

# A three-legged stool

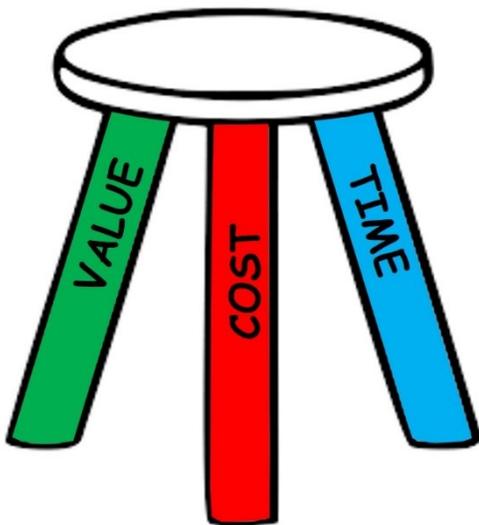
All technological change is preceded by philosophical change. It's when you start to think differently, when you challenge your culture, beliefs and values, that you can set out on a different path.

Seen from the outside, those who support nuclear fission seem to have some curious beliefs:

- Nuclear is special. It's different.
- Normal market rules don't apply to nuclear power.
- Nuclear power only produces electricity.
- Nuclear power is a matter for governments and states.
- Physics is more important than chemistry.
- Technology is more important than humans.
- **Value is more important than cost and time.**

Let's have a look at that last one.

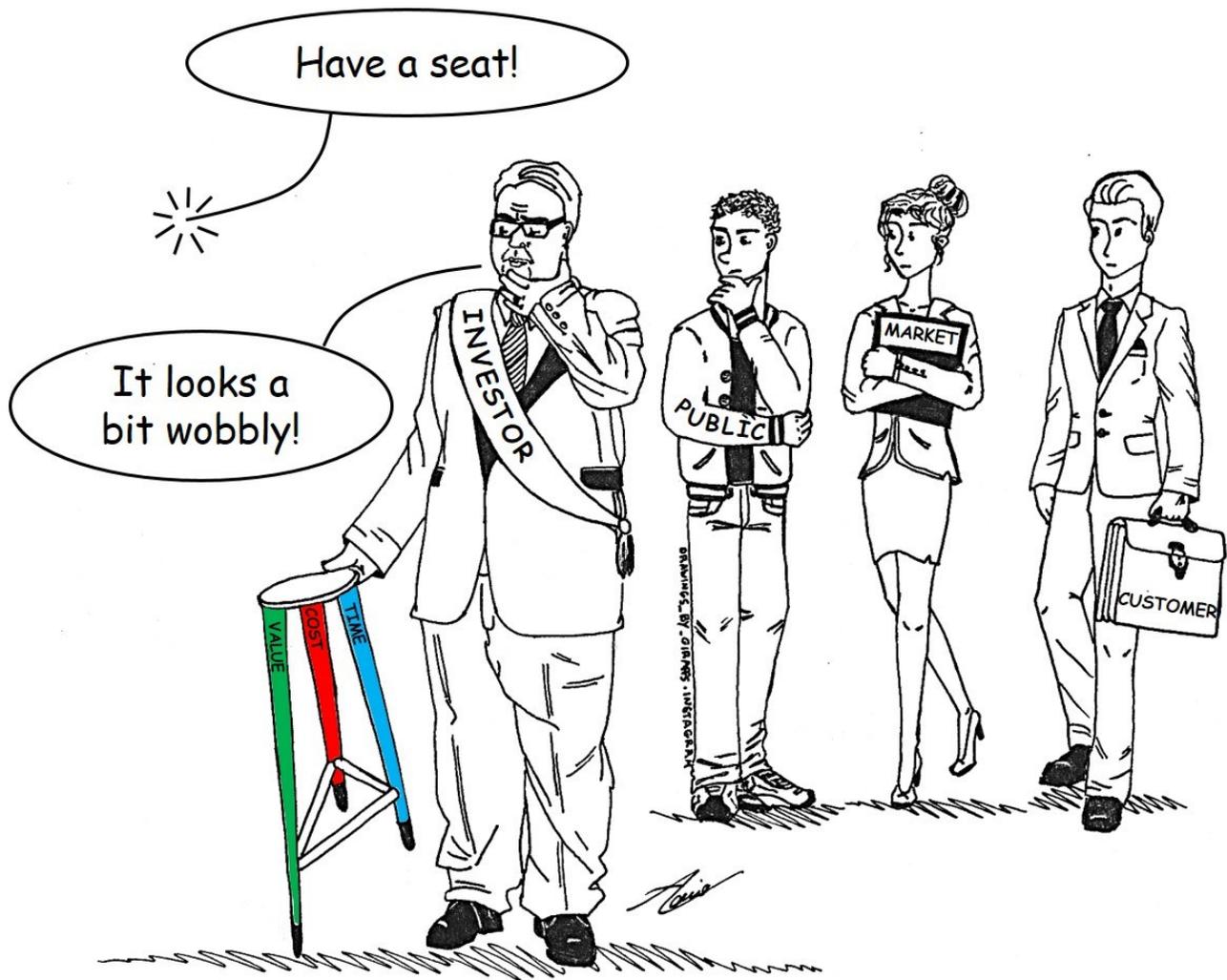
In technology transfer, between the spark of an idea and its arrival on the market, many different paths are imagined and explored, then evaluated according to three criteria: **Value, Cost and Time**. Like a three-legged stool, proposals for products and services which have a good balance between these criteria are attractive to investors, customers and the public, leading to the development of a market.



The discovery of nuclear fission has opened up a new value proposition for the production of energy for humanity: For the same mass, it produces about a million times more energy than combustion. And it can produce these massive amounts of energy in a reliable and dispatchable manner, without emitting pollutants such as carbon dioxide into the environment. By concentrating on mastering the scientific and industrial aspects of this value proposition, the nuclear community has developed a culture where cost and time are downsides to be dealt with later.

At first this strategy worked well. Even though machines capable of sustaining a chain reaction were more expensive and took longer to design and build than coal or gas plants, the value and economies of scale offered by increasingly powerful reactors broadly covered cost and time differences. Nuclear power was able to keep its promises and attract large investments.

But the energy market has changed. The fossil fuel industry, lacking ideas to increase its value, has focused on reducing its costs - for example, the development of fracking to extract natural gas. An intense lobby has attacked all aspects of nuclear energy: Regulation, public image, construction time, safety, fear of radioactivity... The ferocity and constancy of these attacks are impressive, but instead of defending itself from erosion of its cost and time performance, the nuclear community has responded by offering more and more value: More power! More safety! Better fuel cycle management! Less risk! Better reliability! To the point where technology and project complexity is such that the right balance between value, cost and time has been lost, and the industry is no longer able to keep its promises for the construction of new nuclear power plants:



In the fight against global warming, the world needs nuclear fission energy. But which one? There are dozens of possible concepts for nuclear power plants, each with its own pros and cons.

The market wants access to the value of nuclear power, but cheaper and faster. The survival of nuclear energy will depend on the ability of the community of people who care about its value proposition to adapt their beliefs when evaluating new concepts.

We are beginning to see this paradigm shift in advanced nuclear firms, who have understood the paramount importance of **time**. The search for modular innovations is an attempt to put an end to the idea that it takes ten years to build a nuclear power plant. Also, some concepts with significant cost reduction potential, such as molten salt reactors, have not yet been deployed on an industrial scale. It is essential to show investors a path to market which is credible, rapid and with the least possible risk. To avoid long research programs, proven components, processes and materials must be used, which means making difficult compromises with value propositions, and sometimes cost.

In a conference in Paris on 28<sup>th</sup> September 2017, the president of the American Nuclear Society Robert Coward said that the goal for advanced nuclear should be to offer "half the cost, twice as fast". If the nuclear community can take a long hard look at its beliefs and values, if it can put all its strength behind concepts which are **balanced** in terms of value, cost and time, then the market holds a bright future for this energy, for the environment and for humanity.