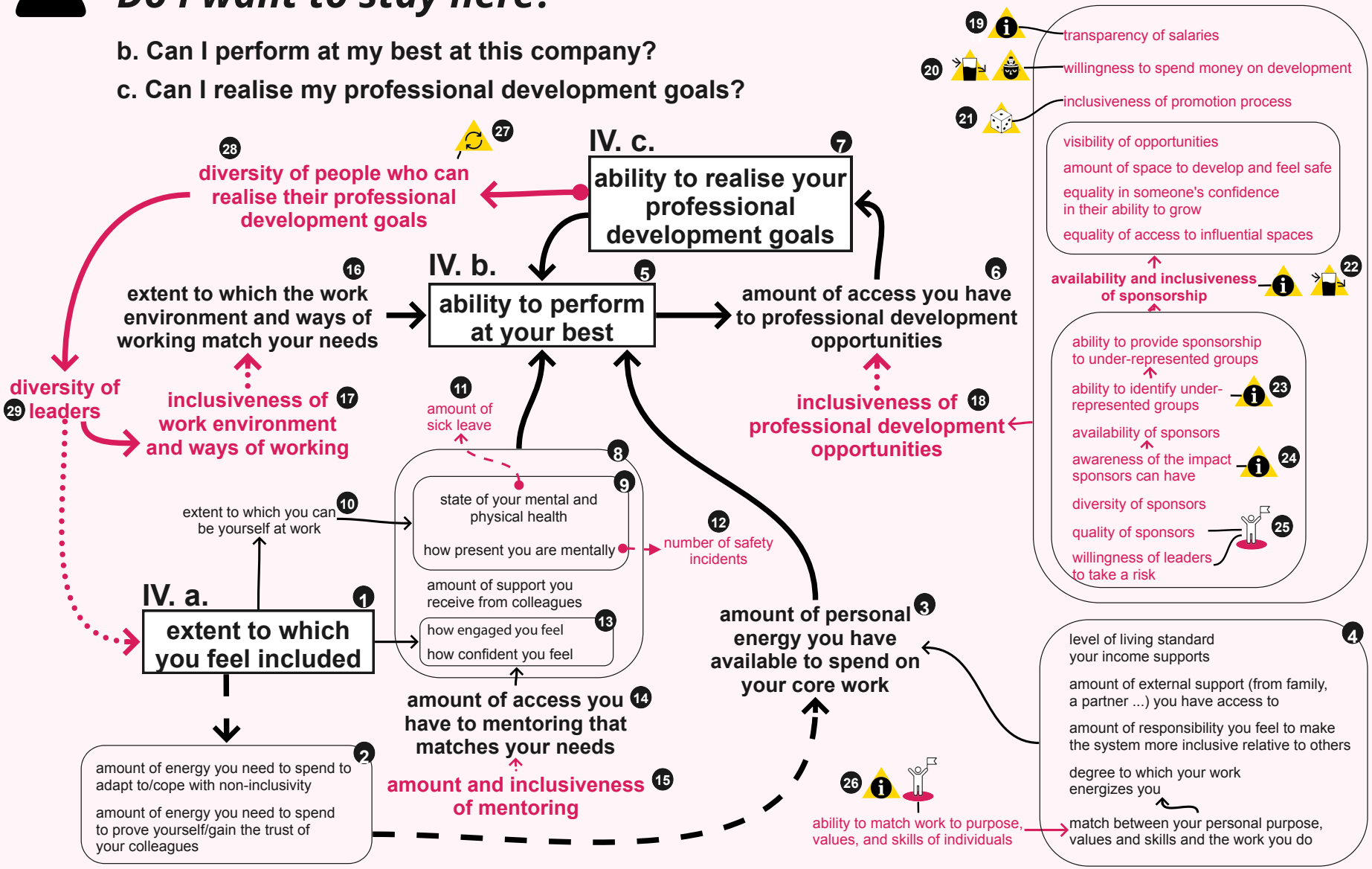


Figure 20: Professional development

Can I perform at my best at this company? Can I realise my professional development goals?

An increase to the extent to which you feel included (1) leads to a decrease in (box 2) the amount of energy you need to spend to adapt to/cope with non-inclusivity and to prove yourself/gain the trust of your colleagues, which increases the amount of personal energy you have available to spend on your core work (3). This (3) also increases with (box 4):

- level of living standard your income supports
- amount of external support (from family, a partner ...) you have access to
- amount of responsibility you feel to make the system more inclusive relative to others
- degree to which your work energises you, which increases with the level of match between your personal purpose, values, and skills and the work you do, which increases with the ability of your employer to match work to the purpose, values, and skills of individuals.

An increase in the amount of personal energy you have available to spend on your core work (3) increases your ability to perform at your best (5), which increases the amount of access you have to professional development opportunities (6), increasing your ability to realise your professional development goals (7), further increasing your ability to perform at your best (5).

Your ability to perform at your best (5) also increases with (box 8):

- the state of your mental and physical health (box 9), which decreases the overall amount of sick leave (11) and how present you are mentally, which reduces the overall number of safety incidents (12). Both variables increase with the extent to which you can be yourself at work (10), which itself increases with the extent to which you feel included (1)
- amount of support you receive from colleagues
- how engaged you feel and how confident you feel (box 13), both of which increase with the extent to which you feel included (1) and the amount of access you have to mentoring that matches your needs (14), which itself is influenced by the overall amount and inclusiveness of mentoring (15).

Additionally, your ability to perform at your best (5) increases with the extent to which the work environment and ways of working match your needs (16), which is influenced by the overall inclusiveness of the work environment and ways of working (17).

The amount of access you have to professional development opportunities (6) is influenced by the overall inclusiveness of professional development opportunities (18).

Influence on the diversity of the stream of engineers

Individuals who are currently underrepresented in the engineering industry are less likely to continue working in an engineering company than those who are part of the majority, for example:

Figure 19:

- They are less likely to feel included (1) because the work environment and ways of working are not designed for their needs (2).
- They are less likely to feel included by the behaviour of leaders and colleagues (4).
- Their personal values are less likely to match the organisational values, they are less likely to understand cultural norms and symbols, and their personal relationship with colleagues might not be as strong (6).
- They are less likely to feel included by organisations the company interacts with (8).
- They are less likely to feel listened to (11) and thus not feel psychologically safe (12), combined with being more likely to experience gaslighting (14), this means they are less likely to call out when they or others are not being included (17).
- They are less likely to be mentored organically (30), as people tend to mentor others who they can see themselves in.

Figure 20:

- They are less likely to be able to perform at their best (5) because:
  - the work environment and ways of working are less likely to match their needs (16)
  - they likely need to spend more energy to adapt to/cope with non-inclusivity and to prove themselves/gain the trust of their colleagues (2)
  - they are likely to feel less included (1), making them feel less engaged and confident (13) and meaning that they can be themselves less, reducing their mental health and mental presence (9).
- They are likely to have less access to professional development opportunities (6) and are therefore less likely to be able to realise their professional development goals (7).
- They are less likely to have access to mentoring and the available mentoring is less likely to match their needs (14).

Places to intervene

See **Figure 19: Experience of inclusiveness**.

Multiple leverage points help to increase the inclusiveness of the work environment and ways of working (3):

(46) Information flows – Before we can adapt the work environment to match the employees' needs, we first need to find ways to discover what those needs are in order to become aware of them (box 45), employee voice groups can be one source of information, therefore they need to be supported with the necessary resource flows (47). Exit interviews can also be a source of information, but the priority should of course be on understanding people's needs before they decide to leave.

(48) Mindset – Increasing awareness of differing needs also increases the motivation and willingness to adapt the work environment.

(49) Resource flows – Next to knowledge about people's needs we also need to have the necessary resources available to adapt to the work environment.

(50) Rules – Making the inclusiveness of behaviour a criterion in the recruitment process increases the overall inclusiveness of the behaviour at the company (5).

(51) Mindset and Leadership – The organisational culture manifests in behaviours which result from the beliefs and values. It is the role of leaders to enact and reinforce these values through their behaviour and by encouraging a similar behaviour in others. An inclusive culture values building personal relationships, dedicating time to activities outside of work and individuality. It therefore encourages using inclusive language, making sure that social events are inclusive, and that there are frequent social interactions.

(52) Goals, Information flows, and Rules – Making the shared values and visions for the team clear for everyone, makes it easier to work towards the same goal together. At the same time this is also about giving everyone equal access to the information and explaining the rules of social interaction for the group.

(53) Rules, Information flows, Leadership, and Guidelines – An important variable that influences the likelihood of someone changing their behaviour towards more inclusiveness (20) is how much their behaviour is being acknowledged, which can be recognition for inclusive behaviour or consequences for non-inclusive behaviour (box 24). These consequences are part of rules on how to interact with each other and they provide an information flow, giving people feedback about their behaviour. Publicly acknowledging inclusive behaviour, reinforces the effect of role models. It is the role of leaders to provide this feedback. **The Academy could provide guidelines on ways to acknowledge the inclusiveness of behaviour.**

(54) Information flows and Leadership – Self-awareness is key to the ability to change one's own behaviour. Actions that allow us to gain more information about ourselves are, for example, stepping back to reflect and interact with people that are different from us, making us more aware of the challenges others face and our privileges. Mentoring, including 'reverse' mentoring, can increase the frequency of these activities, especially when the group of available mentors is diverse. Because of their role model function, it is especially important for leaders to work on their self-awareness to increase the inclusiveness of their behaviour.

(55) Information flows – Increasing the awareness of the impact mentors can have can increase the availability of mentors.

(56) Rules and Guidelines – The amount of impact that mentoring has is influenced by the quality of the mentoring process. **The Academy could explore and publish guidelines for an effective mentoring process.**

(57) Leadership – It is the role of leaders to provide good mentoring.

(58) Leadership – It is the role of leaders to passionately model inclusive behaviour and to include everyone in the conversation and actions about EDI. This will help to inspire others to change their behaviour (32).

(59) Information flows – Change towards more inclusiveness happening in society at large can provide an extra source of inspiration for people to change their behaviour. Discussing these changes within the organisation can help to reinforce this information flow.

(60) Information flows – Adding small information flows in the form of reminders and nudges helps people to remember to work on changing their behaviour.

(61) Mindset and Information flows – For some people, their lack of openness to change can be what is holding them back from changing their behaviour. Understanding and addressing the underlying fears can help to remove this barrier.

(62) Mindset and Information flows – The mindsets in box 40 can stop people from changing their behaviour. Addressing and discussing the underlying assumptions can help to remove this barrier.

(63) Information flows and Guidelines – The clarity of information pathways to speak up about non-inclusive behaviour have a strong influence on the likelihood that someone speaks up. **The Academy could develop and publish guidelines on how to set up these pathways to provide safe ways to speak up.**

(64) Leadership – It is the role of leaders to create a psychologically safe space (12). Making people feel listened to is one key aspect of this (11).

(65) Leadership – Another way that leaders can increase psychological safety is by showing vulnerability.

(67) Information flows, Rules, and Leadership – Calling out other organisations for non-inclusive behaviour provides them with feedback and needs to be backed up by the ability to talk about non-inclusive behaviour. Making calling out non-inclusive behaviour of other organisations a rule increases its frequency. **Leaders should take on the responsibility of calling out non-inclusive behaviour of other organisations.**

(68) Guidelines – **The Academy providing guidance and evidence on EDI can increase the ability to have this conversation with other organisations.**

(69) Rules – Individual organisations setting EDI requirements for the organisations they choose to interact with as well as EDI requirements set by higher institutions (including government, umbrella organisations, trade unions) can help to increase the overall inclusiveness of engineering companies.

(70) Information flows – Providing education on EDI increases how well individuals understand EDI and its importance and relevance (35), making them more likely to change their behaviour towards more inclusiveness (20) and increasing the ability to identify non-inclusive behaviours and structures as well as increasing the confidence about using the EDI-related vocabulary (box 45). Together this will increase the likelihood that people speak up about non-inclusive behaviours and structures (22).

(71) Feedback loops – The inclusiveness of behaviour (5) is part of a reinforcing feedback loop, where the overall behaviour of the collective influences the behaviour of individuals and vice versa. When the inclusiveness of behaviour increases (5), the percentage of people who are being listened to increases (10), which is likely to increase the extent to which you personally feel listened to (11), increasing how psychologically safe you feel (12), reducing your:

- worry about asking for too much (13), which increases when others gaslight you when you speak up about your experience (14)
- worry about causing upset (15)
- fear of saying the wrong thing (16).

A decrease in these fears (13, 15, 16) in turn increases the likelihood that you will call out when you or others are not being included (17), increasing the overall likelihood of non-inclusive behaviour and structures being called out (18), which increases how much your own behaviour is being acknowledged (19), which increases the likelihood that you will change your behaviour towards more inclusiveness (20), which over time increases the inclusiveness of your behaviour (21), which closes the loop by further increasing the overall inclusiveness of behaviour.

Implementing the measures discussed above (50, 51, 52, 53, 54, 58, 59, 60, 61, 63, 64, 65, 70), increase the variables that are part of this loop, which ensures that the reinforcing feedback loop spirals in the desired direction, increasing the inclusiveness of behaviour (5).

(72) Feedback loop – The likelihood of non-inclusive behaviour and structures being called out (18) is part of a reinforcing feedback loop: When the likelihood of non-inclusive behaviour and structures being called out (18) increases, it increases how often you see others speak up about non-inclusive behaviours and structures (22), increasing the likelihood that you will call out when you or others are not being included (17), which further increases the likelihood of non-inclusive behaviour and structures being called out (18).

Implementing the measures discussed above (63, 70), increases the variables that are part of this loop, which ensures that the reinforcing feedback loop spirals in the desired direction, increasing the likelihood that non-inclusive behaviours and structures are being called out (18) (see **Figure 20**).

There are many places to intervene to increase the inclusiveness of professional development opportunities:

(19) Information flow – Making salaries transparent adds an information flow that can make salaries more fair.

(20) Mindset and Resources flow – The mindset on the importance of spending money on development determines the resource flow towards development.

(21) Rules – The inclusiveness of the promotion process.

(22) Information flows and Resource flows – Sponsorship provides access to information and resources:

- it increases the visibility of opportunities
- gives space to develop and feel safe
- gives people confidence in their ability to grow
- provides access to influential spaces.

(23) Information flows – To make sponsorship more inclusive we first need to know who the underrepresented groups are.

(24) Information flows – Raising awareness of the impact sponsors can have can increase the availability of sponsors.

> **An increase in the diversity of leadership increases how included individuals who are underrepresented feel**

(25) Leadership – **It is the role of leadership to provide sponsorship.** To make their sponsorship inclusive, they need to be willing to take a risk.

(26) Information flows and Leadership – To be able to match the work assigned to individuals with their purpose, values, and skills, pathways need to be put in place to find out about these characteristics of individuals. **This will often be the responsibility of leaders.**

(27) Feedback loop – When the ability to realise their professional development goals increases for individuals who are currently underrepresented at the company (7), it increases the diversity of people who can realise their professional development goals (28), increasing the diversity of leaders (29), influencing the extent to which individuals feel included (1), increasing their ability to perform at their best (5), increasing the amount of access they have to professional development opportunities (6), further increasing their ability to realise their professional development goals (7).

An increase in the diversity of leaders (29) likely leads to an increase in the inclusiveness of the work environment and ways of working, ultimately also increasing the ability of individuals to realise their professional development goals (7), leading to a further increase in the diversity of leaders (29).

Increasing the inclusiveness of professional development opportunities (18) ensures that this reinforcing feedback loop spirals in the desired direction. An increase in the diversity of leadership increases how included individuals who are underrepresented feel, increasing the likelihood that they will reach leadership positions. However, the loop is currently working in the opposite direction in many companies. The low diversity of leadership leading to underrepresented individuals not feeling included and making them less likely to reach leadership positions.

V. Engineering industry

Do I want to keep working in engineering?

If you decide to leave your current company, you will have to consider if you want to keep working in engineering (**Figure 21**). This decision is influenced by:

- how included you feel in the engineering industry (1)
- your ability to perform at your best in the engineering industry (2)
- your ability to realise your professional development goals in the engineering industry (3).

These in turn are influenced by the same variables at the level of the engineering industry (4), which in turn increase with the same variables within individual companies (5).

Influence on the diversity of the stream of engineers

Individuals who are currently underrepresented in the engineering industry are less likely to choose to keep working in engineering than those who are part of the majority, for example:

- they are less likely to feel included in the engineering industry
- they are less likely to perform at their best within the engineering industry
- they are less likely to be able to realise their professional development goals within the engineering industry.

This was the last map that centres around the experience of the individual. From here we will move to the level of the company and society.

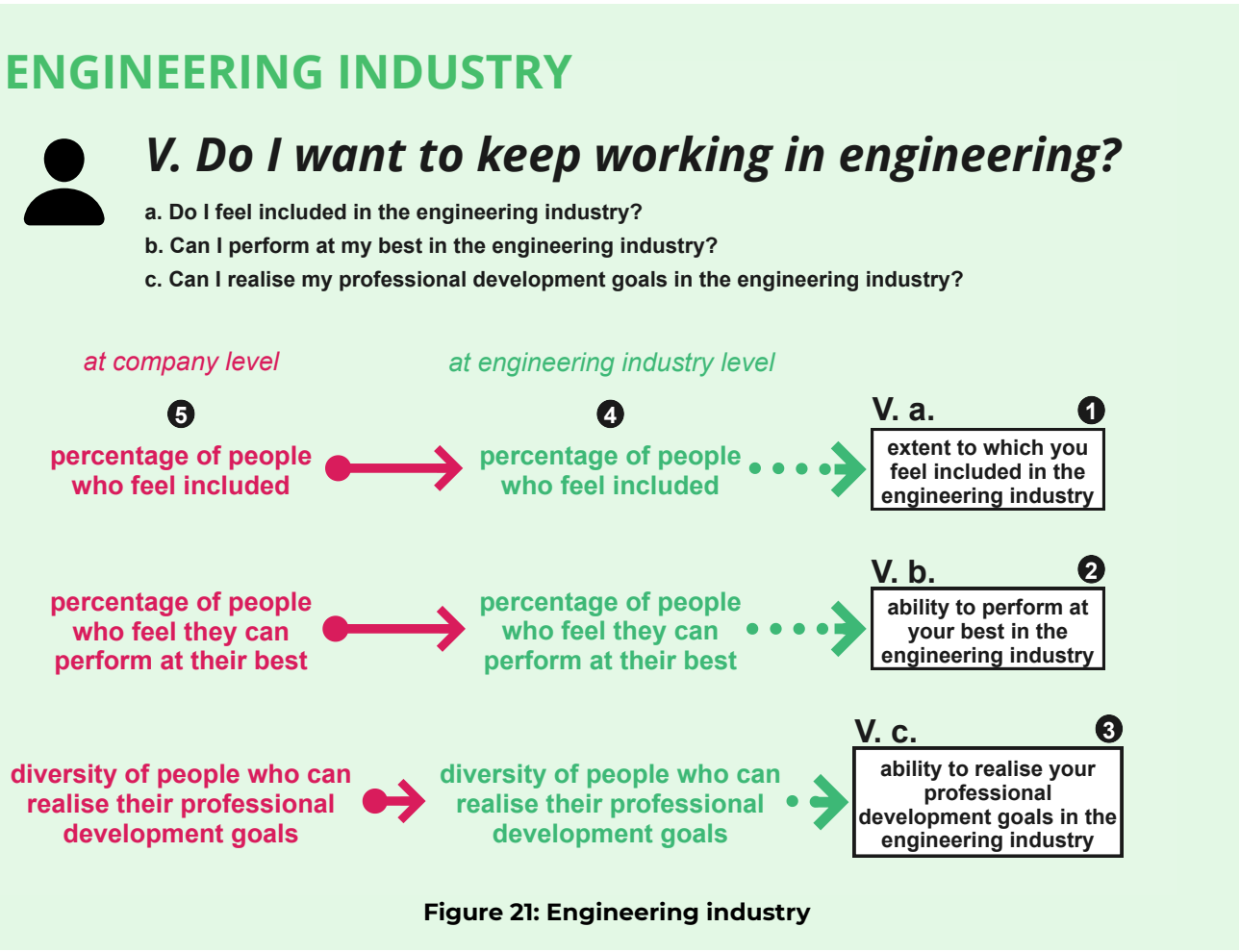


Figure 21: Engineering industry

Places to intervene

The places to intervene are described based on **Figures 17 through 23**.

A. Company X

Can we draw on diversity to provide good engineering solutions for society?

From the perspective of the company, the ability to draw on diversity to provide good engineering solutions for society, the quality of outcome (1), depends on the level of diversity (2) and the percentage of people who feel they can perform at their best (3), being at high levels simultaneously (**Figure 22**).

When both variables (2) and (3) increase, it increases:

- the number of perspectives (4) and experiences the company has access to, meaning that fewer decisions have to be made based on assumptions (5), increasing the quality of decision making (6) when designing engineering solutions. An increase in the number of perspectives (4) can also increase the amount of conflict (7), but ultimately increases the amount of creativity (8), which increases the amount of innovation (10), as long as leaders are able to work with the conflicts that occur (9)
- the complementariness of skills, expertise, approaches, and so on (11), increasing team performance (12).

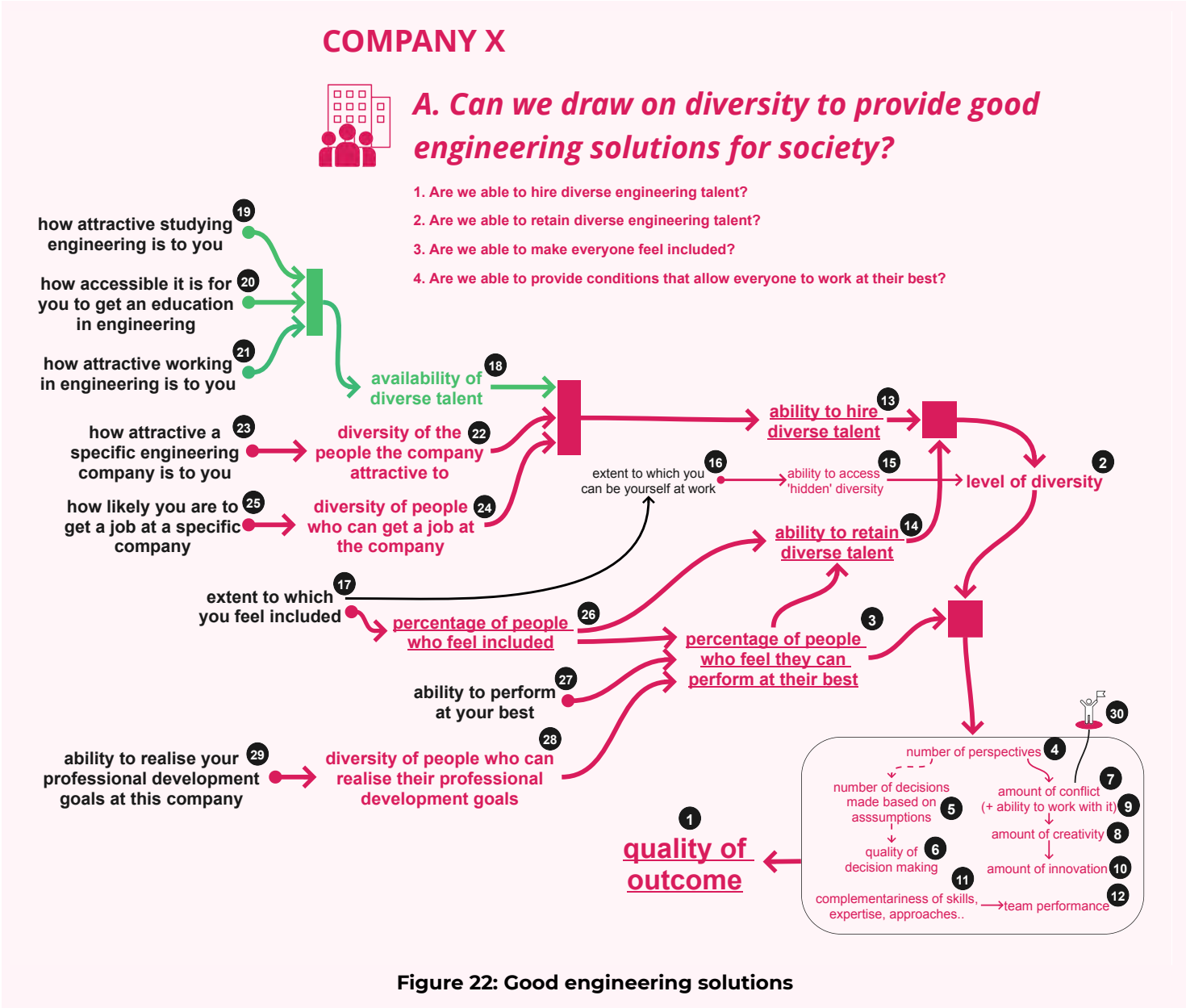


Figure 22: Good engineering solutions

The level of diversity (2) increases when the ability to hire diverse talent (13) and the ability to retain diverse talent (14) increase simultaneously. Additionally, the level of diversity (2) increases with the ability to access 'hidden' diversity (15), which emerges when the extent to which individuals can be themselves at work (16) increases, which increases with the extent to which individuals feel included (17).

The ability to hire diverse talent (13) increases when the following three variables increase simultaneously:

- availability of diverse talent (18), which increases if the following three variables increase simultaneously for individuals who are currently underrepresented at the company:
  - how attractive studying engineering is to them (19)
  - how accessible it is for them to get an education in engineering (20)
  - how attractive working in engineering is to them (21)
- diversity of the people the company is attractive to (22), which increases with the attractiveness of the company to individuals who are currently underrepresented at the company (23)
- diversity of people who can get a job at the company (24), which increases with the likelihood of individuals who are currently underrepresented at the company getting a job at the company (25).

The ability to retain diverse talent (14) increases with:

- the percentage of people who feel included (26), which increases with the extent to which individuals feel included (17)
- percentage of people who feel they can perform at their best (3), which increases with:
  - percentage of people who feel included (26)
  - ability of individuals to perform at their best (27)
  - diversity of people who can realise their professional development goals (28), which increases with the ability of individuals who are currently underrepresented at the company to realise their professional development goals (29).

Places to intervene

The majority of the places to intervene have been discussed around the previous figures, which show the variables that influence the starting variables in this figure (17, 19, 20, 21, 23, 25, 27, 29).

(30) Leadership – To combine different perspectives into creativity, **leaders need to be able to work with conflict.**

Leaders need to be able to work with conflict

B. Society

Can we draw on diversity to address big issues?

At the societal level, the ability to address big issues (such as climate change, social inclusion) (1) increases with the quality of outcomes from the engineering industry (2), which increases when the level of diversity (3) and the level of inclusiveness (4) in the engineering industry increase simultaneously (**Figure 23**). The overall level of diversity (3) and inclusiveness (4) in the engineering industry increases with the level of diversity (5) and inclusiveness (6) at individual companies. The level of inclusiveness of the engineering industry (4) also increases with the clarity of the business case (moral, social, economic) for EDI in engineering (7).

The quality of outcomes of the engineering industry (2) overall also increases with the quality of outcome from individual companies (7).

An increase in inclusiveness of the engineering industry increases the likelihood of the engineering sector to lobby/influence policy on EDI (9), increasing the quality of policy and laws on EDI at the societal level (10), further increasing the overall inclusiveness of the engineering industry (4).

The level of diversity (3), inclusiveness (4), and quality of outcomes (2) together increase how attractive working in engineering is to individuals who are currently underrepresented in engineering (11), which further increases the level of diversity (3). Diversity attracts diversity.

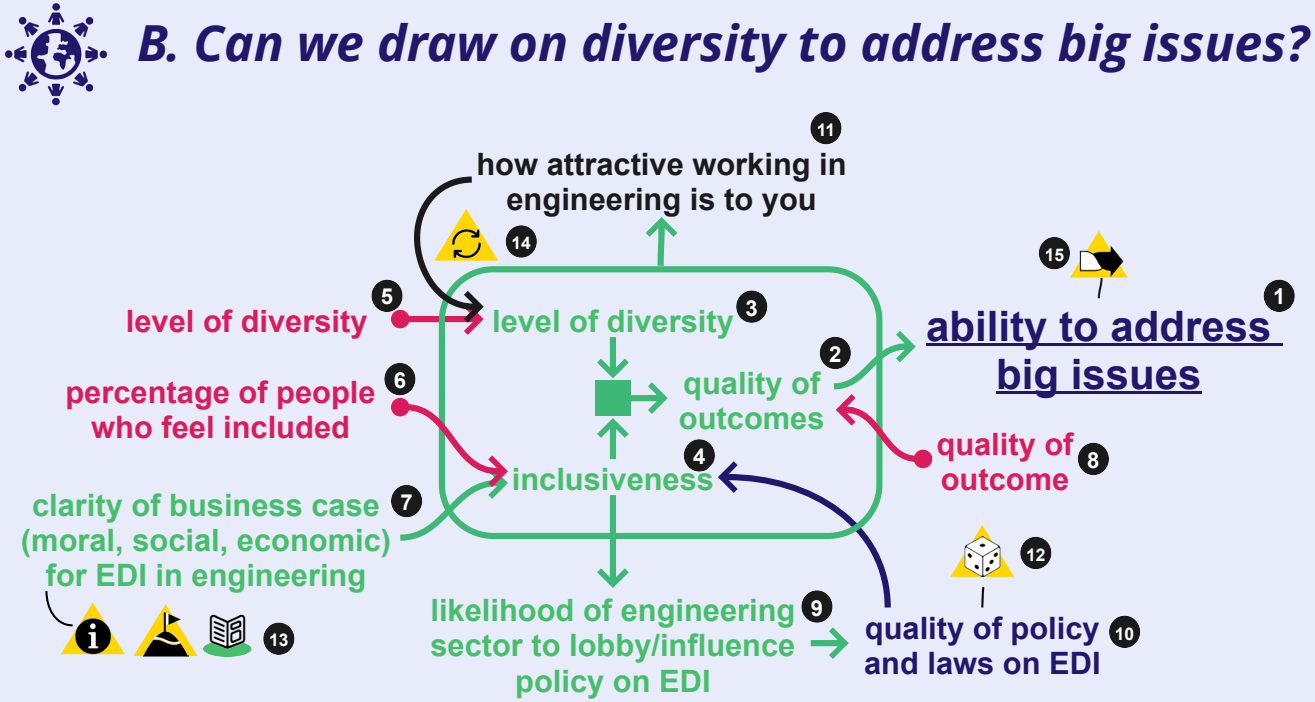


Figure 23: Societal issues

Places to intervene

(12) Rules – Policies and laws on EDI set by the government will increase the inclusiveness of the engineering industry.

(13) Information flows, Goals, and Guidelines – By making the business case for EDI in engineering clear, diversity and inclusion can become a goal for the engineering industry. **The Academy could provide a description of this business case.**

(14) Feedback loops – Shortening delays in this feedback loop: The current level of diversity, inclusiveness, and quality of outcomes in the engineering industry increases the attractiveness for people who are currently underrepresented in engineering to work in engineering, which further increases the level of diversity and quality of outcomes. This can, for example, be achieved by communicating what it is currently like to work in engineering to students and by sharing the ambition for engineering, as discussed in **Figure 17**.

(15) Ability to change system structure – Increasing diversity and inclusion increases society's ability to evolve, adapt to change, and address big issues.

Places to intervene and the implications for leaders

In **Figure 24** on the following page, we have brought together all the places to intervene that have been identified in the systems map and the areas where the Academy could provide guidelines.

Reinforcing feedback loops

The system contains multiple reinforcing feedback loops (summarised in **Figure 24**), which currently tend to reinforce low diversity and inclusiveness. To increase the diversity and inclusion in the system, we need to change the direction of these loops.

Each variable in the feedback loop is not only influenced by its neighbour in the loop, but also by forces outside of the loop, which push them up or down. To give the loop a large enough push to change its direction, the increasing influences need to be higher than the decreasing influences for several of the variables in the loop simultaneously. Therefore, it is important to address many of the places to intervene simultaneously. Once this initial push has been given and the feedback loops move in the desired direction, this movement will reinforce itself.

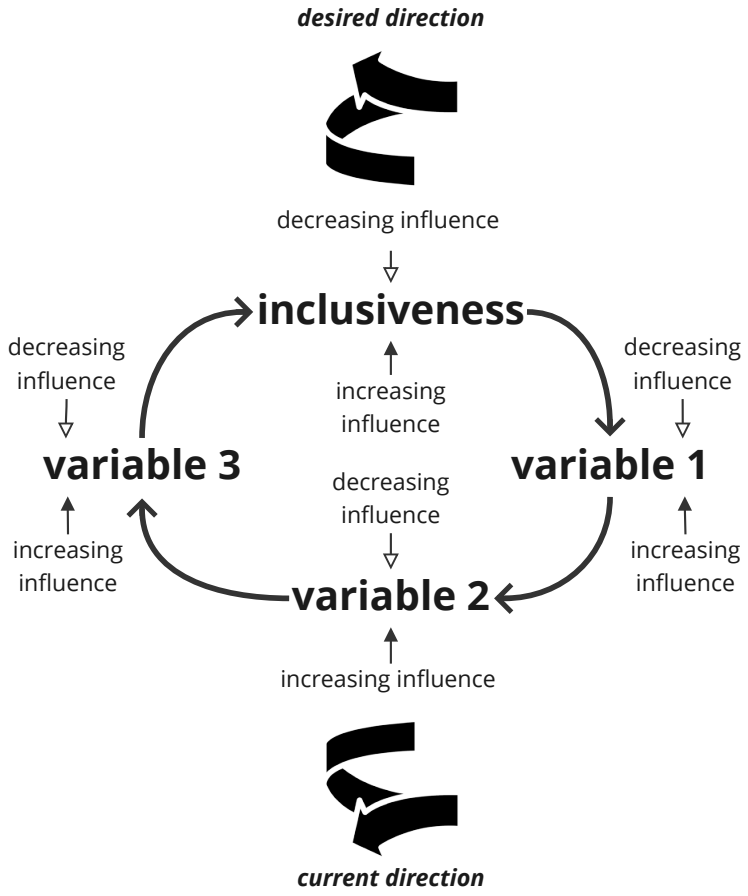


Figure 25: Feedback loops

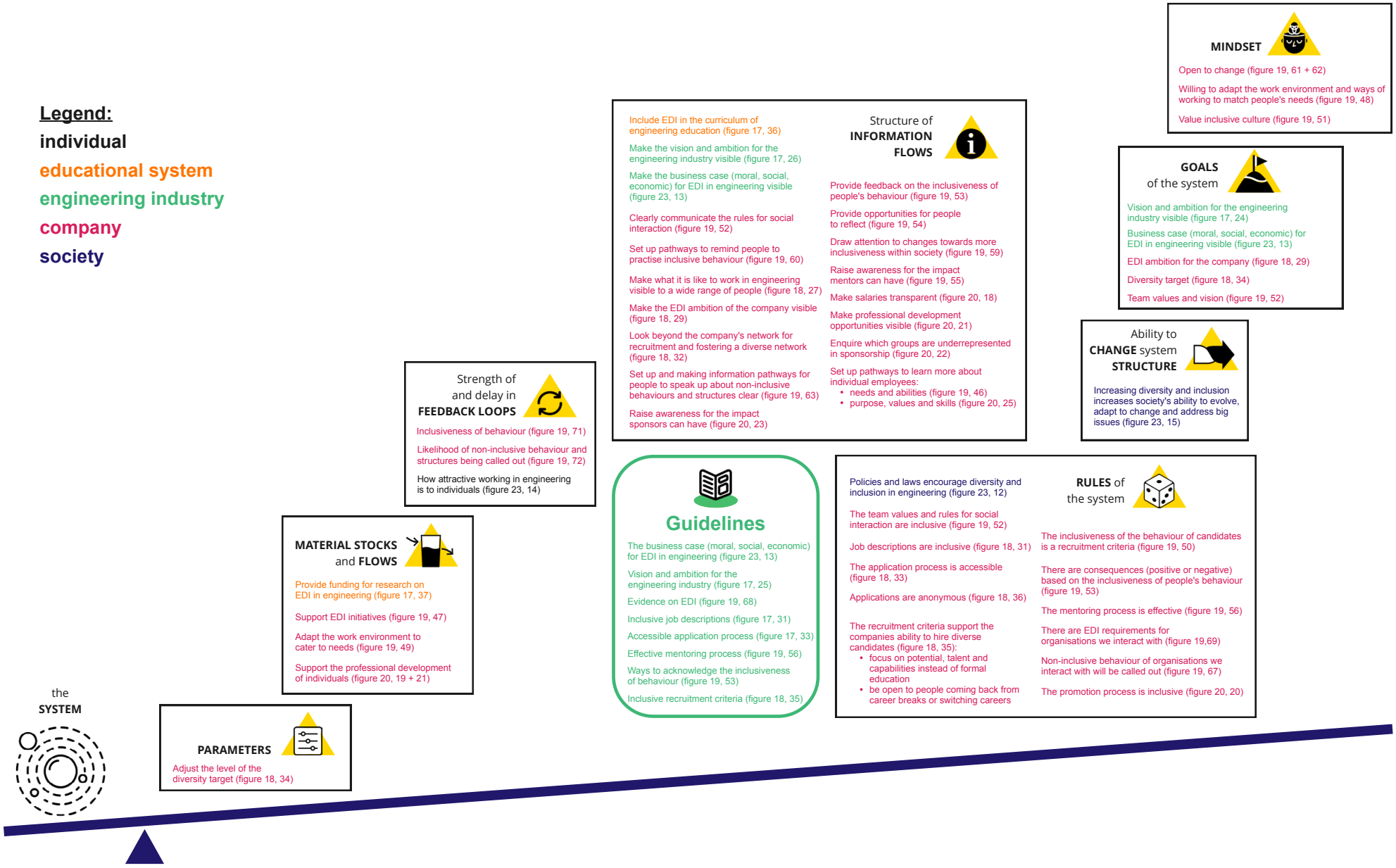


Figure 24: Overview of places to intervene in the engineering system

A coordinated push of interventions in multiple places is needed now, but once the reinforcing feedback loops start to move in the desired direction, the system should be able to sustain itself and some of these interventions will no longer be needed. For example, diversity targets can give a helpful push now, but as the system starts to move in the desired direction, we might be able to phase them out. As the mindsets of people change, behaviours that at first felt forced and needed reinforcement will become natural.

What makes this more challenging to achieve in practice is that the reinforcing feedback loops and the forces that influence them span over many areas of influence, including leverage points that leaders in engineering companies do not have direct access to. Therefore, it is important for leaders to start by implementing measures in their own companies, but from there also look outside and consider how they can increase their area of influence. Examples of this could include: by sharing stories about their work to increase the exposure of young people to engineering, by calling out non-inclusive behaviour from other organisations they interact with, or by lobbying for better legislation on EDI.

Leadership commitment

Senior leaders have a critical role to play in making the industry more inclusive. In **Figure 24** we have gathered all the places in the system where leaders can intervene.

In **Figure 26**, we have listed the mindsets, characteristics, and behaviours that are needed to increase the inclusiveness of leaders.

Although many of these interventions do not need to be executed by leaders themselves, they do require active commitment from senior leadership to ensure adequate resources. Making people and money available to get new initiatives off the ground and follow through for sustainable implementation.

Figure 26: Mindsets, characteristics, and behaviours of inclusive leaders

> **Senior leaders are important role models**

Inclusive leadership mindsets, characteristics, and behaviours

But commitment of leadership alone is not enough. The mindset, characteristics, and behaviour of senior leaders have a huge influence on diversity and inclusion within companies and the industry at large. Senior leaders who are authentic and inspiring in articulating the why for inclusive engineering, will be able to take the rest of the organisation along, as well as partners in their supply chain and other external stakeholders. Moreover, senior leaders are important role models, as employees are likely to look at the most senior levels in their organisation as an indication of what is acceptable and what is the norm. If senior leaders don't show inclusive behaviour, employees may not feel compelled to do so either.

Throughout the process, beliefs, characteristics, and behaviours have been identified that increase the inclusiveness of leaders. They are summarised below. In the next step in developing the inclusive leadership programme, the Academy has planned to explore what leaders need to help them adopt these mindsets and characteristics and to carry out these behaviours.

Inclusive leadership mindsets

Inclusive leaders believe that:

- sharing power is beneficial for everyone
- feedback helps them to improve and match their behaviour to people's needs
- change is needed and brings new opportunities
- everyone benefits when they continue to learn every day
- diversity is valuable in many ways
- taking risks opens up opportunities.

Inclusive leadership characteristics

Inclusive leaders are:

- self-aware
- approachable
- curious
- empathetic
- honest
- humble
- transparent
- passionate
- authentic
- courageous
- confident
- compassionate
- patient
- emotionally intelligent
- culturally aware.

Inclusive leadership behaviours

Storytelling

Leaders should be able and willing to share stories about their professional development and current work experience in engineering. This can increase the visibility of what it is like to work in engineering, to expose more people to the engineering profession, and make studying engineering attractive for a more diverse range of people (**Figure 17**, intervention point 28).

Needed knowledge and capabilities: To tell compelling stories about their work, leaders need to be approachable, authentic, and able to understand the perspective and interests of their audience. In addition, they need to be vulnerable and willing to share not only success stories, but also challenges they encounter.

Listening

Leaders should be effective listeners and be able to make people feel listened to through (**Figure 19**, intervention point 64):

- addressing when people are being interrupted
- including all voices in decision making
- one-on-one personal conversations
- considering people's viewpoints
- giving credit for ideas.

Needed knowledge and capabilities: A lot goes into being a good, active listener. It requires cognitive skills, understanding verbal and non-verbal communication and the ability to integrate that information. It requires emotional skills such as curiosity, humility, compassion, and patience. Active listening also includes behavioural skills, showing interest, and comprehension, both verbally and non-verbally.

Showing vulnerability

Leaders should be able to show vulnerability, to make others feel safe to open up (**Figure 19**, intervention point 65).

Needed capabilities: To show vulnerability, leaders need to feel safe and confident themselves. This requires self-awareness and a self-reflective learning attitude.

Learning continuously

To be able to adapt structures of the company and their own behaviour to the changing context, leaders need to learn continuously (**Figure 19**, intervention point 54). Leaders can learn through training, by listening to others and through reflection.

Needed capabilities: To learn continuously, leaders need to be humble, curious, and open to change.

> **Leaders should be able to show vulnerability, to make others feel safe to open up**

> **Leaders need to have a deep understanding of the nuances of inclusive or non-inclusive behaviour**

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Role modelling inclusive culture and behaviour

Leaders should be able to role model an inclusive culture, to set the tone and increase the inclusiveness of culture, by (**Figure 19**, intervention point 51):

- encouraging activities to strengthen personal relationships
- celebrating activities outside of work
- celebrating individuality
- guarding the inclusivity of social events
- developing and clarifying shared values and vision with the team.

Leaders should also be able to role model inclusive behaviour, to inspire others to change their behaviour towards more inclusiveness (**Figure 19**, intervention point 58).

Needed capabilities: To role model inclusive culture and behaviour, leaders need to be passionate about the need for inclusiveness and gain a deep understanding of what inclusive behaviour looks like. This will increase their confidence to act inclusively, even if others are not acting in that way yet.

Giving feedback on the inclusiveness of behaviour

Leaders should be able to give feedback on the inclusiveness of people's behaviour to support them in changing their behaviour, by holding people accountable for non-inclusive behaviour and by recognising and rewarding inclusive behaviour (**Figure 19**, intervention point 53). They should do this not only for the people working at their company, but also call out non-inclusive behaviour from other organisations they interact with (**Figure 19**, intervention point 67).

Needed capabilities: To be able to give feedback on the inclusiveness of behaviour, leaders need to have a deep understanding of the nuances of inclusive or non-inclusive behaviour, so they can identify it. From there, they also need to know appropriate ways to address this behaviour, provide feedback, and take appropriate action.

Including everyone in the conversation about EDI

Leaders should be able to include everyone in the conversation about EDI, to inspire them to change their behaviour towards more inclusiveness (**Figure 19**, intervention point 58).

Needed capabilities: To be able to include everyone in the conversation about EDI, leaders need to have a deep understanding of EDI as well as be able to enable dialogue.

Mentoring

Leaders should be able to mentor to support people in growing their self-awareness (**Figure 19**, intervention point 57) and to increase people's confidence and engagement (**Figure 20**, intervention point 13).

Needed capabilities: To be good mentors, leaders need to have high self-awareness and good mentoring skills, such as active listening, providing constructive feedback, and building trust.

Sponsoring

Leaders should be able to sponsor, to increase the inclusiveness of professional development opportunities (**Figure 20**, intervention point 25).

Needed capabilities: To be good sponsors, leaders need to be well connected to spot relevant opportunities for the people they sponsor. They also need to be willing to take a risk sponsoring people who might usually be overlooked.

Matching work to people's purpose, values, and skills

Leaders should be able to match the work they assign to the purpose, values, and skills of people, to increase the amount of energy individuals have available to spend on their core work (**Figure 20**, intervention point 26).

Needed capabilities: To match the work they assign to people's purpose, values, and skills, leaders need to be able to have meaningful conversations with people and an understanding of psychology and what motivates different kinds of people.

Working with conflict

Leaders should be able to work with conflict, to be able to combine different perspectives to increase creativity (**Figure 22**, intervention point 30).

Needed capabilities: Working with conflict is an essential aspect of facilitation skills that leaders should be familiar with.

Leadership at all levels

Leadership takes many different forms and shapes. It does not only exist at the top of organisations but can be found at all levels. As shown in the systems map, interventions that break through existing patterns and make room for new perspectives and ways of working are spread throughout organisations. Inclusive leadership skills can also be developed at different levels within organisations. This will create a more fertile soil for culture change throughout organisations and help to speed up the transition to a truly inclusive engineering industry.

When inclusive leadership becomes the norm throughout organisations, new ways of working can spread much faster. EDI issues will then not only be addressed top-down through strategic interventions and leading by example from the top, but also bottom-up, by young leaders, and within teams in their day-to-day collaborations.

The inclusive leadership development programme could thus include different target audiences:

- **Top-level leadership:** in which senior leaders within the engineering industry develop new knowledge and capabilities and can share their EDI experience and challenges with peers.
- **Early career leaders:** supporting employees at different stages in their professional careers to strengthen their skills as inclusive leaders and support them to develop in-company activism to initiate EDI interventions within their organisation.
- **Employee development:** through which any employee engages in EDI awareness and skills training, including topics such as unconscious bias, safe space, and deep listening.

Systemic in-company experiments

Making the engineering industry more diverse and inclusive is a systemic challenge. No single actor, variable, or lever alone will be able to achieve the desired change, not at the organisational level, nor in the industry, let alone in society. While this research has identified numerous leverage points and specific implications for leadership, the situation in each organisation will be unique, because of company size, sector, culture, history, composition of the workforce, and so on.

To further enhance learning in practice within the engineering industry, **the Academy could facilitate a few participatory EDI experiments in selected companies, as part of the inclusive leadership development pilot.** Building on the systems map produced in this report, a representation of stakeholders in each participating company will identify relevant intervention points to increase EDI in their own organisation. Based on this they will elaborate strategies and action plans together to start experimenting on the job with inclusive new ways of working. **The Academy can support this by setting up a knowledge structure to share lessons learned between participating companies and feed these lessons back into the larger leadership development programme.**

The on-the-job EDI experiments require a representation of the organisational system of each company, including senior leadership, the various underrepresented groups, employees from majority groups who are already open to and those who do not see the need for EDI, HR, future potential workforce, and so on. A diverse group will gather in a series of workshops per company to identify diversity and inclusion opportunities and challenges specific to their organisation. Based on the outputs, they will then design strategies and experiment with concrete actions to address these company-specific leverage points.

This systemic approach will enable actors at the organisational level to look at their own system and to explore context-specific answers to make change in their system. This will also allow senior leadership to apply newly acquired skills and discover what is needed to gain broad support and involve all employees in the process. **The lessons learned can be shared by the Academy with the engineering industry at large.**

> **Inclusive leadership skills can be developed at different levels within organisations**

EQUALITY means being able to participate on an equal basis with others in any area of economic, social, political, cultural, or civil life. Treating people equally is not about treating people the same but rather differently depending on their different circumstances.

DIVERSITY considers similarities and differences in terms of age, ethnicity, disability, gender, and religion; and less visible differences such as sexual orientation, disability, religion, educational background, personality type, nationality.

INCLUSION is about the culture, environment, and processes created by an organisation. It is measured by how people feel, and it needs effort to achieve. Creating a culture of inclusiveness is about establishing behaviours that support inclusion.