Leadership and ethos in complex problem solving

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Abstract

Some people are of the opinion that complex problems should be left to the market - that governments do not 'pick winners'. Here it is argued that the success of an organisation is not dominated by whether it is a private or a public body but is critically dependent on the ethos that the leadership adopts and requires to be used.

I identify three aspects of competence: ethos, character and skill, Figure 1, and suggest that ethos - the guiding principles that prompt one to act - is no less important than skill. Or to put it another way: how you think is as important as what you can do.

How this classification relates to the success of three highly complex 20th century endeavours is briefly analysed and how it may be used to create the competence needed to solve 21st century problems is then discussed.

Features of an organisation for solving complex problems

Figure 1 shows three features that contribute to the success of an organisation.

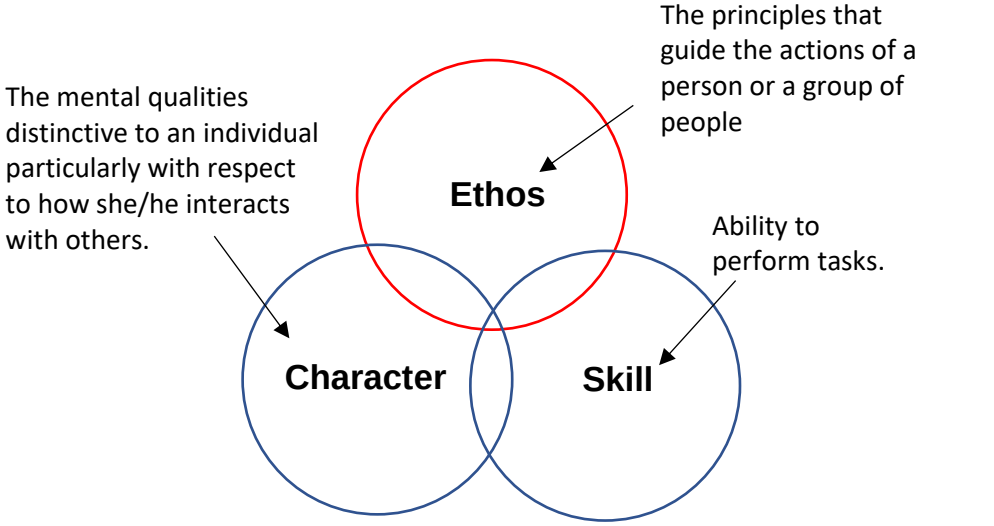

Figure 1 The collective competence of an organisation

Character is more related to genetic heritance and ethos to cultural inheritance and logic. Skill comes mainly through education and practice. These are not tight categories. In some situations, it

is possible to copy the methods of those who do things naturally - character becomes ethos. The difference between a guiding principle and a skill may not be clear.

Both character and ethos tend to be tacit i.e. we take action without thinking about why we do it. I suggest that ethos be considered to be the way we go about doing things that can be made explicit - i.e. that can be expressed in the form of guiding principles. That such principles should be made explicit within an organisation is the main message of this paper.

As an example of the difference between character and ethos, consider Adolf Hitler. His character allowed him to gather devoted followers. On the other hand, the ethos that he promoted was monstrously evil.

A range of character and skills is needed in an organisation and the ethos must be pervasive.

20th century events

1. The Apollo Mission[1]

In the early 1960s, US President, Jack Kennedy, decided that putting people on the moon ahead of the Soviets was an essential objective for the prestige of the US nation. For 10 years about 2% of the US domestic product was allocated to this enterprise. The project was brilliantly successful. NASA had responsibility for the programme.

When George Mueller, an electrical engineer, took on overall management of the programme in 1963, he introduced methods to control the project - task control, budget control, risk control, change control - that were highly successful. He was a world-class project manager.

People with a wide range of high-level skills, especially in engineering and science, were recruited. The innovative capacity and entrepreneurial potential of the US people was harnessed by looking widely for ideas from industry/practice and using them where appropriate.

Safety was a critical feature of the NASA ethos. Proposals were examined in great detail to keep the risk of failure as low as possible. Unexpected consequences were identified at the design stage. Testing, theoretical and physical, was at the heart of the project.

It is well-known that as the degree of innovation in a project increases, the level of risk of unsatisfactory outcomes also increases. The Apollo Mission was highly innovative. The likelihood of failure was very high and failure would have been very negative to the original objective (of showing superiority over the Soviets). Especially in enterprises of this type, risk cannot be eliminated but it is essential to ensure that only necessary risks are taken.

A main strategy for controlling risk is to look for what might go wrong, for example by asking 'what if?' questions. 'What if the rocket engine on the lunar module did not fire up after the moonwalk?' How might that occur? Should some of the circuits/equipment be doubled up? How much would that increase the payload? A relentless drive to foresee what might happen, and to take account of what was found, was a core feature of the ethos of the Apollo project.

2. The Normandy Landing 1944[2]

The Normandy Landings may have been the most complex logistical exercise ever undertaken. About 160,000 troops crossed the English Channel on D-Day, 6th June 1944, and 875,000 crossed within the next 25 days. The operation was planned in the greatest detail.

On D-Day, Admiral Bertram Ramsay 'conducted' the invasion from a ship anchored offshore, with great success. His character was suited to such responsibility. His ethos was that field commanders should be given clear instructions for action but that they should be allowed to make changes if required by circumstances during engagements. On the basis of disagreement with colleagues regarding such delegation, he retired had from the navy in 1938. Winston Churchill persuaded him to come out of retirement to take part in the war effort.

At the time of the Normandy Landings, General Alan Brooke was the senior military adviser to the War Cabinet. His diaries noted that Winston Churchill had the characteristic of putting forward ideas, over 90% of which Brooke deemed to be unsatisfactory. Brooke's ethos was that all ideas

needed to be tested and felt that one of his most important tasks was to seek to ensure that Churchill's bad ideas were not implemented. Churchill might bang the table to defend his ideas but Brooke had the character to be equally vigorous in attacking them. Brooke was a validator of ideas and Churchill had an ethos of not forcing adoption of a proposal if it was not supported by his Chiefs of Staff.

It seems too obvious to mention that controlling risk was a major issue in the planning of the landings

3. Bletchley Park[3]

During WW2, an extraordinarily successful body was set up at Bletchley Park to seek to decrypt enemy radio messages. In his book *The secrets of StationX*, Michael Smith quotes Bill Bundy, who was in charge of an American team at Bletchley Park, as saying:

> "It was a terrific human experience. This was a totally dedicated group working together in absolutely remarkable teamwork. Their whole structure was one where you might readily find a major working under a lieutenant or a civilian somewhat younger. Whoever was in charge was the person who had been judged to be the most effective at doing it."

That statement explains one of the principles of the ethos of the Bletchley Park organisation

Smith also describes a situation that arose:

> "Squadron Leader Humphreys had the highest technical qualifications through his mastery both of intelligence and of German, but unfortunately, he tried to set up within Hurt 3 a semi-independent and almost rival organisation responsible to himself. It cannot be doubted that he made a great contribution to our work and to getting it to be taken seriously at the highest levels. Nevertheless, he caused great dissention and disturbance."

Humphreys had the necessary skill but lacked the character/ethos to work within the ethos of a Bletchley team.

A new leader for Hut 3, Squadron Leader Jones, was appointed

> "Jones was just ideal. He had left school at fourteen and had been in the cotton business in Manchester. He was very intelligent, did not know German but understood organisations very well. He gave people a free hand. Quite a lot of brainy people had the habit of resigning when they were miffed but Jones dealt with them."

Jones, like Ramsay, had an ethos of not micro-managing, and had the character to deal with difficult people.

There were major risks in the work at the Park. What if the enemy became aware that their codes had been broken? How could that be prevented? One of the strategies used was to instil an ethos of deep secrecy. One did not speak about what was going on to anyone except on a 'need to know' basis. Even within the organisation, there were few people with a comprehensive knowledge + what was happening. Use of this principle was necessary in the context. In most contexts active sharing of information should be a feature of the ethos.

I chose to use these examples because they capture my imagination; I could have used projects from across the engineering spectrum; I could have used a scientific achievements or examples from success in business.

In *Sapiens*[4] Yuval Harare surmises that homo sapiens dominates the planet because we can formulate plans that involve large numbers of people i.e. that complex problem solving is a defining feature of our species. However, I suspect that most people do not understand the principles of complex problem solving[5]. For example, I explain to people why actions to change the electricity system need to be carefully assessed[6] - that it is necessary to 'do the sums'. A common reaction is that "What needs to be done is clear; doing the sums will only hold back progress." We see governments, world-wide, promoting policies for energy that show strong evidence of being based on an ethos that did not include a 'do the sums'principle - i.e. decisions were not made on the basis of identifiable hard facts.

The 21st century context

While the 20th century was marked by two of the most disastrous wars in history, in the 21st century we have moved to a different imperative. We now realise that nations need to stop fighting each other and to work together to solve global environmental and societal problems - as epitomised by the UN Sustainable Development Goals

A fundamental question is 'How can organisations be created, or transformed, to be successful in solving complex problems of this type? The basic requirement is the appointment of leaders who have the character to inspire their colleagues to adopt an ethos that is suited to achieving the objectives - and that there is a suitable mix of skills within the organisation.

Ethos of an organisation for solving complex problems

The ethos may be expressed in the form of a statement of the guiding principles under which the organisation operates. As an illustration, I discuss three such principles.

Example guiding principle 1: 'Test solutions'

Using a solution strategy without testing it, can be a very high-risk approach. A number of actions logically follow from an intention to test a solution:

- It is necessary to understand the objectives that are to be achieved - hence a statement of requirements needs to be established.
- Solutions (it is preferable that more than one solution is identified) are established. Information about them is gathered using, where appropriate: risk analysis, sustainability analysis, cost analysis, data analysis, predictive models, etc.
- The solutions are compared against the requirements leading to a decision, based on informed judgement, about the one to be used.
- The solution is implemented.
- Since there is normally much uncertainty, outcomes are kept under constant review and revisions are made where needed.

An internet search on 'problem solving process' indicates wide use of these actions. In *To Engineer* it is called the 'Engineered design process'. The list may be compressed or extended but the core actions do not vary - because they follow logically from the need to test solutions. What does vary is the amount of resource allocated to such activity. Not doing any testing in unprecedented situations, i.e. jumping to conclusions, is inadmissible. Using their experience, experts may justifiably come to decisions quite quickly. The resource that should be allocated depends on the degree of innovation, the complexity and the level of risk involved. In situations where seriously negative consequences may ensue, the testing process needs to be based on the most advanced methods available and no compromises made in the drive to avoid errors and unsatisfactory judgements. This situation pertains, for example, in the design and operation of nuclear facilities.

A corollary to the 'Test solutions' principle is therefore: 'Ensure that an appropriate level of resource is allocated to testing of solutions'.

Managers can induce people to adopt the 'Test solutions' principle by requiring submission of reports on the actions taken. The objective should be to attain an ethos where no one would consider jumping to conclusions for important decisions.

In the listed actions for solution testing, sub-principles such as 'Do a risk analysis', 'Do a cost analysis', can be identified. How well these actions are performed depends on the skill of the people involved.

Example guiding principle 2: 'Treat failures as a learning opportunities'

I refer here to failures that are caused by ignorance or carelessness rather than negligence. Although avoiding failures is a core objective, when working with complex uncertainty it may be very difficult to get straight to a good solution, especially if innovation is involved. Having review and revise activities in the list of actions for solution testing implies that changes are likely to be required. If a failure occurs, rather than focus on who was at fault, seek to improve the process so that errors will not be repeated. The ethos should be: to seek to identify errors, to readily admit to them and to correct them. Not admitting to failures or errors should be treated as negligence or dishonesty.

Example guiding principle 3: 'Focus on the project goals'

While it is common for people to seek publicity for themselves and to seek promotion, such aspirations should be secondary to the drive for project success. Shameless ambition or egotistical behaviour have no place in a sound ethos.

Principles of this type are used explicitly in many contexts. While the compilation of a generic list of principles would be worthwhile, it would be important not to view this as a fixed standard that will be relevant for all situations. For the Apollo Mission, the decisions were essentially technical, involving the design of physical objects. In other contexts, the way people might react may be a dominant issue. For example, measures taken to reduce CO_2 emissions that lead to increased prices are very unpopular with people on low incomes. They will protest that they are being treated unfairly. Taking account of such social behaviour needs to be included in the ethos when appropriate.

Conclusion

The need for a pervasive ethos that is capable of leading to the success of an organisation is paramount. In engineering, such ethos is perhaps more important for the success in problem solving than having the latest design software or mathematical techniques. If the tools are applied inefficiently because of low morale or a lack of clear understanding of what the task involves, then progress and profitability, as well as job satisfaction, will not be optimal.

Leaders in organisations that seek to solve complex problems should be explicit about the ethos to be used and to treat its adoption as a prime responsibility.

References

1. Johnson S B, *The Secret of Apollo,* Johns Hopkins University Press, 2006
2. Kennedy P, *Engineers of Victory, The problem solvers who turned the tide in the Second World War,* Allen Lane, 2013
3. Smith M, *The secrets of StationX, How Bletchley Park helped win the war,* Biteback, 2011
4. Harare Y N, *Sapiens,* Vintage 2015
5. MacLeod I A, *To Engineer - Strategies for solving complex problems,* IESIS, 2017 http://www.iesis.org/toengineer/To-Engineer.pdf
6. IESIS, *Engineering for energy A proposal for governance of the energy system,* 2018 http://www.iesis.org/efore/engforenergy.pdf