When designing path towards Maker Intelligence, aka Governance AI Toolset, MakerDAO should take into account the following.

Recent advances in machine learning have led to it being considered synonymous with the entirety of artificial intelligence, at least in popular conception. However, as exemplified by deep learning, this represents a very specific form of program synthesis, in which:

- Mission objectives/constraints are specified a priori.
- Voluminous data and potentially massive computational resources are available for training.
- The trained system is deployed into the production environment and remains unchanged thereafter.
- It is assumed that the training data/learning algorithm suffices for generalization to the production environment, even over time.

In order to solve a problem via machine learning, it is therefore necessary to impose strong a priori constraints, both on the design space and the production environment. Constraining the design space of the learner is almost always done via specialized human labor: pruning the space of possible input features, crafting a reward/objective function, selecting and optimizing hyperparameters, etc.

While objectives can readily be specified for simple domains (e.g. generating text with a specified message within a specified narrative), in complex application domains such as those in the real world, the practical difficulties have caused initial high expectations (e.g. for autonomous vehicles) to be repeatedly revised downwards.

An additional vital concern for the artificial intelligence community is the increasing evidence that machine learning is not

operating at the appropriate causal

level. This is problematic since it is likely to lead to overfitting, something which is anyway encouraged by the trend for huge parameter spaces (117M for GPT-1 vs 175B for GPT-3, undisclosed for GPT-4).

More generally, machine learning is good at manipulating data, but this has not been demonstrated to lead to understanding, i.e., the ability to represent the space of possibilities spanned by the constraints that are latent in the training set. This has corresponding implications for robustness and safety.

Maker is a complex adaptive system exposed to the real-world environment.

For Maker Intelligence to deliver on its mission it must not only embrace a stronger notion of causality, but also embed it in a more comprehensive learning framework that supports reflective reasoning.

Its roadmap should assert the importance of embodiment and the 'Physical Grounding Hypothesis', i.e., the necessity of making decisions, anytime, in a complex, noisy environment, with the resulting system capable of open-ended learning in inevitably-changing, real-world production environment, starting from minimal objectives. The value proposition of Maker Intelligence is then the elimination of the need to specify meaningful reward functions upfront and maintain them in tandem with a changing environment, which cannot scale in practice.

For the purposes of further discussion let's postulate that value proposition of Maker Intelligence for MakerDAO, which will help define key requirements for the system and hence its properties, goes as

owning an autonomously adaptive system capable of performing work on command

meaning

- MakerDAO owns the know-how: how to specify goals, constraints and targets to the system at any time and the system will immediately couple it with its latest world model (knowledge) to come up with new plans to control the protocol;
- The knowledge of the system is always white box and verifiable, so that its reasoning can be audited by MakerDAO;
- The system remains continuously adaptive: it learns on the job not suffering from retrain-freeze-deploy

cycles that are inherent in typical Machine Learning techniques of today;

- Work on command: the system predicts, simulates, recommends, (re)plans and acts as MakerDAO instructs it to coupling its latest world model to its latest goals at any time.

Henceforth, MakerDAO should be seeking Maker Intelligence (MI) to possess the following properties:

- Robustness to change: MI must be swiftly reconfigurable to drastically reduce reconfiguration downtime whenever MakerDAO or subDAO requirements change

- Data efficiency: MI must acquire relevant data autonomously bottom up and in real time bypassing lengthy data collection processes and other impediments to speed reducing to 0 the dependence on big data
- Rapid innovation: adopting principles of short innovation cycle MI guides proof of concepts and then transfers them immediately to production
- Safety: MI complies proactively with verification and validation procedures and is certifiable at any stage of its life cycle
- Open system of systems: MI integrates with other systems, leverages human domain expertise and opens its own expertise
- Capitalization: MI creates actionable knowledge. This is MakerDAO's key asset continually expanded and shared with other systems, engineering processes and stakeholders.