FIRST PRINCIPLES THINKING REVIEW

in theory and practice

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LETTER FROM THE EDITOR

Dear reader,

In the last two years, the Factory for Innovative Policy Solutions has come a long way: from producing solution reports on societal challenges and sending them to policymakers, to publishing our *Manual to Generate Innovative Solutions to Today's Challenges*, to organizing training sessions for those interested in learning more about the philosophy and methodology that drives our organization. Our most recent development is the publication of the *First Principles Thinking Review*, the first issue of which you have before you. It is our hope that through this publication, what initially began as a small brainstorming session on a little-known problem-solving method will develop into an international and interdisciplinary conversation about tackling societal challenges with first principles thinking.

About this publication

The *Review* is divided into two sections. In the first section, *Theory*, our contributors seek to expand the area of knowledge related to first principles and the associated methodology itself. Here, history, philosophy and the exploration of other problem-solving methods come together in order to better our understanding of what exactly first principles thinking is and how it can be used. In the second section, *Practice*, our contributors investigate different ways of applying the first principles thinking method to societal challenges. This is where abstract ideas are turned into concrete proposals for overcoming real-world problems through first principles thinking.

The *First Principles Thinking Review* is the first of its kind with respect to its scope and focus. Although first principles thinking can be traced back to ancient times, surprisingly little has been done to develop its potential as a catalyst for societal innovation and progress. It is therefore the purpose of this publication to finally change that status quo. By dedicating the pages of the *Review* to create an outlet for interdisciplinary research and experimentation, the Factory for Innovative Policy Solutions hopes to engage as many inquisitive minds as possible in the realization of this project. For this reason, we remain dedicated to the principles of open-access publication and encourage you, our reader, to share the content found herein and join our global network of first principles thinkers.

Call for submissions

For those readers who would like to see their ideas published in the next issue of the *First Principles Thinking Review*, please submit a draft article through the Factory for Innovative Policy Solutions website, where the editorial guidelines are described in greater length and detail. In the event that you would like to make a contribution but are not sure of how to get an article off the ground, our editorial team welcomes unsolicited emails with rough ideas or topic proposals. Our editors are more than happy to work with you on developing such ideas into articles that can be published and shared with those who are in a position to help implement your ideas to solve the societal challenges you care about. We hope that the articles you will find herein shall serve as a source of both inspiration for new ideas as well as the motiativation that is necessary to make those ideas a reality.

Sincerely,

Kacper Grass, *editor-in-chief*

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PART 1 – FIRST PRINCIPLES THINKING

IN THEORY

Ending World Hunger: Analogical vs. First Principles Thinking

By Alexander Verkerk

Originally published electronically *on 25 February, 2019* [1]

What do you do when facing a problem? Do you first look to see how others have sought to tackle it? Then you're probably an analogical thinker. Or do you try to think of new solutions instead? Then you might be a first principles thinker. In this series you will learn how first principles thinking differs from other techniques to solve real-world problems. Hopefully this will enable you to make an informed decision on how you deal with hurdles in your professional and personal life. In this article, first principles thinking takes on its biggest rival within societal problem-solving, being analogical thinking, to eradicate malnutrition.

Analogical thinking spreads innovative solutions

So, how would an analogical thinker approach the problem of malnourishment? Before answering this question you should first know that an analogy is a comparison between objects that highlights aspects in which they are thought to be similar. In turn, analogical problem-solving relies upon

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[1] Verkerk, A. (2019). Ending World Hunger: Analogical vs. First Principles Thinking. *Factory for Innovative Policy Solutions*. Retrieved from https://www.innovativepolicysolutions.org/articles/ending-world-hunger-analogical-vs-first-principles-thinking

identifying analogies and 'good practices' before settling on a plan of attack (Bartha, 2019). Most societal problem-solvers, such as policymakers, NGOs and donor agencies, traditionally employ analogical thinking to generate insights and formulate possible solutions to their problems at hand – with considerable success.

Take malnutrition in the lower-middle-income country of Bolivia. An analogical thinker would first search for similar cases that have managed to escape hunger, or never experienced it in the first place, and then then examine what has worked well and not so well in these instances. Subsequently, this person would apply the identified good practices to their situation with minor modifications to better serve the needs of their own unique situation. A good practice could, for example, be to import fertilisers to increase crop yield. Such practices have namely contributed to a 42 percent reduction in the prevalence of undernourishment in lower-middle-income countries between 1992 and 2014 (WHES, 2018).

First principles thinking sparks innovative solutions

First principles thinkers like Aristotle and Elon Musk, on the other hand, would start identifying obstacles that undermine food security. Limited soil moisture retention is one such obstacle in realising a genetic diversity of cultivated plants.

How would you then go about getting to the core of this obstacle? By asking critical questions, that's how, such as "how much water does a crop exactly need?" Your search engine will tell you that a lettuce crop, for example, needs about 300 millilitres of water during its growing period of 40 to 80 days, depending on the climate (Sunshine Seedling Services, n.d.). This is what we call a *first principle*, which serves as a foundation from which new solutions can be discovered.

Oftentimes new solutions do not appear right away, but don't give up! Just ask more follow-up questions, such as: "where does unabsorbed moisture go?" It turns out that it largely escapes as vapour to the atmosphere during the day (Brouwer et al., 1986). "So how can we prevent this moisture from evaporating?" Such lines of so-called 'Socratic questioning' help you get closer to the problem's core as well as to new solutions. By now you may have thought of 'drip irrigation', which is a micro-irrigation system either above or below the soil surface that delivers water and nutrients directly to the crop's roots zone, in the right amounts and at the right time for it to grow optimally – and with minimal water loss (NETAFIM, n.d.).

Drip irrigation, through the burying of unglazed clay pots that continually leak water among crops, actually goes back to ancient times and has been refined throughout the years to today's smart technological solutions that can monitor crops meticulously and apply different amounts of water to different parts of the same field, if need be (Gold Standard, 2015; Harland, 2013). This also demonstrates that once you have found an ingenious solution you should continue to ask critical questions and welcome new ideas for further improvement.

So, which one wins?

Before giving a final verdict, let's compare the strengths and weaknesses of both methods. Analogical thinkers are inclined to accept widely held assumptions, for example that watering plants through surface irrigation is the most cost-efficient way to go (Troy Peters, n.d.). They work with what they have and pose solutions that barely differ from one another, which is perfectly satisfactory in many instances when a concept has proven to work well. Today's digital capabilities provide access to many useful international analogies and good practices, and you should make use of them.

However, what do you do when there are no analogies or when current practices are unsatisfactory? Then you might want to swap your analogies for first principles. First principles thinking, that is without analogy, namely encourages you to look beyond long-standing beliefs, and instead invites you to boil down a problem to its core by asking critical questions. This gives you a unique perspective on the nature of things and can inspire unique solutions, such as drip irrigation and cultured meat (Verkerk, 2019).

Enemies or best friends?

Contrary to what I said earlier, first principles thinking and analogical thinking can actually be best friends, and I propose the following mode of cooperation: to tackle a problem such as limited soil moisture retention, you should first put on your first principles thinker's hat and invent drip irrigation, and then switch to being an analogical thinker to both disseminate this technology to similar contexts and teach farmers how to use It. When such an innovation is used excessively, however, unintended consequences may arise, such as soil degradation and groundwater contamination (FAO et al., 2017). In that case, you may need to switch back to first principles, and back again, to analogies. Unless you find a durable solution right away, be prepared to continue leapfrogging.

My final verdict

In my opinion, both approaches are crucial to achieve societal aspirations such as Sustainable Development Goal 2 to end global hunger. Unless you want to be a full-time innovator like us at the Factory for Innovative Policy Solutions, there is no need to always wear your first principles thinker's hat, as there are adequate analogies for most things in life. However, once you have the feeling that a current approach is not satisfactory enough, you know what to do. Just have an open mind and keep asking critical questions to discover improvements, and when you do, remember that this is probably not the final panacea.

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Who Uses First Principles Thinking and Why You Should Become One of Them

By Kacper Grass

Originally published electronically on 12 May, 2019 [2]

What is first principles thinking? When did it originate? Who can use it? And why is it such a big deal? Ever since Elon Musk, founder and chief executive of a number of highly innovative companies like Tesla and SpaceX, attributed first principles thinking to part of his entrepreneurial success, the problem-solving method has begun to experience a comeback. Nonetheless, despite its relative simplicity and versatile applicability, first principles thinking remains a concept merely skimmed over in philosophy classes or only briefly mentioned in business courses. In order to clarify some of the confusion surrounding the concept, this article outlines the history and development of first principles thinking from its philosophical foundations to its place at the forefront of modern problem-solving and innovation.

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[2] Grass, K. (2019). Who Uses First Principles Thinking and Why You Should Become One of Them. *Factory for Innovative Policy Solutions.* Retrieved from https://www.innovativepolicysolutions.org/articles/who-uses-first-principles-thinking-and-why-you-should-become-one-of-them

First principles in classical antiquity

The first account of the methodical use of first principles as a problem-solving technique dates back to ancient Greece, when it was proposed by Aristotle in both the *Metaphysics* and the *Physics*. In the former, Aristotle defines first principles as "the first basis from which a thing is known," while in the *Physics* he explains that "in the science of nature as elsewhere, we should try first to determine questions about the first principles" because the "proper direction of our road is from things better known and clearer to us, to things that are clearer and better known by nature; for the things known to us are not the same as the things known unconditionally" (Irwin 1988, p. 3). In other words, by warning the problem-solver never to accept common knowledge unquestioningly, Aristotle makes an early reference to epistemology, the branch of philosophy concerned with understanding the nature of knowledge itself. How do we go about knowing things? How do we know what is true and what is false? How can we determine what is a practical solution and what is not? All these basic epistemological questions can only be answered by deconstructing what we already know—or what we think we know—into first principles.

While Aristotle's work dealt largely with the theoretical notion of first principles, the method was notably applied in practice by his contemporary Euclid, whose groundbreaking mathematical treatise the *Elements* used an indispensable set of first principles to establish what today are considered fundamental geometrical proofs. Book I of the *Elements* begins by providing a number of relevant definitions to conceptualize the terminology—point, line, circle, etc.—that would be used to present five first principles, called postulates or axioms, which serve as the basis for all of his later proofs: (1) a straight line segment may be drawn from any given point to any other; (2) a straight line may be extended to any finite length; (3) a circle may be described with any given point as its center and any distance as its radius; (4) all right angles are congruent; and (5) if a straight line falling on two straight lines makes the interior angles on the same side less than two right angles, the two straight lines, if produced indefinitely, meet on that side on which are the angles less than two right angles (Joyce D. E., 1998). Understanding that these five principles are unconditionally true—and apparently not bothered by the fact that the last might be a bit difficult to read—Euclid was able to use them to prove hundreds of geometric propositions, perhaps most famously the Pythagorean Theorem, which states that the square of the hypotenuse of a right triangle is equal to the sum of the squares of the other two sides ($a^2 + b^2 = c^2$).

From the Renaissance to modernity

Though much of ancient philosophy was abandoned in the Medieval Ages, first principles thinking experienced a revival during the Renaissance, when René Descartes began to introduce foundationalism into the Western epistemological tradition. The foundationalism of Descartes, itself largely based on Aristotelian thought, argued for the justification of any commonly held beliefs with fundamental beliefs, or first principles. This methodological approach, also known as Cartesian doubt, had a profound impact on the development of the modern scientific method, which stresses the use of empirical trials and various forms of reasoning to either prove or reject hypotheses. Of these various forms of reasoning, inductive and deductive reasoning in particular exemplify the application of first principles thinking to reach conclusions. While the inductive approach relies on first principles in the form of specific observations to build general theories, deductive reasoning utilizes them to create a top-down system of logic in which specific conclusions are drawn from basic premises, as in the example: (1) All men are mortal; (2) Descartes is a man; therefore (3) Descartes is mortal.

As the Renaissance gave way to the Enlightenment, new generations of philosophers continued to explore the use of first principles. In his *Critique of Pure Reason*, Immanuel Kant contributed to the epistemological debate by analyzing the relationship between "a priori" knowledge, which is derived from nature, and "a posteriori" knowledge, which is acquired through experience (Kant, 1781). Kant's work laid the groundwork for what would become the philosophical school of idealism, or the belief that all human knowledge is subjective and mentally constructed through experience. The idealist tradition was, in turn, inherited by the Romantic thinker Georg Wilhelm Friedrich Hegel, whose philosophical approaches had a profound impact on Karl Marx after the Industrial Revolution. Marx advocated the ideological employment of first principles as a tool for making political criticism and promoting class consciousness. In a letter to his colleague Arnold Ruge, titled *A Ruthless Criticism of Everything Existing*, Marx (1843) argues that when making an effective political criticism,

> *[...] we shall confront the world not as doctrinaires with a new principle: 'Here is the truth, bow down before it!' [Instead] we develop new principles to the world out of its own principles. We do not say to the world: 'Stop fighting; your struggle is of no account. We want to shout the true slogan of the struggle at you.' We only show the world what it is fighting for, and consciousness is something that the world must acquire, like it or not* (p. 14-15).

First principles in practice

Although their value to the historical development of philosophical theory may be clear, how are first principles being used in practice in the 21st century? Returning to Elon Musk, he explains that "first principles is kind of a physics way of looking at the world. You boil things down to the most fundamental truths and say, 'What are we sure is true?'… and then reason up from there" (Ranadive, 2017). Peter Thiel, who worked with Musk as a co-founder and first CEO of PayPal, adds that "because every innovation is new and unique, no authority can prescribe in concrete terms how to be innovative. Indeed, the single most powerful pattern I have noticed is that successful people find value in unexpected places, and they do this by thinking about business from first principles instead of formulas" (Ranadive, 2017). Jeff Bezos, the founder and CEO of Amazon, has also incorporated first principles into his business model, urging entrepreneurs to "resist proxies" like established processes or market research and instead strive towards more fundamental truths like real outcomes or customer needs (Ranadive, 2017). Like Bezos, Reed Hastings, co-founder and CEO of Netflix, also discourages entrepreneurs from following established processes. Providing the anecdote of a software company he had started before Netflix, Hastings claims that there was a lack of innovation and creativity because his colleagues "were unable to adapt" due to "a bunch of people who valued following the process, rather than the first principles thinking" (Mejia, 2017).

The application of first principles thinking has no bounds. Wherever and whenever there are problems to be solved, one should always analyze the situation by first breaking down what is already known into fundamental truths. Only by understanding what is true unconditionally can a person hope to discover practical and innovative solutions to the task at hand. Whether that task is academic or professional, personal or political, there are always first principles from which one should begin to reconsider commonly held beliefs or re-evaluate existing precedents. In a world with no shortage of problems to solve, there is no time to waste repeating the same mistakes or waiting on someone else to take the initiative. First principles thinking is not only a tool of the philosopher or the CEO, but a method that can be employed by anyone who is passionate about a problem and serious about making a change. If you are such a person, then perhaps you too could benefit from using first principles thinking.

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First Principles Thinking as a Tool for Researchers to Overcome the Challenge of Conceptualization

By Kacper Grass

Originally published electronically on 22 March, 2020 [3]

At the foundation of every scientific study must lie a clear definition of what is being studied. Such a definition of key concepts is reached through the process of conceptualization, to which there exist two main approaches: the classical (or first principles thinking) approach and the prototype (or analogical thinking) approach. Through the example of finding an adequate definition for the concept of 'democracy', both approaches to conceptualization are demonstrated in practice. This article compares the effectiveness of both approaches before proposing a model for the more rigorous and reliable first principles thinking approach.

The challenge of conceptualization

When one thinks of the names commonly associated with the first principles thinking method—not least the likes of Socrates or Aristotle—it is easy to believe that first principles thinking is a

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[3] Grass, K. (2020). First Principles Thinking as a Tool for Researchers to Overcome the Challenge of Conceptualization. *Factory for Innovative Policy Solutions*. Retrieved from https://www.innovativepolicysolutions.org/articles/first-principles-thinking-as-a-tool-for-researchers-to-overcome-the-challenge-of-conceptualization

tool with which only the greatest of people can do the grandest of things. While it may be true that some of the most innovative minds in history have used first principles thinking to produce a number of groundbreaking and revolutionary ideas, one should not be intimidated by their precedent. In fact, if you are a researcher or have ever conducted a research project, then there exists a strong likelihood that you are also a first principles thinker. The only question is whether or not you are aware of it.

In any field of research, one of the initial tasks of the researcher is to clearly define the subject matter of his or her study, a process known as conceptualization. Dimiter Toshkov (2016) defines concepts as "the building blocks of scientific reasoning, and of human cognitions in general," adding that they "are essential for core scientific activities such as theory formation, description, categorization, and causal inference" (p. 84). That being said, if a social science researcher were to conduct a study on democratic government, he or she would first have to begin by defining what exactly is meant by the concept of 'democracy'. There are two main approaches to tackling this problematic challenge: first principles thinking or thinking by analogy.

The classical approach to conceptualization

According to the so-called classical approach to conceptualization, "concepts have rule-based definitional structure," meaning that they are "defined by a set of individually necessary and jointly sufficient conditions that delimit unambiguously what qualifies as [their] empirical realizations" (Toshkov 2016, p. 3). Simply stated, a concept's definition is not effective unless it clearly outlines exactly what that concept is and what it is not. Following Aristotle's explanation of a first principle as "the first basis from which a thing is known," the researcher must begin by deconstructing the concept of democracy into its underlying first principles in order to be able to adequately define it (Irwin 1988, p. 3). What qualities must a state possess in order to be considered a democracy? In the view of German sociologist Dietrich Rueschemeyer and colleagues (1992), being a democracy entails:

> [...] first, regular, free and fair elections of representatives with universal and equal
> suffrage; second, responsibility of the state apparatus to the elected parliament…
> ; and third, the freedoms of expression and association as well as the protection
> of individual rights against arbitrary state action (p. 43).

Therefore, according to the conceptualization of Rueschemeyer et al., the underlying first principles of democracy are (1) governance through popular election, (2) subjection of the government to the will of the citizenry, and (3) protection of basic human rights and personal liberties. American sociologist Barrington Moore (1966) defines the development of democracy as:

> *[...] a long and certainly incomplete struggle to do three closely related things: to check arbitrary rulers, to replace arbitrary rules with just and rational ones, and to obtain a share for the underlying population for the making of rules* (p. 414).

Similarly to that of Rueschemeyer et al., Moore's conceptualization of democracy rests on a set of three first principles. Specifically, those are (1) subjection of government to the will of the citizenry, (2) protection of basic human rights and personal liberties, and (3) governance through popular election. Finally, for the Swedish sociologist Göran Therborn (1977), a democracy is a regime that:

> *[...] has a representative government elected by an electorate consisting of the entire adult population, whose votes carry equal weight, and who are allowed to vote for any opinion without intimidation by the state apparatus* (p. 4).

A pattern is now becoming increasingly evident. Like Rueschemeyer et al. and Moore, Therborn deconstructs the concept of democracy into the first principles of (1) having a government that is subject to the will of the citizenry, (2) governance through popular election, and (3) protection of basic human rights and personal liberties. Based on this common set of first principles uncovered by deconstructing the three scholars' respective views of democracy, the researcher can now begin to reconstruct a conceptualization of democracy that is concrete and precise. Figure 1 provides a comparison of each scholar's first principles for the concept of democracy.

Figure 1: Chart comparing first principles uncovered in each scholar's definition of democracy

	Rueschemeyer	**Moore**	**Therborn**
First Principle 1: Governance through popular election	*"regular, free and fair elections of representatives with universal and equal suffrage"*	*"to obtain a share for the underlying population for the making of rules"*	*"an electorate consisting of the entire adult population, whose votes carry equal weight"*

First Principle 2: Subjection of the government to the will of the citizenry	*"responsibility of the state apparatus to the elected parliament"*	*"to check arbitrary rulers"*	*"a representative government elected by an electorate"*
First Principle 3: Protection of basic human rights and personal liberties	*"the freedoms of expression and association as well as the protection of individual rights against arbitrary state action"*	*"to replace arbitrary rules with just and rational ones"*	*"who are allowed to vote for any opinion without intimidation by the state apparatus"*

The question that remains is whether the resulting set of first principles can be considered appropriate and comprehensive. After all, the classical Greek conceptualization of democracy can be etymologically deconstructed into a single first principle: *dēmos* + *kratia*, which translates to 'rule by the people'. In the 21st century, however, a conceptualization so broad as to permit slavery in a democratic state—as was the case in ancient Greece—would be considered too minimalistic by modern standards, putting into question whether just three first principles would be similarly insufficient. On the other hand, the researcher must likewise be careful not to let positive questioning be overtaken by normative considerations. While the researcher may view the state's recognition of homosexual marriage as something that should be common in democracies, it would be very dangerous indeed to consider this a first principle of democratic government itself, as it would result in an extremely narrow set of cases of exemplary democracies around the world throughout human history.

The prototype approach to conceptualization

In contrast to the classical approach, concepts under the prototype approach "are not defined by clear rules based on necessary and sufficient conditions but have a 'family resemblance' structure," meaning that "an object is considered to belong to a concept if it sufficiently resembles a prototype member of this concept" (Toshkov 2017, p. 87). Returning to the challenge of conceptualizing democracy, the prototype approach would not require the researcher to deconstruct the concept in search of underlying first principles, but instead to find an ideal example of what a democracy should be to serve as a point of reference for analogical thinking. Unlike first principles thinking, which aims to solve challenges by first deconstructing them to their

core elements, analogical thinking duplicates solutions applied to similar contexts. What country comes to mind when one says 'democracy'?

When searching for an ideal example of a democracy to serve as a point of reference, one is likely to think of Sweden sooner than of El Salvador. The reason for this is that Sweden exemplifies many characteristics that are commonly associated with democratic government, such as economic development and political stability, whereas the high poverty and violent crime rates of El Salvador are commonly associated with undemocratic government. However, if economic development and political stability are to be considered characteristics essential to the concept of democracy then Saudi Arabia should qualify along with Sweden, when in fact it is an absolute monarchy while El Salvador is a presidential republic. With El Salvador unable to meet the democratic standards set by Sweden, thinking by analogy leaves the researcher not with a solid definition of democracy but with a merely superficial idea of what one should look like.

A model for conceptualization with first principles

Figure 2 proposes a model for the process of conceptualization according to the classical approach, or by first principles thinking. The *term* refers to the word that represents the concept to be defined. In this case, the term 'democracy' is the label used to represent the abstract form of government that is the subject of the study. The initial step in the process is *concept intension*, or deconstructing the term to uncover the underlying first principles. Based on the views of the three sociologists that have been examined, possible first principles of democratic government are governance through popular election, subjection of the government to the will of the citizenry, and protection of basic human rights and personal liberties. Secondly, *concept extension* refers to finding cases that embody those first principles in the empirical world. Such cases of democracy would be Sweden and El Salvador, amongst others.

Figure 2: Model for conceptualization with first principles, adapted from "Figure 4.1: The structure of concepts" (Toshkov 2016, p. 89)
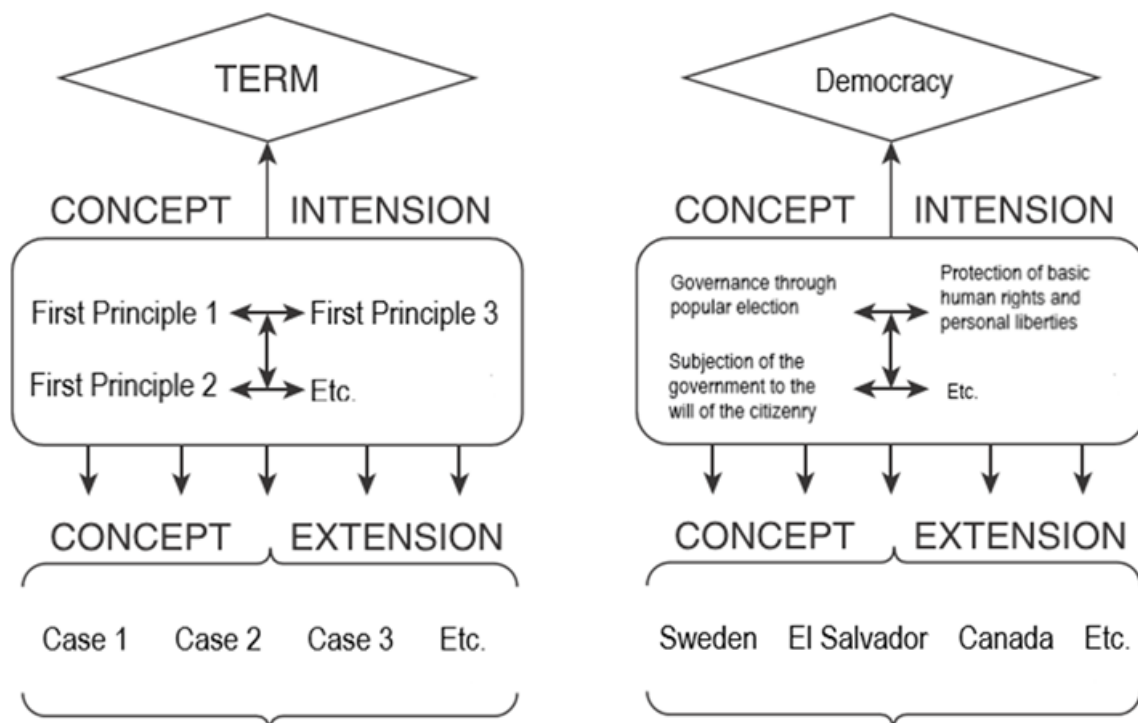
Naturally, one could argue that the inability of the Salvadoran government to protect its citizens from gang violence might undermine the first principle of protecting basic human rights and personal liberties. In a similar manner, chronic corruption and cronyism could be argued to undermine the first principles of governing through popular election or subjecting the government to the will of the citizenry. If such doubts arise, the process of conceptualization must be applied again in order to clearly define what exactly is meant by concepts like 'human rights', 'personal liberties', and 'popular election'. Which rights are all humans entitled to? What liberties are inalienable to every individual in society? Who can and cannot vote in a popular election? Asking such questions is the key to deepening one's own understanding of the initial concept of democracy and constructing a more solid conceptual framework on which to base one's study.What is certain is that there always remain more first principles to be found. And it is by pursuing these first principles—by incorporating first principles thinking into his or her methodology—that the researcher can finally overcome the challenge of conceptualization.

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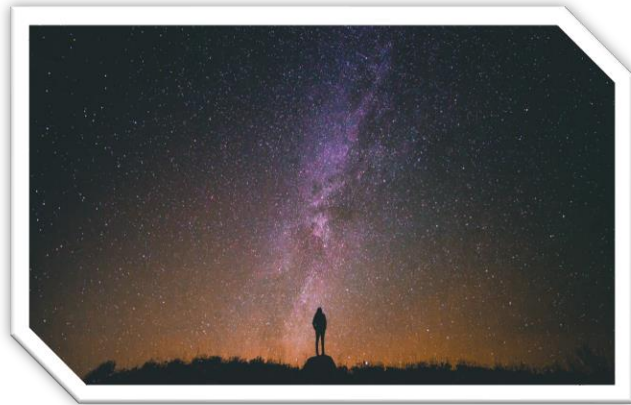
Was Parmenides the First of the First Principles Thinkers?

By Amy Huang

Originally published electronically on 9 April, 2020 [4]

While first principles thinking is commonly associated with the writings of Aristotle and the teachings of Socrates, the contributions made by pre-Socratic philosophers remain either largely forgotten or ignored. This article traces the first recorded instance of first principles thinking at work to the thought-provoking questions posed by Parmenides a generation before Socrates.

What about Socrates and Aristotle?

Modern advocates of first principles thinking commonly attribute the methodology to the foundations laid down by Aristotle, who argued that no problem could be adequately solved before being deconstructed to reveal its underlying causes. Aristotle, in turn, was influenced by the method of Socratic questioning—a rigorous re-evaluation of one's previously held assumptions—as passed down to him by his mentor Plato, who was himself a student of Socrates. According to most historical accounts, the roots of first principles thinking cannot be traced any further back,

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[4] Huang, A. (2020). Was Parmenides the First of the First Principle Thinkers?. *Factory for Innovative Policy Solutions*. Retrieved from https://www.innovativepolicysolutions.org/articles/was-parmenides-the-first-of-the-first-principles-thinkers

as many consider Socrates to be the absolute bedrock of all Western philosophy. Catherine Osborne (2004), author of *Presocratic Philosophy: A Very Short Introduction*, dismisses this view as historically inaccurate and intellectually negligent. Her critique of the all-too-common narrative adopted by many textbooks and school curricula, which simply depict Socrates as having invented reason and logic out of nothing, brings much needed attention to the generations of philosophers who actually came before Socrates and influenced his work. Particularly interesting were the questions of first principles raised by Parmenides.

Was a single element truly responsible for the origin of all matter?

Parmenides of Elea was born around the late sixth or early fifth century BCE, making him several decades older than Socrates. Though much of his work was lost after his death, what has been preserved shows Parmenides' great interest in the subject of cosmology, the branch of astronomy primarily concerned with studying the origins of the universe. At the time, it was common to believe that a single element was responsible for the origin of all matter. For example, Thales—one of the earliest Greek philosophers on record—believed that the whole world floated on water and that all things somehow derived from it. Anaximander, who succeeded Thales, rejected the water hypothesis, arguing that the building blocks of the universe were something indefinite. Later, Anaximenes argued that air was the basic element, while Heraclitus (a contemporary of Parmenides) proposed that it was fire. Although these hypotheses may have been convenient, Parmenides argued for more intellectual rigour when searching for first principles.

The universe could neither have originated out of nothing...

In his poem *On Nature*, Parmenides establishes what would come to be known as the 'way of truth' by which he investigates the origin of something. Osborne explains:

> The first option to consider is that what we now encounter perhaps arose from 'non-being': did what is come from 'what is not'? 'No,' says Parminedes, 'you should not think that, because you are not allowed to think or say "it is not".' A further consideration adds to the weight against this: 'what could have made it happen?' he asks, if it came from non-being? (p. 41-42).

Thus, Parmenides begins to re-evaluate the problem of origin by asking basic questions and re-examining what was already thought to be known. By doing so, he challenges and eliminates the

possibility that the universe could have originated out of nothing. In a sense, his questioning can be compared to the analogy of the chicken and the egg. Could a chicken be spawned out of nothing? Certainly not. Osborne continues her analysis:

> *The second option… is that it arose from something that already had being, so that something besides what is there already arises from what is there before. This also, Parmenides suggests, is not to be allowed* (p. 42).

...Nor could the universe have originated out of something

To counter the argument that the universe could have originated out of nothing, Parmenides then proposes that it, in fact, originated out of something that had already existed before. Upon closer examination, however, this proposal leads back to the root of the problem. If the universe originated out of something, then what is the origin of that thing? Following the analogy of the chicken and the egg, if the chicken originated from the egg, then what was the origin of the egg? Certainly the egg could not have spawned itself. Osborne concludes:

> *And thirdly, he tells us that we are not to accept that what now is can cease to be... if something has a beginning or an end then at some point we have to say of it, not that it is, but that it is not, or is not right now (though it will be or was)* (p. 42).

Although Parmenides never proposed an alternative to the prevailing belief that a single element served as the origin of the universe, his system of logical questioning introduced a paradigm shift that challenged the existing approaches to cosmology.

Parmenides deserves a branch on the genealogical tree of first principles thinking

By ruling out the idea that the universe originated from nothing and rejecting the idea that it comes from something, Parmenides' way of truth led to the conclusion that the universe can have neither a beginning nor an end. This philosophical milestone came decades before Socratic questioning, a century before Aristotelian first principles thinking, and over two millennia before Einstein reached the same conclusion in his famous maxim "energy cannot be created or destroyed; it can only change from one form to another".

Thus, if Aristotle is to be considered the father of first principles thinking and Socrates the grandfather, then Parmenides likewise deserves a branch on the genealogical tree. His approach to problem-solving focused on re-evaluating challenges by asking basic questions before jumping to hasty or convenient conclusions. What Osborne stresses in her work is that Parmenides would have warned against the dangers of looking for answers without first asking the right questions, a valuable lesson indeed for all problem-solvers thereafter. This is true not only for the abstract musings of ancient philosophers who sought to explain the origins of the universe, but likewise for contemporary problem-solvers who use first principles thinking in search of solutions to today's societal challenges.

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PART 2 – FIRST PRINCIPLES THINKING

IN PRACTICE

How First Principles Thinking Is Revolutionising the Meat Industry

By <u>Alexander Verkerk</u>

Originally published electronically on 28 January, 2019 [5]

First principles thinking transforms obstacles into stepping stones on the path to new solutions. Many people have used this problem-solving method without being aware of it – you probably have done so as well. In this series you will learn about the power of first principles thinking by examining its application to real-world problems, even if the people involved didn't know they were using this process. This article will take a look at a revolution within the meat industry.

The problem of meat consumption

Over the past seventy years, annual global meat consumption has increased six-fold, from 45 million tons per year in 1950 to 300 million tons today, and this number is expected to rise further. As a result, both environmental and animal welfare have suffered (Slow Food International, 2015).

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[5] Verkerk, A. (2019). How First Principles Thinking Is Revolutionising the Meat Industry. *Factory for Innovative Policy Solutions*. Retrieved from <u>https://www.innovativepolicysolutions.org/articles/how-first-principles-thinking-is-revolutionising-the-meat-industry</u>

The solution of meat substitutes

One question first principles thinkers could ask themselves is why cultivate a whole chicken when only the breast and wings are eaten? Can this not be done more efficiently? As far back as 1931, Winston Churchill asked these exact questions in his book 'Thoughts and Adventures'. Others have gone even further to ask what meat is actually made of. A quick query in your search engine will tell you that meat mainly contains proteins, and traces of iron and vitamin B12 (FAO, 2015). This is called a *first principle*. First principles are fundamental, proven facts that are accepted by the scientific community.

Now pretend that you are a first principle thinker. What follow-up question would you ask next? If you asked in what other sources we can find these components, you are on the right track of becoming an amazing problem-solver. It turns out that similar proteins are also found in various other sources such as plants, dairy, eggs, and fish but also in insects and fungi (Better Health Channel, n.d.). Indeed, this is yet another first principle, which very well could have led to the creation of meat substitutes that are now widely available in supermarkets worldwide.

The solution of cultured meat

Others have taken Churchill's question even further and managed to produce real meat without needing to breed, raise and slaughter animals. How? It began when the French Nobel Prize-winning physiologist Alexis Carrel, who spoke with Churchill about this, succeeded for the first time in 1936 to keep organs 'alive' outside the body for an indefinite period of time. At the time, however, the technology to cultivate and grow organs was nonexistent. It would not be until 2013 when Mosa Meat's Chief Scientific Officer Mark Post unveiled the world's first hamburger made through the growing of cow stem cells (Mosa Meat, n.d.). The company is now lowering production costs and improving taste with the aim to enter the market by 2020 (Hosselet, 2017).

With other companies also managing to artificially cultivate meat and with consumers in several countries (40-70%) indicating to be open to try cultured meat, the future of lab-grown meat looks very promising (Debusschere, 2016). On top of that, it should be noted that cultured meat can be produced in less than three weeks, whereas traditional beef production takes about three years from start to finish (Meatable, n.d). Meatable, a producer of cultured meat, expects that this method will revolutionise the meat industry's impact on the environment and animal welfare while at the same time increasing food security for a growing world population (Meatable, n.d.).

Try it yourself

And that's the power of first principles thinking. Indeed, sometimes you need to ask multiple critical questions to identify the first principles necessary to discover innovative solutions. The fun thing is that anyone can do it. You don't need to have professional work experience or be a creative genius to come up with creative solutions. Just have an open mind, ask critical questions and allow your intuition or search engine to do the rest.

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Solution Report to Increase Literacy Rates Among Women in Rural Mauritania

By <u>Alexander Verkerk</u>, <u>Danielle Peterson</u>, <u>Kacper Grass</u>, <u>Nabil Chtatou</u> and <u>Tom Kortenbach</u>

Originally published electronically on 29 January, 2019 [6]

This solution report proposes a series of innovative ideas to increase literacy rates among women and girls in the rural areas of Mauritania. The report was produced by the Factory for Innovative Policy Solutions (FIPS), a global platform where anyone can learn and apply first principles thinking, for example to generate original solutions to societal topics that they care about. Contributors provided the ideas to FIPS, which were then refined into three actionable solutions: (1) create an educational radio channel, (2) introduce mobile teachers and (3) combine madrasas with purposeful learning.

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[6] Verkerk, A., Peterson, D., Grass, K., Chtatou, N., & Kortenbach, T. (2019). Solution Report: To Increase Literacy Rates Among Women in Rural Mauritania. *Factory for Innovative Policy Solutions*. Retrieved from https://irp-cdn.multiscreensite.com/101291b2/files/uploaded/Web%20version%20FIPS%20Solution%20Report%20literacy%20rates%20women%20rural%20Mauritania.pdf

Introduction

Mauritania has a low literacy rate, particularly among girls (59%), adult women (61%) and elderly women (67%) (Knoema, 2017). The lowest literacy rates can be found outside the cities. While public schooling is free and compulsory between the ages of 6 and 14, other costs such as books and lunches make education unobtainable for many children. In addition, many girls do not attend school due to distance and the need to support their families in domestic work. Rural Mauritania is characterized as a collectivist society where the man is the dominant figure. An uneducated woman has little to no mobility in the justice system and solely relies on men to represent her legal rights.

Much commendable effort has been put into creating an enabling environment for women and girls to learn to read and write, with various degrees of success. Examples are building an all-girls school, providing microloans and making it compulsory for girls to attend schools. While this has laid a solid foundation for change, there are still persistent obstacles:

- Costs, such as books and lunch, make education unaffordable
- Traveling distance to school
- The need to support their families in domestic work

Solution 1: Create an educational radio channel

We recommend the creation of an educational radio channel that transmits education on literacy. Different hours of the day can be scheduled for programmes for different literacy levels. Learners could receive personal radios or even pre-loaded MP3 players.

Learners need to have basic broadcast receivers through which they can listen. This frees them to be able to listen while performing chores if they are unable to listen in a more studious position. Alternatively, a communal radio could be distributed in strategic locations for the possibility of group study, which may be more attractive for some students as a learning practice, or if there are budget concerns regarding individual radios.

Because learning through radio alone is not sufficient to increase literacy effectively, the radio channel should be designed to work in conjunction with a workbook that goes along with the programme. This would allow remote learners to learn as well, would reduce the frequency of needing to meet with a teacher, and would allow time to perform other duties as well.

Solution 2: Introduce mobile teachers

We recommend that you facilitate the introduction of mobile teachers, and by extension, mobile schools. Teachers could travel around visiting multiple villages each day according to a schedule. The vehicle could contain teaching and learning materials and instructional modules so not everyone has to buy and own books. The vehicle can pick up the material from the one village and bring it to the next location for circulation purposes. A major benefit is that one teacher has to travel instead of many children, which makes this an appealing solution for parents who rely on girls to contribute to household and other labor.

This can also be facilitated through a training programme that makes it easier for literate women to become paid teachers.

Solution 3: Combine madrasas with purposeful learning

Finally, we recommend that educational institutions be involved with the development of the previously suggested programs. This has the purpose of combining literacy education with skills, entrepreneurship and/or religious education. The education could, for example, be targeted at enabling women and girls to read religious texts but could also involve material that is useful in their communities, for example about cooking or teaching. Alternatively, they could create something as they learn, for example something to sell or something that adds value to their lives, like a cookbook, gardening guide, or other collection of local/traditional knowledge that emphasises the value of their knowledge base. These books could then be sold internationally, perhaps through fair trade organizations. This provides a possible avenue for women to enter the economy.

To gain acceptance in a traditional religious society, a madrasa or female book club could follow a curriculum that is in sync with traditional and religious practices. Classes could be organized by subject, skill and/or language proficiency. The idea is to integrate education into places where women and girls go anyways, for example a mosque or community house.

Focusing largely on the Quran and appropriate secular texts, madrasa-styled schools could provide both girls and adult women with the necessary guidance and practice to develop the foundations of literacy skills. Additionally, the collectivist nature of Mauritanian communities could facilitate the project of establishing such schools, thus lessening the project's dependence on

NGOs for organization and funding. To illustrate, the proliferation of the printed Bible in Europe resulted in a great increase in literacy rates across the continent. Moreover, in other parts of the Muslim world, relatively high female literacy rates have been achieved. Iran serves as a good example with a female literacy rate of 83% (CIA, 2019).

Other ideas worth considering

We received many other ideas that might be worth exploring, mainly targeted at incentivizing family members, men in particular, to encourage women and girls to go to school.

- Schools could provide free or cheap food to learners that is locally produced. This will encourage parents to send them to school because it saves them from having to feed the children. It is also cheaper to provide food at one educational place because of efficiency gains. Local farmers will also benefit, and the revenues can be used to expand educational capacity, which in turn increases demand for local produce. Making education the centre of a local economy stimulates development. Alternatively, or rather supplementary, agricultural lessons could be integrated in the curriculum where learners produce food themselves. To further incentivise women and girls to go to school, surplus food from these agricultural educational programmes can be brought home. Another idea is to give each learner a coupon per attended class that can be used to buy learning materials or school uniforms at a reduced rate. Giving out coupons will furthermore allow for tracking who attends school and who should be further incentivized.
- Enable learners to bring electronic items or water bottles to school to charge or fill.
- Promote the concept of literacy among men. Promote the concept of literate, educated and working women in society at large, for example during Friday sermon.

Conclusion

In summary, the potential of literate women would contribute substantially to the economic development of rural areas and the country in general. The Factory for Innovative Policy Solutions suggests (1) creating an educational radio channel, (2) introducing mobile teachers and (3) combining madrasas with purposeful learning. Of course, these solutions could function synergistically in one comprehensive education programme that can be piloted in a few rural villages.

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How First Principles Thinking Can Turn the SDGs' Good Practices into Best Practices

By Tom Kortenbach

Originally published electronically on 6 March, 2019

New goals to address sustainability concerns can have a global impact, but are felt locally for the most part. Because of the diverse nature of the issues that are targeted by the Sustainable Development Goals (SDGs), first principles thinking is a very applicable thinking method to overcome assumptions, tackle the core issues, and lift them from good to best practices.

First principles thinking

First principles thinking is a problem-solving method that guides you with a few steps to abolish your assumptions and come up with innovative solutions. The first step pushes you to dig to the core of the issue by defining what you think the ideal situation should be, that is, when the problem is overcome or an aspiration is achieved. The second step focuses on investigating what are the main obstacles between now and your preferred situation. In step three you need to ask critical questions, such as why these obstacles are in place, and by doing this you can identify the fundamental truths underlying these issues. Moreover, these questions will prompt you to look beyond your assumptions regarding both the problem and potential solutions. In the fourth step, the answers to the previously asked questions help to make it clear as to what solutions there

could be. What is crucial in this step is that you should not be hesitant when developing innovative solutions. By writing them down, you can make a distinction between quickly implementable solutions and long term out-of-the-box solutions.[7]

The Sustainable Development Goals

The 17 SDGs, created as a follow-up to the eight Millennium Development Goals, are constructed to tackle an array of different global societal issues, such as *"ending poverty and hunger, improving health and education, making cities more sustainable, combating climate change, and protecting oceans and forests"* (United Nations, 2012). Many of these issues are very diverse and broad, with many actors involved. Because of the complexity of the issues, 169 targets have been created to have more concrete and manageable objectives (United Nations, 2019c). Yet even these condensed targets are still large problems. As explained in the previous paragraph, first principles thinking allows you to undertake problems because it assists you in establishing the core obstacles that need to be addressed in order to solve the greater issue, or in this case, the target. Subsequently, when the targets are met, the SDGs will be met as well. Therefore, first principles thinking should be employed to the process of problem-solving for the SDGs.

First principles thinking in practice

An example of tackling the targets of the SDGs is shown in the *Solution Report* created by the Factory for Innovative Policy Solutions on increasing literacy rates among women in rural Mauritania (Verkerk et al., 2019). Solving this issue addresses SDG target 4.6: "By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy" (United Nations, 2019b). The Solution Report provides concrete examples to overcome some obstacles that people in rural areas of Mauritania face when trying to receive education. Examples of these obstacles are the distance to travel to a school, a lack of money to pay for books and lunch, and responsibilities to perform domestic labor. In order to overcome these challenges, FIPS came up with the idea of creating an educational radio channel, among other ideas, that allows them to learn while remaining close to home. This way they do not have to leave home for a longer time and are therefore able to eat at home and support the household. Through this method, obstacles such as the distance to a school and the lack of financial means

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[7] After the publication of this article, the first principles thinking steps have been further developed. This means that the steps in this article do not fully correspond to the steps presented in later publications.

are overcome, contributing to more equality and development among the population of Mauritania.

From good to best practices

In approaching these SDGs and targets, it is very important to determine exactly what it is that needs to be tackled. By applying first principles thinking to all targets, you are furthermore likely to discover 'shortcuts' to address multiple targets at once, as demonstrated by the *Solution Report* on female illiteracy in Mauritania.

The UN has called for "good practices" from the field to showcase the different solutions that have been created to achieve the targets (United Nations, 2019a). While there are multiple commendable initiatives taking place, I believe that first principles thinking could build upon existing efforts to produce even more innovative solutions to achieve the SDGs.

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First Principles Cleaning My Street

By <u>Mylène Dupuis</u>

Originally published electronically on 18 April, 2020

First principles thinking has been championed by many throughout history, ranging from philosophers to business leaders, from politicians to scientists. My first reaction was "This is all nice and good… but what does it mean for me?". After some discussion it became clear to me that aside from the more grandiose applications, it can offer some tools to rethink a situation. Below you find how I developed a new idea on how to deal with a very local issue, on a beer coaster in a bar whilst discussing the topic with my friend.

Step 1: Identify your objective

I am a resident of a larger city in Western Europe. Personally, I care deeply about the environment and try to separate my garbage, reduce my CO_2 emissions and try to purchase sustainable products. When I look at my street, however, I see more garbage than I would like, and this annoys me. This led me to question why it seemed as if I cared more about environmental issues than did my neighbours. After some deliberation the answer was not that I was somehow a better person as many of my contemporaries like to believe; in my view it is because I started to personally identify with these values. I see my actions to be part of a bigger objective and feel empowered that I can organise my life in such a way that it contributes to something that I believe to have intrinsic importance, namely a healthy environment. Other people might have different

beliefs that take the forefront in how they act and therefore make different choices. As the amount of trash in my street still really bothers me, the objective that I identified is: to make sure that there is less trash in the street.

Step 2: List your obstacles

As for the obstacles, I took a hard look at my street and which factors might contribute to the situation as it stands:

- People throw too much trash in the street
- The containers that are close by are often full
- The municipality does not clean often enough
- There are many people that come to my street as it is home to a large supermarket and a mosque

These factors combined all have a possible influence on the given situation in my view.

Step 3: Question your assumptions

Everybody has assumptions, and since I am not perfect, so do I. In this more self-confronting step of the first principles thinking method, it is important to say them out loud (or write them down as I am doing at the moment). Assumptions sometimes get a bad reputation when they get confused with unjust stereotyping or ignorance. Assumptions might also bring you closer to a solution, or in other words: you could be right! Additionally, they can also bring you a step closer to solving a factor that you had not even considered before starting your thought experiment and creating the problem-solving domino that you are looking for. In my case, my assumptions were as follows:

- People that walk through the street do not care for the street and how it looks
- The municipality does not care for the street
- The municipality does not have the funds to clean regularly
- When one container is full, people put their trash next to it, resulting in it ending up in the street

Step 4: Uncover your first principles

Visitors to the mosque and supermarket litter the most. According to the first principles thinking method, to get to the core of these assumptions, I started asking questions: Where does the litter come from? The street I live on is diverse in cultural and ethnic backgrounds. Generally speaking, however, there are three groups of people that live here: native people that have been living on the street for generations, students, and people with a migration background (often these people are Muslims and regular visitors of the mosque at the end of the street).

From my personal experience (which may be biased as I have previously mentioned), it is especially this last group that litters the most. In their defence, this group is also disproportionately represented as the mosque attracts Muslims from the wider region that might not even live in the neighbourhood. Regardless of the reasons, a first principle appears to be: visitors to the mosque contribute the most litter.

I continue my search for first principles: Why do those walking through the street not care for the street? While this is more of a hunch than based on actual facts, I feel that many pedestrians might not be as passionate about sustainability and do not judge their own actions accordingly. I probably should have asked additional 'why' questions, but for the purpose of carrying on with this exercise I will go on and consider this to be another first principle. So what do these pedestrians care about? The success of the mosque, perhaps? This could be a third first principle.

Step 5: Come up with new ideas

I try to find a reasoned ideal world in order to confront it with the current situation. In my case, I believe that due to the restraints that be, people have to be inspired not to put their garbage next to the containers or casually throw it on the sidewalk. And so I start asking additional questions: How can we make visitors of the mosque care about the tidiness of the street? What can we do so that the mosque benefits from a clean street?

As previously established, I have very strong feelings about environmental concerns; but at the same time this might narrow my sight for the concerns of others, whose ideas and actions are based on an entirely different framework.

As the mosque is the most significant magnet for people to visit my street, I want to move from blaming its visitors to making it part of the solution.

Like the people who frequently come and visit the mosque, I think that many people care deeply about both the building and what it represents. This resulted in my idea to financially compensate the mosque for the litter it collects. This way, people do not have to be convinced, as I have been, of the importance of environmental sustainability in the same way that I do not have to be convinced of their aspirations and beliefs. By linking the two concepts together, environmental sustainability and the success of the mosque, they can strengthen each other instead of being in conflict.

Step 6: Refine your ideas

It is easy to lose oneself in the idea. How do we make this tangible, and how do we make sure it does not have negative side effects that could be prevented? First we have to discuss scale. Do we want the mosque to collect all of the trash? – Would that not result in people bringing entire garbage bags?

Maybe we should start with objects that are littered the most, can clearly be attributed to their functionality (objects that people bring with them regardless) and can easily be defined in the collection. After all, we do not want to target the wrong people, and we do not want legal discussions when collecting the trash and granting the compensation.

In my mind this results in disposable plastic bottles, as they fulfil all criteria. They are among the most littered objects, they are clearly brought by people to drink from on their way and they are easy to identify when collecting them.

Conclusion

First principles thinking can be used in both abstract and tangible situations. I tried to use its characteristics to critically evaluate a situation I personally would like to see solved. The idea that I came up with is not necessarily the solution that the world has been waiting for; maybe you disagree with its effectiveness, maybe it is too expensive, maybe it is based on the wrong assessment of the situation, etc. It did, however, help me to come up with an idea on how to improve a problem from which we can start a concrete discussion to move forward.

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The First Principles Thinking Review is the first of its kind with respect to its scope and focus. Although first principles thinking can be traced back to ancient times, surprisingly little has been done to develop its potential as a catalyst for societal innovation and progress. It is therefore the purpose of this publication to finally change that status quo. By dedicating the pages of the Review to create an outlet for the theoretical development and practical application of this problem-solving method, the Factory for Innovative Policy Solutions hopes to engage as many inquisitive minds as possible in the realization of this project.

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