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The Chemical Engineer

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The Adaptive Engineer

Leadership is more than mastering the technical model

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We love a shiny gizmo. We do. Give us Laplace and a differential of the third order and we can attempt to explain the theory of everything in a formula. Of course it must be thermodynamically sound, with bells on. After all, we are chemical engineers. And chemical engineering is all about making things through applied chemical science, right? What more needs to be said? End of story.

Yet is it? Over many years I have held various operational roles at DuPont and Koch Industries and have interacted with, reported to, and directed work programmes for chemical, mechanical and electrical engineers as well as chemists and physicists – all technical people, who are really good at what they do. But over time, chemical engineers often end up in leadership positions.

To succeed in a senior role they must build upon a sound technical understanding and pragmatic approach to their subject matter, and marry this with an 'adaptive' mindset. I have seen trends in leadership and management evolve from autocratic command and control to emotionally intelligent, value-driven empowerment, with people often learning from their own mistakes.

So what do I mean by adaptive? Theories on leadership are two-a-penny and everyone has an opinion. LinkedIn is full of blogs, discussions, forums, groups and apologists for various forms of methodologies. One thing that all are agreed on though is that leadership is about more than mastery of the technical model alone. Professional engineers need to understand this and adapt knowledge, to drive innovation.

Whether they like it or not, or invite it or not, chemical engineering professionals will be looked to for leadership. Their views and technical knowledge will be sought out. Their judgement will be a key part of governance and decision making with huge implications for the welfare and safety of individuals and groups who can be placed in harm's way. At DuPont, we learnt this in safety, and keep learning it. Safety perfection is a destination you never fully arrive at, but constantly have to work towards, continually adapting your models and approach, learning and modifying your thinking. If you don't, you will regress. Human behaviour has a profound effect on safety outcomes, as does the behaviour of chemical engineers in leadership positions.

LEARNING THE HARD WAY

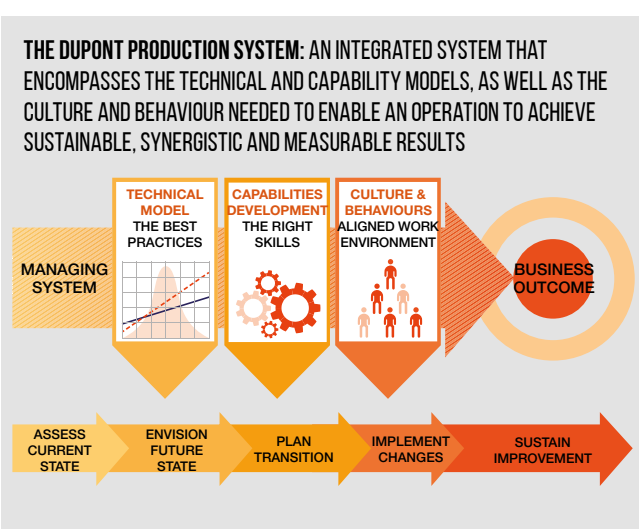
At DuPont we continually take a good long look at ourselves. Over 200 years old, we have invented revolutionary new materials through chemistry such as nylon or Corian, are big into technical models, have published books, and patented new science. But as we entered the 21st century we were falling behind, losing significant ground to competitors in areas which we had considered as our core capabilities.

We had to examine why we were losing value in the margins of technically-excellent frameworks. We adapted our own production system in 2010 with the aim of ironing out inefficiencies, in an effort to attain operational excellence. It melded four dimensions: governance, technical, capability and culture. This change was led and implemented by many disciplines, with chemical engineers at the vanguard. We embraced, among other best practices, the methodology of Heifetz, which helped us to move away from technical autocracy to adaptive behaviours. That means that we expect chemical engineers to apply their capabilities and processes to other disciplines and direct the work of electrical, mechanical and other engineers.

LEADERSHIP IS ABOUT MORE THAN THE TECHNICAL MODEL. PROFESSIONAL ENGINEERS NEED TO UNDERSTAND THIS AND ADAPT

I remember when I first moved from a technical role to being an operations manager. I inherited an area and a process which had a 'background noise' of 3–4 injuries per year, and 3–4 grievances per year from the staff. I did not really know what to do, but engaged with my supervisor to brainstorm ideas. We acted on one of these immediately. In order to contain the safety issue, I started to spend two hours a day on the shop floor talking with operators about safety, and my first line did the same. We discussed safety and hazards and mitigation. Every day. We ended up talking about football, families and holidays as well. As a result we eliminated the safety incidents and went five years without a recordable injury.

But here's the moment of serendipity. We received not one single further grievance from the staff for over five years. I found that face-to-face interaction on safety and family matters had destroyed barriers of mistrust. This had a profound effect on me for the rest of my career. It was an accidental 'adaptive' discovery that value creation is about more than the technical model. In recent years I have moved into operations excellence in maintenance and reliability, and feel enriched by the experience of working in a new discipline and greet the discomfort that momentarily brings.



ENVISAGING THE BIG PICTURE

When we went through an adaptive change process in 2008, we chose chemical engineers to lead it, people who could envision the big picture. We had come to the conclusion that previous models to improve our productivity and performance, good as they were, were not enough. We had various managing processes, had trained a lot of people in tools like Six Sigma and Lean, and had very capable and well-qualified people in place to drive technical improvements. But our initiatives were slightly disjointed and separate and that meant we could not sustain improvement for long. We had to 'join up the dots' by taking existing processes and linking them together, using the approach shown in the figure (*below, left*). We believed this approach, which focuses on four key areas, would give us a more sustainable model for excellence, and so it has proved in the past ten years.

This model is all about being adaptive and anticipating instead of being reactive. It allows us to understand and work in the dimensions that underpin and sustain success in safety and operations excellence. For chemical engineers, both these areas are focus practice areas at DuPont. Over time, we had discovered that technical solutions in operations and safety were more likely to succeed when we also addressed the other three aspects: governance, capability and culture. So, for example when addressing improvements in reliability, we had to design technical, standardised work processes, put in place competency frameworks to help people acquire the skills they needed to perform the tasks necessary to improve reliability, and carry out a lot of coaching to ensure everyone was aligned in terms of work culture and behaviour. In other words the managing system governs all the processes and is focussed on the outcome (better reliability), and the other three dimensions (technical, capabilities development and culture/behaviour) are addressed as we plan the improvement and transition to a better state. We have found that this model has worked, although it was and remains an adaptive process.

In the area of governance and managing processes it is expected that we put in place compliance oversight and

procedures at a strategic and tactical level to drive performance. In the area of risk mitigation, for example, we identify risks in our management processes by quantifying consequence with probability. We then drill down to more specific unit risks and identify barriers to harm. These barriers form the basis of our strategic approaches. For example, having a good process safety management system is one strategic barrier, and this translates into tactics further down the line such as management of change, mechanical integrity, and process hazard analysis. It is important to check the health of these barriers and tactics periodically, as risk is dynamic. That leads to questions such as "do we have the right barriers?" and "how good are our barriers?" This is just one example of how governance can determine strategy and tactics.

We apply the technical model to operations, maintenance, reliability, energy, process safety, and employee safety. It is a sound basis for building results and outcomes. This part plays naturally to the strengths of our chemical engineers.

The capability model focuses on competency and setting up centres of excellence. It's about continuous professional development, always learning and applying, and it concerns all levels in the organisation. We often find that our chemical engineers lead these processes across many disciplines.

The culture process is about values and beliefs, mindsets and behaviours. It is mission critical for our chemical engineers to be masters in this area, because our governance and technical and capability frameworks will not function without it. We are a core-value driven company and we need our engineers to be so too.

IF YOU ARE A CHEMICAL ENGINEER WHO WANTS TO MOVE BEYOND THE TECHNICAL MODEL (NOT AWAY FROM IT), THEN BE ADAPTIVE. GET COMFORTABLE WITH BEING UNCOMFORTABLE

Now, even though there are many papers and research areas on these topics, they are not routinely taught in university courses. There may be several reasons for this. Perhaps they are not considered as sufficiently academic, or too much of a side issue. Training the next generation of chemical engineers should involve close collaboration with industrial companies to ensure that the imperative need to be adaptive in an exponentially-changing environment is grasped by chemical engineers right from the start.

So, if you are a chemical engineer who wants to move beyond the technical model (not away from it), then be adaptive. Get comfortable with being uncomfortable. ■