SYSTEMS SKILLS DEVELOPMENT – THE YELLOW BRICK ROAD APPROACH

Simon Swales
sswales@dstl.gov.uk

Jo Wright
Defence Science and Technology Laboratory (Dstl)
Porton Down, Salisbury, SP4 0JQ
jfwright@dstl.gov.uk

David Oxenham
daoxenham@dstl.gov.uk

ABSTRACT

Dstl has summarised the characteristics and skills that are typical of an effective systems person and identified a number of development stages to put together a programme to accelerate the movement of people from Stage 2 (supervised practitioner) to Stage 3 (practitioner) within 2-3 years compared to 5-10 years with no intervention.

Development starts by addressing underlying attitudes through increasing Emotional Intelligence. The remainder takes people out of the classroom and creates an environment in which they gain the necessary work experiences to meet their Stage 3 needs. Mentors from senior positions in the organisation are assigned to help participants see the bigger picture and challenge them to step out of their comfort zone.

The programme is close to achieving the original target for Stage 3 systems people within existing training budgets. Demand is also increasing and so the challenge is to expand the programme and transition it to business-as-usual.

Keywords

Systems skills, Emotional Intelligence, Development

1. INTRODUCTION

Dstl was established in 2001 as a trading fund of the UK's Ministry of Defence (MOD) with the remit to provide independent, high-quality Science and Technology (S&T) services to MOD, the UK armed forces and Government in those areas inappropriate for the private sector and to maintain the expertise and capabilities that were necessary to fulfil that role in the future. Since 2001, Dstl's programme has evolved to meet the changing needs of MOD and Government. This has resulted in increased emphasis on supporting operations at home and abroad, insuring against future threats and addressing the wider security agenda [4].

With a workforce numbering ~3,500, our people provide input to the development of defence and security policy and strategy, and advise on the ways in which S&T can impact on the strategy itself or support its delivery. Our critical success factors include "Understanding and delivering against the UK's defence and security priority issues" and "Skilled, innovative and motivated staff". To achieve these "We must consider complex and integrated systems from the perspective of our customers, suppliers and partners and understand the interfaces between them while challenging preconceptions" and "have the skills and expertise we need to do our work" [4].

Indeed, the range of work that we do and the challenges that we face are increasingly complex, and consequently adopting a holistic approach is vital. Consider an example that is closer to home – taking the kids to school. For many this might be in a car, but a systems approach needs to consider other factors such as the training needed to operate the car, someone to drive it, the availability of suitable roads, the rules of the road, the confidence that the road network will be maintained, the availability of maps and sources of fuel. They are all common sense considerations and, fortunately, can be taken for granted in this example, but this isn't the case with military capabilities.

Some recent examples of the impact we have made include: the production of new protection systems designed to protect Royal Navy personnel from pirates and other asymmetric threats [5]; improvements to vehicle armour systems and, in particular, fixtures that protect personnel on the inside of vehicles [6]; and the

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development of innovative armoured netting capable of stopping rocket propelled grenades [7].

Back in 2002, developing the people with the right skills and experience to meet these sorts of challenges was the motivation behind the start of a project to develop systems skills. This paper takes you through the approach taken by answering the following questions:

- What does a systems person in Dstl look like? (Section 2)
- How many do we have and need in the future? (Section 3)
- How do we develop them? (Section 4.1)
- Is the approach we have taken working? (Section 4.2)

2. WHAT DOES A SYSTEMS PERSON IN DSTL LOOK LIKE?

2.1 A Note on Terminology

The first hurdle to overcome was the proliferation of labels already in use in Dstl linked to systems work, which included systems engineer, systems integrator and systems thinker. The differences in meaning and usage varied and were difficult to describe. For example, many people will be familiar with the term 'Systems Thinker', which is widely used outside Dstl and particularly within the systems engineering community [9]. However, the definitions for these labels created through our early work on systems were specific to our needs and did not necessarily have the same meaning as when used elsewhere. Therefore, we recommended the use of the terms 'Systems Skills' and 'Systems Person' in Dstl, so as to avoid confusion with other usages. This is the terminology adopted within this paper.

2.2 Early Results

Dstl's 2002 Systems Integration Technical Strategy [17] identified that Dstl needed "to exploit skills and capabilities more widely across Dstl" and gain "more well-rounded systems people with good communications and networking skills" in order to respond to the MOD's systems requirements. A study was taken forward to investigate training and development options relevant to systems people and 25 good systems people (as identified by their peers) were interviewed about their own development and ideas for developing systems skills in others. The study found a strong consensus among interviewees that the right kind of work experience is the most important factor in developing a good systems person. The project team made a number of recommendations, including the development of a systems competency framework and an integrated systems awareness course [19].

2.3 Structured Interviews

The Dstl Executive requested that more and better evidence was needed before putting in place any of the recommendations from the 2003 proposals and a team was pulled together to consider the best way of growing the systems people needed by Dstl in the future. The first question they set out to address was to define a systems person in Dstl [18]. Eighteen members of staff, identified as working in close contact with systems people in Dstl, were interviewed using a structured process. Analysis and grouping of the findings resulted in a prioritised list of factors that could be used to distinguish systems people from non-systems people. These were, in turn, grouped into four areas – knowledge, skills, experience and personal attributes (Figure 1).

What is a systems person?			
Knowledge	**Skills**	**Experience**	**Personal attributes**
• Understanding whole systems • Operational context • MOD acquisition process • Operational Analysis techniques (hard and soft) • Dstl's work and direction	• Use of workshop skills • Use of models and simulations • Uses customer's language • Broad networking • Consulting skills	• Has moved across domains • Experience of the military • Various jobs • Engineering background • Use of models and simulations, workshops	• Personal confidence • Curious/creative • Challenging • Not status conscious • Responsive

Figure 1: Early definition of a Dstl systems person [18]

2.4 Systems Person Model

While the list of factors provided a useful starting point, the sum total of the characteristics listed under each factor proved too numerous to measure and to identify systems people in Dstl. Consequently, it was suggested that a more useful definition would be obtained by identifying the core psychological ingredients and factors that underpin and unite the characteristics identified via the structured interviews [2]. All practical work was undertaken by JCA Occupational Psychologists, contractors to the project and with expertise in the development and implementation of psychometrics.

After reviewing all previous strands of systems skills work in Dstl, JCA proposed a model for a fully rounded systems person in Dstl, as shown in Figure 2. At their core, systems people possess a number of key systems attributes, which, when coupled with domain knowledge and experience, interpersonal skills and characteristics, and appropriate people networks, make up a Dstl systems person [12]. The extent of these people networks and their effectiveness is linked to consulting skills, which are tackled separately.

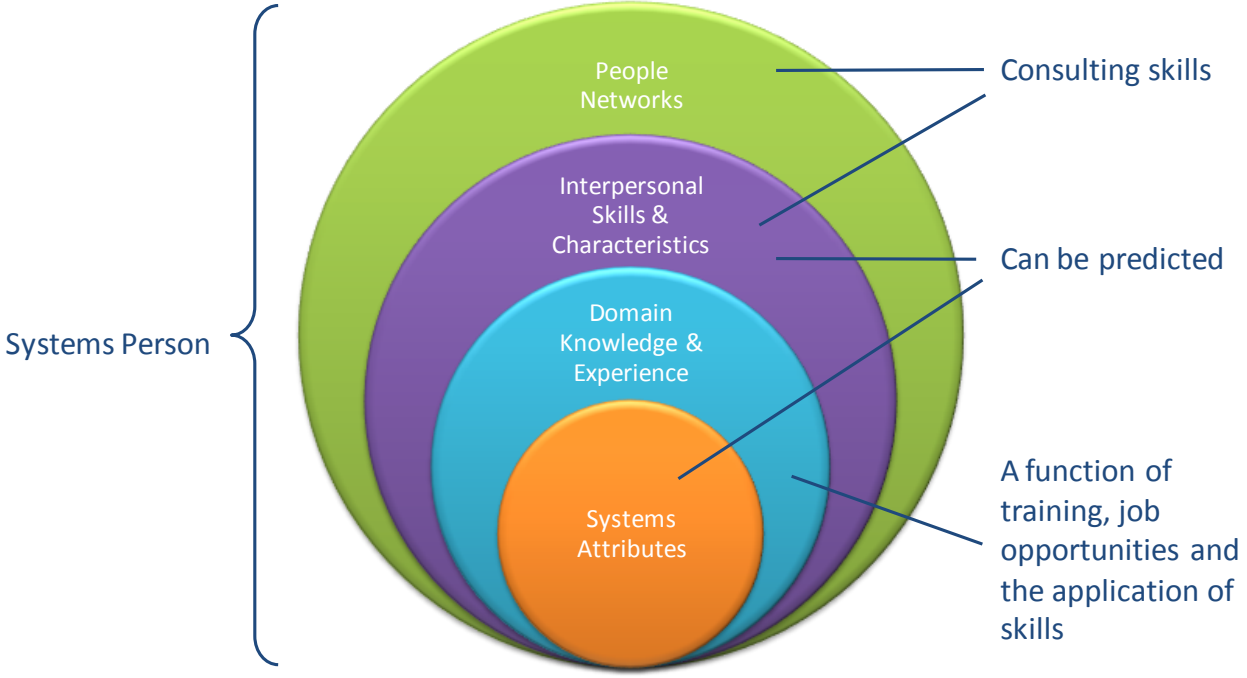

Figure 2: Dstl model of a systems person

JCA proposed that both the core systems attributes, and interpersonal skills and characteristics could be predicted by psychometric measures, and thus identified and developed at an early stage [14]. To aid the selection of appropriate psychological factors, JCA carried out competency-based critical incident interviews with staff across Dstl, investigating how an individual approached important events in their career, and thereby identifying the types of skills and processes they used. JCA then selected seven psychometric measures in order to identify the factors underpinning systems people. The measures selected reflected three psychological factors: predisposing factors (including cognitive abilities, thinking styles and personality); intentional factors (attitudes, values and motivations); and application factors (skills and habits) [14].

2.5 Psychometric Results

Eighty-seven people representing a cross-section of Dstl staff completed the psychometric tests. In total, 92 different psychological scales were used, e.g. introversion, creativity, assertiveness, willingness to include others and abstract reasoning [2]. Each participant was also rated by their manager against a number of attributes drawn from Dstl's earlier work to define systems people, as well as their performance and their perceived potential to progress [18].

The first statistical analysis indicated that four scales were able to explain 70 per cent of an individual's systems skills rating. Further analysis identified 11 scales that significantly correlated with a number of systems attributes, predominately around interpersonal style and thinking style [2]. These are referred to as 'true positives' and are identified in Figure 3 below. The results also identified a number of correlations that were not predicted [15], identified as 'false positives'. These aspects are possibly a cultural issue as they appear to be valued in Dstl and yet do not fit the systems person model. Equally, there were a number of

correlations that were predicted, but were not found. Identified as 'false negatives', these were not proven to be irrelevant and so were included.

Low need for detail	Interdependent – confident in own abilities but takes others into account
Assertive	Not overly trusting
Modest – lets results speak for themselves	Emotional resilience – bounces back
Low need for familiarity or 'sameness' in the job	Doesn't need to conform
High self-regard	Doesn't need to follow procedures
Flexibility – adapt to changing situations	

Figure 3: Systems skills attributes – true positives [2]

Overall, the Dstl sample group was typical of the working population on 87 of the 92 scales. The five differences included: being less self-aware; less aware of others; less conforming; less likely to simplify complex issues; and less likely to align their objectives with those of the organisation than the working population [13]. These could be cultural characteristics specific to Dstl that may impact how we build systems teams and create an effective climate for working in a systems way.

2.6 Systems People in Dstl

The overall results were combined to summarise the characteristics that are typical of an effective systems person in Dstl [15]:

- They are flexible, adapting their thinking to changing situations
- They prefer to let their results speak for themselves rather than seeking personal recognition
- They are self-assured and confident and trust their own perception of a situation
- They do not need to have all of the detail to form an opinion
- They work interdependently with others and generally have a low interpersonal orientation;
- They have less interest in conforming and do not have a need to 'fit in'
- They prefer some stability in their day-to-day routine, but do not like to be hidebound by procedures or 'the correct way' to get things done. They do not tend to seek variety and change
- They may enjoy the challenge of difficult and complex issues
- They are not over-trusting of people or naturally inclusive – they probably try to achieve a balance between being open to alternative views and challenging them.

3. HOW MANY SYSTEMS PEOPLE DO WE HAVE AND DO WE NEED IN THE FUTURE?

3.1 The Four-Stages of Systems Development

Reflecting the widely-held belief that various degrees of systems skills were needed within Dstl, and informed by the results from the structured interviews, the main factors were further developed into four stages of systems development: first 'awareness'; second 'supervised practitioner'; third 'practitioner'; and fourth 'expert' [9]. These define systems skills characteristics, from the early stage through to the most advanced with each listing, in broad order of priority, the knowledge, skills, experience and personal attributes needed at these stages. Individually, these elements may be possessed by anyone, but it is the combination and prioritised ordering of elements that is unique to systems people [9].

With this information, the management teams in all the operating Departments were asked to assess the number of people at each of the systems skills stages. They were also asked to reflect on their business needs and to estimate the numbers required three to five years in the future [2]. The result was an increase in demand for higher-stage systems skills, with a specific shortfall at Stage 3 as highlighted in Figure 4. Early in 2008, the Stage 3 population was estimated at 280 with 96 more required. Given the demand for Dstl to be working more closely with their customers on initiatives that cut across the operating Departments, this was not a surprise but served to highlight the challenge.

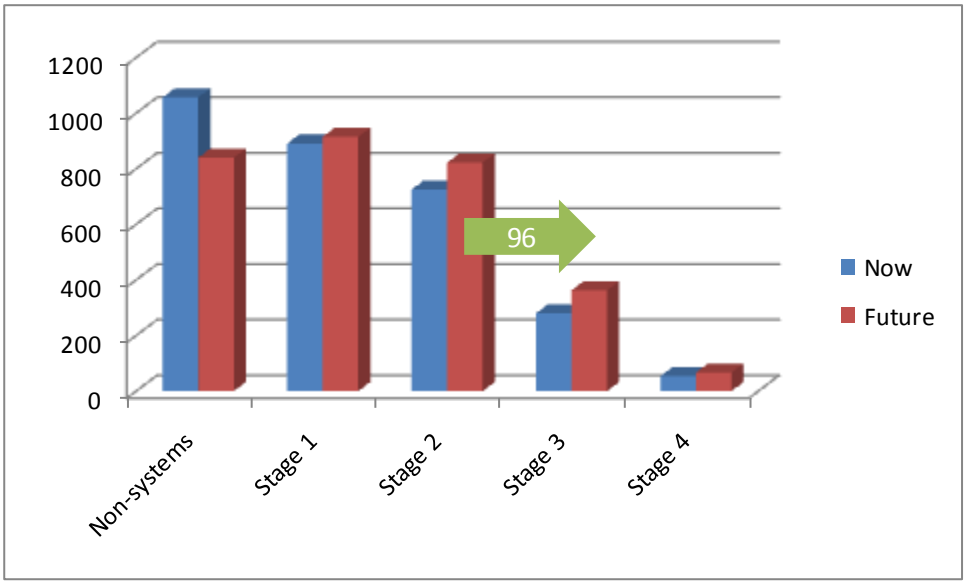

Figure 4: 2008 demand profile for systems people through to 2013

3.2 Mapping the Stages to Competencies

Recent work in Dstl has focused on linking the four stages of systems skills, and their associated pen pictures, with the Dstl Behavioural Competency Framework [1]. This framework provides a common language across Dstl for describing how people do their work and the behaviours for getting the most out of their specialist knowledge and skills. Five competencies from the framework were identified as having a close correlation with systems skills. The language used in the systems skills stage descriptions was then mapped across to the different competencies to provide a simplified means to assess systems skills potential [21]. Figure 5 shows the indicators for all four stages mapped to one of the Dstl competencies: Using Information to Make Decisions.

Use information to make decisions I manage existing information effectively and source appropriate levels of new data, balancing the need for information and the need for action effectively. I reach well-considered and evidence-based conclusions and decisions, supported by thorough analysis where appropriate.	
1	• I can integrate new ideas and information, over and above technical information, to make decisions. • I use models and various technical tools (while challenging their use) to understand problems. • I am comfortable working with incomplete or conflicting information.
2	• I tend not to get bogged down in detail but when required I am able to operate at more detailed levels to understand the implications of key technical or social issues. • I provide quick answers with the important things covered, even if it is not a hundred per cent solution. • I have both hard and judgemental analysis experience, recognising the need for abstraction but adding sound judgement and rigour at arriving at a solution. • I take a rigorous analytical approach employing appropriate techniques and I have a deep and critical understanding of problem-solving approaches, including modelling and simulation, trials and theoretical modelling, enabling a wide range of tools and techniques to be brought to bear on a task.
3	• I identify and understand the application of the technological capability and I am able to commit to system-related decisions based on my technical judgement. • I appreciate and critique the use of appropriate techniques and I am able to quantitatively approach all aspects of advice.
4	• I am tuned in to the political considerations relevant to any advice.

Figure 5: Example Dstl competency mapped to systems skills stages [21]

4. HOW DO WE DEVELOP SYSTEMS PEOPLE?

4.1 Design and Implementation

The early research indicated that the transition from Stage 2 to Stage 3 could take between five and 10 years without any intervention. The task set by the Dstl Executive early in 2007 was to shorten this development time to between two and three years to meet the demand.

From the outset, it was clear that neither the development budget (nominally five days' training a year) nor the learning objectives would be met with a classroom-based programme. In fact, the early research confirmed that attaining Stage 3 systems skills was largely through work experience.

Before tackling the experience element, the first step was to look at the results from the psychological analysis. Many of the attributes fell under the domain of Emotional Intelligence (EI) and were in terms of attitude and behaviour rather than personality. These can be developed and measured, and so it was decided that these would be the catalyst to developing systems skills.

JCA designed an event called Maximising Systems People Effectiveness (MSPE). It was a four-day, two-part activity that was very different from anything that most people in Dstl had experienced before [10]. It was designed to unlock potential through increasing personal effectiveness and creating powerful interpersonal relationships – the core of a Dstl systems person.

The remaining element of the programme (known as the Accelerated Systems Skills Programme – ASSP) was aimed at creating an environment in which participants could gain the necessary work experience to meet their Stage 3 needs [20]. To help, mentors were assigned who would be Stage 3 or 4 systems people, be at the most senior levels in Dstl and come from different areas from the participant. Mentors can help ASSP participants to see the bigger picture and challenge them to step out of their comfort zone and to think about systems skills in an unfamiliar context. To support this, we also put in place a programme of half-day seminars to better understand the role of Dstl in the wider defence community. The approach is summarised in Figure 6, with the emphasis on learning by doing.

Figure 6: Development through experience [20]

In November 2007, the first cohort of 13 started on the ASSP. Nominations came from Departments, with applications requiring participant input on their Stage 2 readiness, line manager support for their potential to develop Stage 3 skills and Department Manager endorsement. A Steering Group comprised of senior leaders from across Dstl reviews, monitors and evaluates the programme using annual progress statements. After three-and-a-half years, the ASSP has enrolled 106 participants, with 15 reaching Stage 3 and more than 20 expected by the end of 2011. The mentor pool is over 70 and the average time to complete is two years and two months.

ASSP participants come from all disciplines, range in age from 25 to 55 and span different career levels. With the majority of participants' time spent on gaining the right experiences, the investment in terms of formal training is less than the nominal five days' training per year. Causes given for delayed progress include not having sufficient time to focus on the ASSP. A subsequent meeting with their mentor usually brings this back on track, with a realisation that their day-to-day work does include developing their systems skills.

4.2 Benefits and Impact

With the ASSP intake to date and the average time on the programme, we are close to hitting the original target for Stage 3 systems people. Data from a recent snapshot indicates an increasing demand and so the challenge is to scale up the programme and make it sustainable. Some Departments are also running their own early-stage development schemes to meet their demands for Stage 2 systems skills.

People with Stage 3 systems skills are some of our most valuable assets. For example, Dstl was commended by the MOD Chief Scientific Advisor for embedding Stage 3 scientists and engineers within MOD procurement [16]. As such, they are in demand and so one immediate benefit is that Department Managers have more people who can do the most important pieces of work, allowing them to respond quickly to customer requests for support and reduce the load on those usually tasked.

One of the key components of the programme is the development of Emotional Intelligence (EI). JCA has published a White Paper that highlights the results of 10 years worth of data from their EI measurement tool [11]. As expected, the technology sector scores lower on scales to do with the interpersonal aspects. However, the striking conclusion is that with training, individuals EI improved by 18 per cent and was being sustained after six months. Taking data from Dstl alone and the key measures linked to attitude (Figure 7), there was a 100 per cent improvement three months after EI development [3]: "The development of my softer skills through [MSPE] has enabled me to release information and ideas from others around me and allow me to connect with wider networks, breaking down perceived barriers".

1. **Self regard:** The degree to which you accept and value yourself.

	Avg	Range	1	2	3	4	5	6	7	8	9	10
MSPE Before:	3	1 - 10	15	6	7	5	6	2	2	3	1	1
MSPE After:	6	1 - 10	5	4	4	4	6	2	7	4	2	10

2. **Regard for others:** The degree to which you accept and value others as people, as distinct from liking or approving of what they may do.

	Avg	Range	1	2	3	4	5	6	7	8	9	10
MSPE Before:	5	1 - 10	5	5	10	3		15	5		4	1
MSPE After:	7	1 - 10	1	3	1	4		14	7		14	4

Figure 7: Improvement in Dstl Emotional Intelligence [3]

In at least one case, the ASSP "was the trigger for a career reboot": "The availability of a mentor who has been challenging my thinking … challenged how I approach my work". Re-energising flagging careers could be a side benefit. A Department Manager commented, "The benefits are being seen both in the Department and the wider lab".

Costs have been kept within the target budget, with the average training time less than the nominal five days per year. Harder to quantify are costs associated with gaining experience, although people working in different parts of the business are still booking their time to a valid project and so there are no immediate cost implications. In fact, a side benefit is that teams see the value of working with people from elsewhere in the business and the importance of developing talent: "It has certainly opened doors for me to take on roles that have stretched and developed me".

4.3 Next Steps

At the time of writing, Dstl is exploring ways to expand the programme to include non-technical areas, as well as increasing numbers to meet demand. With more of Dstl's work linked to consulting than research, a new programme has just been launched along the same lines as the ASSP to develop technical consulting skills [8]. Systems skills are a key component, but with a greater emphasis on effective people networks. As numbers completing the programme rise, the alumni are also becoming mentors and engaging with departmental schemes. The goal is to transition systems skills development to business-as-usual in line with Dstl's enhanced role.

5. CONCLUSION

In summary, the demand for systems skills in Dstl is growing. This is reflected in the changing emphasis for Dstl's work and its role in the defence and security community. Here are the main conclusions from our story so far:

- A good systems person in Dstl builds on a core set of systems skills, exploiting their knowledge and experience through strong interpersonal skills to build effective relationships
- Systems skills can be defined as the ability to apply your know-how – while your technical skill or discipline gives you the intellectual know-how to solve problems, your effectiveness at work in Dstl is also on your ability to apply this know-how in a range of situations and to work well with a range of different people (it's not what you do, but the way that you do it and who you do it with)
- Demand for systems people is increasing as the business need shifts towards more consulting than research

- The catalyst for developing systems skills is by addressing underlying attitudes through increasing Emotional Intelligence
- The remaining development is about creating the environment in which systems people can gain the right experiences
- A senior mentor from another part of the business, and who has real-world experience, is crucial to sustaining the development

To quote one of our senior managers: "We now have a growing group of people who have participated in our programme to develop systems skills (ASSP) as well as a number of local initiatives within Departments. We have been able to show the difference these have made within many aspects of our business, and we want to extend the development offerings to anyone who wants to build their ability in this vital skills set" [21].

Why call it the Yellow Brick Road approach? The Wizard of Oz characters Scarecrow, Tin Man and Lion set out on the yellow brick road in search of someone who could give them, respectively, a brain, heart and courage. When they finally meet and receive what they are looking for, it is a symbolic gesture as through their adventures they realise that they already had what they thought they needed. For many, the mindset towards developing skills is seen as attendance at an event or course and is something that will be given to them. The ASSP changes that view and places the emphasis on helping the individual develop those skills for themselves. We create the environment to make this happen (the yellow brick road if you like) but the rest is down to them.

Another question that we are trying to answer is how to assess for systems skills potential in recruitment. Working with JCA, we have developed a situational judgement indicator that attempts to do just that. By placing people in fictitious work-related scenarios, we explore the decisions they make when faced with dilemmas that challenge their systems skills. There are three aspects: thinking broadly and flexibly; engaging effectively with others; and motivation to deliver results and effective outcomes. For example, balancing looking for links with others or focusing only on your specific area; seeing customers' needs as a priority over the technical sophistication of your work; and delivering a solution that is good enough over seeking perfection.

Finally, to quote a recent ASSP graduate: "The ASSP has exposed me to a range of activities and opportunities from which I have gained considerable benefit. When explaining it to others it is often considered to be common sense … but sense is not always common."

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