The Transform-o-meter

A method to forecast the transformative impact of innovation

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Abstract

An achievement-driven methodology strives to give students more control over their learning with enough flexibility to engage them in deeper learning. (more stuff continues)

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Contents

1 - Introduction

The Merriam Webster Dictionary defines "transformative" as

> "[To] cause or be able to cause lasting change in someone or something" (Dictionary, 2022)

Following this definition, it comes natural to describe certain developments, inventions, ideas, and/or discoveries as transformative. Wether that be the wheel, calculus, the World Wide Web, or even Communism; they can all be described as transformative in the sense that they caused lasting change in humanity.

However, the degree in which they were transformative to humanity remains to be measured. How does the impact of the wheel compares to that of calculus? And to that of the American Constitution?

With the advent of Transformative Artificial Intelligence (TAI), the urgency to answer the aforementioned questions becomes apparent. Several academics have warned about the sooner-than-expected coming of TAI and of the life changing effects it would have on humankind (Bostrom, 2014; Gruetzemacher & Whittlestone, 2022; Karnofksy, 2016). These questions cannot be left unanswered.

However, the existing methods used to measure/forecast the transformative impact/potential of innovation are inadequate to answer the questions at hand. In general, they are too specialized, focusing their methodologies exclusively on either patents (Lanjouw & Schankerman, 1999) and/or academic research (Greenhalgh & Fahy, 2015). Their focus is too narrow. For the purposes I describe above, a new methodology needs to be developed.

Thus, paper introduces the Transform-o-meter; a methodology for both evaluating forecasting the transformative impact/potential of innovation.

This paper proceeds as follows. In Section 2, the criteria behind the Transform-o-meter is explained. In Section 3, Transform-o-meter scores for some innovations (as well as their reasoning) are given as examples. Section 4 concludes.

2 - The Transform-o-meter Methodology

2.1 - Defining What to Forecast

The goal of the Transform-o-meter is for it to be able to evaluate the transformative potential and impact of both material and immaterial inventions/innovations/ideas. Therefore, for the sake of simplicity, I'll introduce the concept of an **Innovation Unit** (or **IU**). The Transform-o-meter's criteria's goal is to be applicable to all IUs. Thus, I shall now formalize the definition of an IU.

2.1.1 - Definition of an Innovation Unit (IU)

> An **Innovation Unit** is a specific, named, artificial invention, development, discovery, and/or idea.

2.2 - The Criteria Behind the Transform-o-meter

The Transform-o-meter evaluates an IU through six parameters. These parameters where chosen to be applicable to all IUs, past, present and future.

The parameters act like a rubric. The IU in question is given an integer score from 1 to 5 in each of the criterion. This score is then normalized to an integer scale with a maximum score out of 100.

The criteria are as follows:

- **Super-seedness Protection**
- **Magnitude of Economic Impact**
- **Centralization**
- **Immediacy of impact**
- **Uniqueness**
- **Counter-factual impact**[1]

The following sub-section explains each of the criterion, as well as the reasoning behind each of the possible scores.

2.2.1- Examining the parameters

2.2.1.1 - Super-seedness Protecion Evaluates if this IU been, in it's purest form, has super-seeded by another IU for the purpose it was originally intended for; and if other IUs can be used for the exact same purpose.

2.2.1.1.1 - Scoring

- **1** - The IU has been completely replaced by other, completely different, IU; it is useless.
- **2** - The IU has been mostly replaced by other IUs that take inspiration from the original one.
- **3** - The IU is used for its original purpose in mostly equal conjunction with other, later/contemporary IUs.
- **4** - The IU is, currently, the most dominant tool used for the purpose it was created for, although other IUs exist that do the same thing but are not as dominant and/or severely depend on this particular IU.
- **5** - The IU is, currently, the most dominant and efficient tool used for the purpose it was originally created for. No other known IU can compare.

[1] Special thanks to Christoph Winter for suggesting this parameter.

2.2.1.2 - Magnitude of Economic Impact Evaluates how significant were the changes in humanity's economic activities as a consequence of the development of the IU.

2.2.1.2.1 - Scoring

- **1** - The IU has had minimal economic impact.
- **2** - The economic impact of the IU is significant, but limited to a specific area of expertise/research.
- **3** - The economic impact of the IU is significant and wide-reaching across several areas of expertise.
- **4** - The IU managed to alter the way at least a generation has engaged in economic activities.
- **5** - The IU fundamentally changed the way humanity engages in economic activities.

2.2.1.3 - Centralization Measures how centralized was the development of the IU.

2.2.1.3.1 - Scoring

- **1** - The IU was created by several civilizations/societies over an either unspecified, or centuries-long time period.
- **2** - The IU was created as a decentralized effort by an entire civilization in a period no longer than a century.
- **3** - The IU was created as an uncoordinated effort of different people/groups of people over the span of several decades.
- **4** - The IU was created as a coordinated effort of different people/groups of people over the span of several decades.
- **5** - The IU was created as a coordinated effort of a singular person/group of people over a period no longer than a decade.

2.2.1.4 - Immediacy of impact[2] Evaluates the time taken for the full-impact of the IU to materialize.

2.2.1.4.1 - Scoring

- **1** - The full impact of the IU was not felt until centuries after its invention.
- **2** - The full impact of the IU was not felt until no more than a century after its invention.
- **3** - The full impact of the IU was not felt until no more than half a century after its invention.
- **4** - The full impact of the IU was not felt until no more than less than quarter of a century after its invention.

[2]It ought to be noted that this criterion was of special controversy when discussing the methodology. The objections to it can be found in this article's conclusion

- **5** - The full impact of the IU was not felt until no more than a decade after its invention.

2.2.1.5 - Uniqueness Measures how unique/novel the UI is compared to both prior IUs and contemporary (at the time) IUs.

2.2.1.5.1 - Scoring

- **1** - Not novel at all; similar IUs were developed more than a century before this one.
- **2** - Not very novel; similar IUs were developed less than a century before this one.
- **3** - Contemporarily novel; similar IUs were around the same time as this one.
- **4** - Novel; the IU shares minimal, but noticeable similarity to other contemporary IUs.
- **5** - Top of the line; the IU shares little to no similarity to other contemporary and previous IUs.

2.2.1.6 - Counter-factual impact Measures the likelihood in which the IU could be developed by contemporaries.

2.2.1.6.1 - Scoring

- **1** - Other, independent, unrelated peoples developed virtually the same IU at around the same time.
- **2** - Someone working on the same circle developed virtually the same IU at around the same time.
- **3** - If someone else had the same material resources as the innovator, it is very probable that it could've invented it.
- **4** - If someone else had the same material resources as the innovator, it is very unlikely that it could've invented it.
- **5** - If someone else had the same material resources as the innovator, it is impossible that it could've invented it.

3 - Transform-o-meter scores for some IUs

The following subsections score 3 IUs evaluated under the Transform-o-meter methodology, as well as the reasoning behind the scores. These are provided as examples on how the methodology can be applied to any IU rather than as definitive scoring.

3.1 - The Wheel

Criteria	Score	Explanation
Super-seedness	5	The wheel has not been replaced by any other IU.
Economic impact	5	Thanks to the wheel, humanity has transportation, agriculture, etc., all fundamental for humanity.
Centralization	1	Several cultures developed the wheel at different time periods, in different parts of the globe.
Inmediacy of impact	1	Timeline; arguably felt since the development of agriculture.
Uniqueness	5	No other IU can be described as similar.
Counter-factual impact	1	Several, unrelated peoples developed the same IU at different times.
Overall	60	

3.2 - The World Wide Web

Criteria	Score	Explanation
Super-seedness	5	It's synonymous to the Internet; the most dominant protocol.
Economic impact	5	It has fundamentally changed how humans produce and communicate.
Centralization	3	The protocol was developed as an iterative effort from different parties.
Inmediacy of impact	1	Less than 10 years passed from its development to the Dot-com Boom.
Uniqueness	3	Similar communication protocols were developed around the same time (i.e. Usenet)
Counter-factual impact	4	Developed thanks to an iterative process and U.S. government funding.
Overall	90	

3.3 - Communism (as defined by Marx)

Criteria	Score	Explanation
Super-seedness	2	There are government systems that take inspiration from Communism, but no strict Communist "state" currently exists.
Economic impact	4	Communist states changed how societies produced during the 20th century.
Centralization	5	Developed by one man (Marx), with editing help by Engels.
Inmediacy of impact	2	74 years passed from the publication of the Communist Manifesto (1948), to the establishment of the Soviet Union (1922).
Uniqueness	3	Marx wasn't the first 18th/19th century philosopher to reject private property.
Counter-factual impact	3	Being developed in a book, it is likely someone else could've developed a very similar system.
Overall	63	

4 - Conclusion

As shown in the previous sections, the Transform-o-meter's methodology can be utilized to evaluate any IU. That being said, it is best viewed as a framework to be further developed, researched, and improved upon.

One of this methodology's main features is also one of its biggest drawbacks: its serves both to measure the transformative impact of past IUs, and to forecast their future impact. This dual focus on the *a priori* and the *a posteriori* led to the inclusion of a controversial criterion: Immediacy of impact. While it may seem meaningless to evaluate the transformative impact of an IU by it's temporal closeness to its invention (a criticism I am in agreement with), this parameter was included for it's theoretical usefulness in forecasting; particularly in the context of TAI. An AI-related IU that received a high score in this criterion (and also scores well overall) would call for significant and urgent attention, as it's score would signal it's capacity to be part of (or even be) a TAI.

Furthermore, the scores generated by the Transform-o-meter shouldn't be static. Rather, they should be dynamically updated as new information related to each

IU arises. Therefore, it'd make sense for the Transform-o-meter to become an AI.

4.1 - The Transform-o-meter as an AI

Given the limited scope of this paper, the sample of scores given in Section #3 were largely discretionary, and are unlikely to be updated after this article's publication. Thus, it'd make sense to develop a Machine Learning model that applies this methodology to new IUs.

References

Bostrom, N. (2014). *Superintelligence: Paths, Dangers, Strategies*. Oxford University Press.

Dictionary, M. W. (2022). Definition of Transformative. In *Merriam Webster Dictionary*. https://www.merriam-webster.com/dictionary/transformative

Greenhalgh, T., & Fahy, N. (2015). Research impact in the community-based health sciences: An analysis of 162 case studies from the 2014 UK Research Excellence Framework. *BMC Medicine*, *13*(1), 232. https://doi.org/10.1186/s12916-015-0467-4

Gruetzemacher, R., & Whittlestone, J. (2022). The transformative potential of artificial intelligence. *Futures*, *135*, 102884. https://doi.org/10.1016/j.futures.2021.102884

Karnofksy, H. (2016). Some Background on Our Views Regarding Advanced Artificial Intelligence. In *Open Philanthropy*. https://www.openphilanthropy.org/research/some-background-on-our-views-regarding-advanced-artificial-intelligence/

Lanjouw, J., & Schankerman, M. (1999). *The Quality of Ideas: Measuring Innovation with Multiple Indicators* (No. w7345; p. w7345). National Bureau of Economic Research. https://doi.org/10.3386/w7345