مؤسسة دبي للمستقبل
DUBAI FUTURE FOUNDATION

Framework for Research and Publications Standards for **Human-Machine Collaboration**

15 July 2025

Introduction

‘What if we had a Turing declaration for human intelligence?’[1]

this was the question for the future in **Opportunity 41** posed in the 2024 edition of **The Global 50 report** for the post-Turing era, where machine language and intelligence are indistinguishable from human language and intelligence. To follow up on this opportunity, while acknowledging the nuanced and evolving nature of human–machine collaboration, the Dubai Future Foundation (DFF) introduces a classification system that supports a visual representation of human-machine collaboration in research (design) and publications.

Through icons, our aim is to support transparency in research[2] and provide – at a glance – a standard depiction that allows readers, researchers and decision-makers to see the extent to which research outputs have been shaped by machines, i.e. a process based approach.[3] While we recognise that research (including design) and publications in the future may increasingly rely on autonomous processes, this shift may not be uniformly applied across all contexts, fields, functions and industries during the transitional period,[4] a time frame that may last a couple of years or up to (and perhaps even longer than) 10 years.

Scope

By 'research and publications', we mean all intellectual and creative work carried out during the research process, content creation, publication design and related outputs. This includes but is not limited to academic papers, research articles and reports, data visualisations, books, articles, visual content, art, educational materials and technical documentation.

While 'intelligence' is challenging to define,[5] 'artificial intelligence' generally refers to a broad field composed of many elements, including machine learning, big data, neural networks and deep learning,[6] all designed to produce outputs or actions that inform decisions. For the icons, we use the broader term 'machines' as opposed to 'artificial intelligence', taking into account the increasing role of automation and robots in global economies and societies (see the section on megatrends in The Global 50).[7] By framing the visual tools through human–machine collaboration, we aim to make our definition inclusive of future possibilities.

Approach to Visual Tools for Human-Machine (HMC) Collaboration in Research and Publications

In a similar approach to the Creative Commons,[8] and in combination, Part A and Part B below together visually depict extent of human-machine collaboration in research and publications. A user (researcher, designer, writer, etc) matches the human-machine collaboration icon with the respective research and publication function(s). Displayed as such, Human-Machine icon + functions, they could be displayed on research papers and other content produced involving human–machine collaboration. The icons are designed to be flexible and can be adapted to research, content and publications in any industry, field or context, including visual content (such as images, video and art).

Many organisations and researchers have developed general classifications for machine or AI involvement. Non-exhaustive, SAE International's Levels of Driving Automation™ for autonomous vehicles,[9] or general descriptions of human–machine/AI interaction.[10] NEC Laboratories Europe's roadmap puts humans at the centre of the collaboration,[11] irrespective of the specific collaboration model used.[12]

Some have built classifications based on AI's autonomy and responsibility within collaborations,[13] while others have examined leadership roles, i.e. equal, human-led or AI-led contributions,[14] or learning process management models, i.e. active learning (where AI remains in control), interactive learning (where there is closer interaction between users and AI) and machine teaching (where human experts have control over the learning process).[15]

PART A

Human-Machine Collaboration in Research and Publications

All human	Human led	Machine assisted	Machine led	All machine
				
Human role **All human**	Human role **Leader**	Human role **Collaborator**	Human role **Oversight**	Human role **None**
Machine role **None**	Machine role **Oversight**	Machine role **Collaborator**	Machine role **Leader**	Machine role **All machine**
Overall **All human**	Overall **Machines conduct checks, highlight and correct errors, enhance output.**	Overall **Machines and humans work together.**	Overall **Humans conduct checks, highlight and correct errors, enhance output.**	Overall **All machine**

PART B

Common Research Functions

As a foundation for the development of the classification system, we considered various processes that may involve machines in the research and publications process. The HMC Classification System depicts the most common ones.

Ideation

The process of generating ideas and combining concepts to create new insights or solutions. It includes brainstorming, problem-framing, idea development, and the design of approaches and research methodologies.

Literature Review

The search through academic and non-academic research on a particular subject to understand or form the basis for framing research and associated research questions.

Data collection

The application of varied approaches to collect information through primary or secondary research.

Data analysis

The application of varied methods, both qualitative and quantitative, to analyse information collected through primary or secondary research.

Data interpretation

The application of critical analysis and reflection to uncover thematic findings and conclusions from collected and analysed data.

Writing

The use of written language to express opinions, present findings and provide critical analysis.

Translation

The process of converting text from an original, authoritative and operative version into another language while maintaining its meaning and intent.

Visuals

Components of a report, video or other content used to convey information visually. These may include images, charts, graphs, visualisations, motion graphics and other representations.

Design

The process and output of organising visual and functional elements of research into presentations, reports or other media (such as podcasts or videos).

Alternatives Considered

Only Human-Machine Collaboration without Functions

While one could choose to use only the icons that indicate human-machine collaboration (Part A) without functions (Part B), it may dilute human efforts and contribution to research and publications or mislead extent to which machine intelligence was part of the process particularly in the approach when research and publications is mixed.

Percentage of Human-Machine Collaboration

Using objective percentages to depict human versus machine produced content is challenging as it would inherently be subjective and hard to standardise across different research and publications functions. As a result, we used a process-based approach to depict the extent of human-machine collaboration.

Only Research and Publication Functions

Depicting functions that are either human or machine led alone, without specifying the extent of human-machine collaboration, does not meet the intention of this proposal, which is to provide transparency for decisions-makers on the extent to which machine intelligence was involved in the research and publication process and outputs.

Call to Action

We acknowledge that the use of icons will not always represent an absolute and clear delineation of human-machine collaboration, however, through simple visual tools that show both the WHAT and HOW of machine involvement in the research and publication process. Our aim is to support transparency in research[16] and provide – at a glance – a standard depiction that allows readers, researchers and decision-makers to see the extent to which research outputs have been shaped by machines.

The icons are designed to work together, with one representing human-machine collaboration and others representing common research, design and publication functions and we invite the global community to use these icons and provide their feedback and comments to

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Endnotes

1 Opportunity 41 in Dubai Future Foundation (2024) 'Future Opportunities Report: The Global 50'. www.dubaifuture.ae/wp-content/uploads/-41/03/2024Opportunity-Global2024-50-.pdf

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15 Mosqueira-Rey, E., Hernández-Pereira, E., Alonso-Ríos, D., Bobes-Bascarán, J. and Fernández-Leal, A. (2023) 'Human-in-the-loop machine learning: A state of the art'. Artificial Intelligence Review, 3054–3005 :56. https://doi.org/10.1007/s-10246-022-10462w

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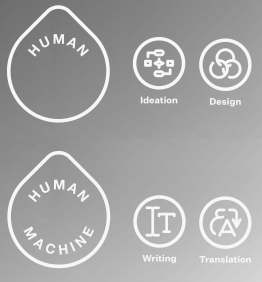

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