
A New Paradigm for Autonomous and Intelligent Systems Development: Why Well-being Measurement Matters

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ABSTRACT

A set of diverse and increasingly rigorous strategies to assess well-being is well positioned to address growing concerns about the influence and mixed impacts of autonomous and intelligent systems (A/IS). In this paper, we describe a broad-based approach to well-being measurement and provide a simple framework for ongoing well-being measurement and A/IS product improvement. We articulate the benefits of this measurement strategy for organizations and individuals concerned with the social, environmental, and ethical implications of A/IS.

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CCS CONCEPTS

• **General and reference** → *Metrics; Design*; • **Human-centered computing**; • **Computing methodologies** → *Artificial intelligence*; • **Software and its engineering** → *Designing software*;

KEYWORDS

Well-being, artificial intelligence, autonomous systems, measurement, design

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THE URGENCY OF WELL-BEING IN THE AUTONOMOUS/INTELLIGENT SYSTEMS ERA

A focus on well-being represents an alternative paradigm to traditional concerns of economic growth and efficiency. Well-being, defined subjectively, includes such components as flourishing, positive and negative affect, and satisfaction with life. Well-being can also incorporate satisfaction with the circumstances of life across domains such as education, economy, environment, health, government, community, culture, work, psychological well-being, and human settlements [1, 11]. Notably, momentum in the well-being movement has grown recently given urgent concerns about inequality, political instability, environmental degradation, and sustainability. In response, a variety of measurement and organizational strategies have surfaced, ranging from the Beyond GDP approach [5] to the Benefit Corporation [14] and the triple bottom line strategy [2]. Organizations and governments are in the process of developing ethics codes, guidelines [4], and international standards.¹

At the same time, the increased influence of technology companies' power and recent scandals over privacy and security, digital manipulation, and propaganda have put the power of autonomous and intelligent systems (A/IS) into the limelight. A/IS are heavily discussed for their role in labor displacement, self-driving cars, military robotics, and issues like facial recognition, and are widely recognized to have an enormous scope and scale of potential influence in every sector of society. It is therefore critical that A/IS design, deployment, evaluation, and policy prioritize the measurement and increase of well-being in society as key performance indicators of successful implementation. Below, we propose an iterative process of stakeholder engagement, indicator selection and measurement, and product improvement before describing the benefits of such an approach.

A FRAMEWORK FOR WELL-BEING MEASUREMENT

Below we share the key principles and components and an example of this approach to well-being measurement.

¹The authors of this paper are involved in the leadership of IEEE's P7010 Well-being Metrics Standard for Autonomous and Intelligent Systems, under development [7], as well as a chapter of IEEE's Ethically Aligned Design (v3) focused on well-being, forthcoming March, 2019.

Key principles of well-being measurement:**1. Broad-based conception of well-being:**

While general metrics such as satisfaction with life and affect are extremely powerful even in isolation, we believe that broad-based well-being assessment is necessary, as it impacts on many aspects of life that ultimately determine well-being. It is important for AI/S creators, monitors, policymakers, and researchers to incorporate a broad definition of well-being, including the kinds of domains and policy sectors reflected in the Sustainable Development Goals [15], OECD Better Life Index [10], World Values Survey [12], Doughnut Economics framework [13], and various promising national strategies [3, 8]. These include domains of education, community, health, work, environment, etc.

2. User and stakeholder engagement:

Another requisite to incorporating well-being measurement is engagement with users as well as indirect stakeholders affected by an A/IS product or service [6, 9]. Especially as measurement has been restricted to technical effectiveness, economic, and efficiency concerns in the past, understanding the many ways in which an A/IS product can affect individuals' physical, mental and emotional well-being directly and indirectly beyond traditional areas of safety or risk is essential.

3. Rigorous but flexible indicators:

Those involved in measurement should take advantage of available scientifically valid indicators and data sources, such as those mentioned previously. However, it is also necessary to carefully interpret measurement indicators and strategies in light of a particular product, context, and users.

- **4. Repeated data collection:** Our approach is to capture relevant secondary data as a baseline, and then customize a measurement strategy based on discussions with users and stakeholders regarding the probable impacts of an A/IS product. Pre-to-post data assessments can then be performed to evaluate whether product has mitigated potentially harmful impacts or realized positive ones. Producing high-quality causal evidence is challenging but optimal.
- **5. Learning from well-being data:** Measurement can help to build awareness and understanding of well-being impacts. This learning will then be followed by improvements to product design, deployment, reporting, and accountability processes. Data should inform internal reporting as well as external reporting, and can advance the understanding of well-being implications of A/IS for corporations, researchers, NGOs, governments, and the public.
- **6. Iterative process:** It takes time to develop a robust measurement strategy. Impacts may evolve as contexts and products change. This framework should be applied in an ongoing fashion to continuously improve efforts of well-being measurement and product improvement.



Figure 1: Example well-being indicators via Happiness Alliance (happycounts.org)

BENEFITS OF THE FRAMEWORK FOR WELL-BEING MEASUREMENT

Organizations have implemented A/IS to maintain competitive advantage and increase operational efficiency. At the same time, as adoption of A/IS has risen steeply, the technology has become increasingly pervasive. Continued adoption and implementation face public challenges as A/IS may cause job displacement, perpetuate inequities, and otherwise risk harming human and environmental well-being.

As more lives and critical impacts are in the sphere of influence of A/IS, cultivating trust in A/IS deployment has become essential. Organizations and individuals concerned with public welfare must now be able to articulate and realize clear benefits for their A/IS projects. Well-being goal articulation and measurement are first steps in realizing beneficial outcomes across the environmental, social, and political landscape. Among other benefits, well-being measurement is expected to help:

1. Build awareness: support diverse organizations and individuals across job roles in understanding the importance of well-being as well as the connection between well-being measures across different domains;

2. Develop infrastructure: help organizations build necessary infrastructure for thinking about, analyzing, and responding to well-being data;

3. Provide evidence: provide concrete data regarding well-being impacts in place of ignorance or assumptions that certain impacts are inevitable or unlikely;

- **4. Evaluate success:** determine the level of success of an A/IS product or service that is deployed against goals and expectations;
- **5. Manage risks:** help organizations and society both individually and collectively assess the risks of various AI products and services across sectors of society;
- **6. Improve well-being:** result in positive improvements to A/IS product and service designs, towards impacting human lives and the world for the better.

CONCLUSION

Identifying and implementing indicators as part of A/IS design using the proposed well-being measurement framework can help organizations develop systems and procedures to increase the well-being of users of A/IS products and services as well as that of indirect stakeholders and society at large.

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