October 2020
Ekkono Solutions AB

# How To Start An Edge Machine Learning Project

**The Internet of Things is facing a super-fast development due to an increasing number of software innovations deployed to hardware. The phenomenon that connects the physical world with the Internet has increased dramatically in recent years and the number of IoT devices is estimated to reach move from 35 billion devices in 2020, to more than 88 billion in 2024[*]. When this enormous amount of 'things' gets connected, we cannot continue to make them dumb. Yes, dumb. IoT devices typically have limited computing power, small memories, and could generate large amounts of data. Cloud computing has worked very well for the IoT sector to grow, but it is time to transform the Internet of Things to their maximum capability and make them smart, effective and sustainable by incorporating the intelligence on the device, on the edge. But is 'edge' for everyone? And where do you start?**

Machine learning (ML) has been used to train and learn machines for decades. Moving into Industry 4.0, we all need to take that extra scope of responsibility to make machines, factories and entire supply chains seamlessly connected. We have to create truly smart devices to learn individually, predict and optimize themselves. All product companies most likely have the scenario of product improvements or quality issues that needs to be addressed. If you are one of those companies, then Edge Machine Learning[†] applies to your products. Let us explain how you get started with your first Edge ML project, what to think of when starting up, and show you a framework to use in the form of a CRISP-DM process.

---

[*] [Juniper Research, March 2020](Juniper Research, March 2020)

[†] Edge machine learning means running machine learning (ML) at the edge of the network – onboard the connected device. Ekkono develops an edge machine learning software. In Ekkono's case, it is possible to do incremental learning at the edge, which means that the ML model continuously gets better but also that it gets personalized as it is fed with sensor data while in production.

EKKONO .AI

# 1.    Scenario Matrix

When starting any project, first you have to do is identify the problem/scenario it is going to solve. It could be scenarios for product improvements or maybe for solving quality issues. When scenarios are identified, Ekkono has created a simplified matrix called the "Scenario matrix" to estimate the machine learning project potential. The matrix evaluates scenarios in four different categories: ML Applicability, Business Value, Feasibility and Sustainability by giving individual scores. The sum of those scores generates a total, that gives valuable guidance in selecting the scenario with the greatest potential for a successful ML project. This framework also allows others to understand how the scenario selection is approached.

ML Appicability + Business value + Feasibility + Sustainability = Project potential

Figure 1 — Scenario Matrix — Overview

## 1.1   Machine Learning Applicability

It is a challenge in this early stage to forecast the applicability of ML for a specific scenario, but what you should focus on at this level is scenario understanding and influencing factors. A high level of understanding of the scenario and if the influencing factors are predictable, also enhance the machine learning applicability.

## 1.2   Business Value

By looking at each time business value is created by ML, and the frequency of the occurrence, you get the total amount of created value; E.g. optimization of energy consumption for a machine will lower the energy cost for every installation.

## 1.3   Feasibility

The feasibility of the scenario is a combination of IoT platform readiness, sensor availability for required signals and the availability of data for modeling.

## 1.4  Sustainability

Sustainability is in Ekkono's DNA; therefore, we have added the sustainability category and encourage our customers to make it an important part of the scenario selection. This scenario describes to what degree the scenario will contribute to a more sustainable environment.

## 1.5  Project Potential

The combination of scores for each category generates a total score that gives valuable guidance in the selection of a scenario suitable for a ML project.

## 1.6  The Team

When working with the matrix it is important to engage the right team – people that are knowledgeable about the product (or products) on various levels, from the platform needed to run Edge ML, to the experienced engineer you trust and send into the field when you need to analyze or solve the trickiest of problems. This, however, only covers the technical aspect. There is also a need for product owners, service managers and sales experts to help quantify the business value.

## 2.  Use Case Stair

Another guidance when selecting a suitable scenario/use case is to take the complexity into account. For guidance, we have created a stair with four different levels of use case complexity. Starting with 'Current State', describing the normal state right now. When looking into the future you advance one step to 'Predictive', and when getting recommendation for actions from the predictions you are on the third level called 'Prescriptive'. The highest level is 'Cognitive', in which the product act on the recommended actions and go fully autonomous. The stair visualization is to point out that each of the steps benefit from the one below.
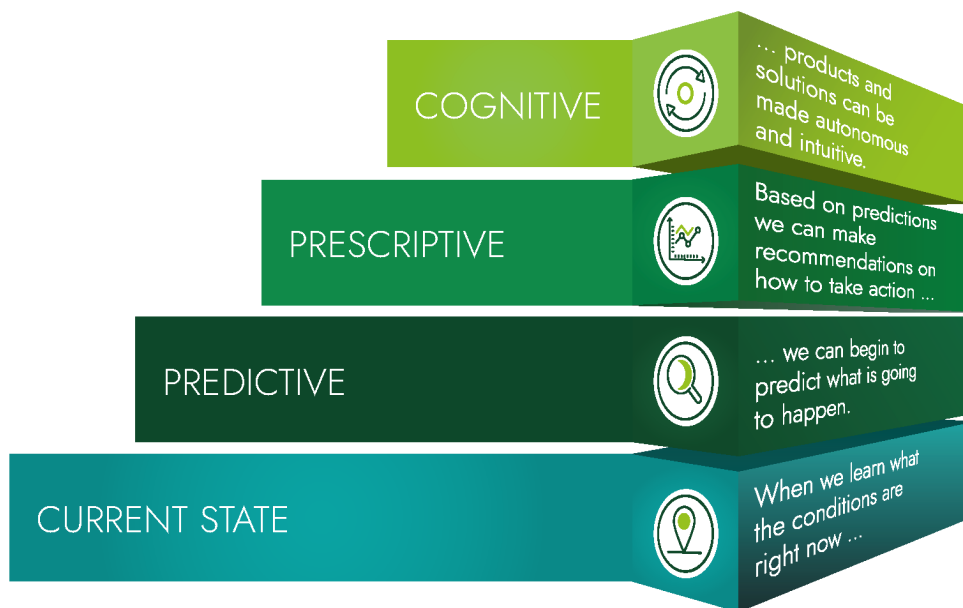


Figure 2 — Use Case Stair

It is appealing to go directly for fully autonomous. When being in the beginning of your Edge ML journey a recommendation is to start with 'Current State' level, to build a solid base before taking the next step up the stair. Two good examples of use cases for the first step are health monitoring and virtual sensor.

# 3.    Business Success Criteria

After use case selection it is time to define the criteria for business success when the use case is executing in production. The business success criteria will be the guiding star throughout the whole project life cycle. As in the use case selection process, the team composition is essential when defining a valid and correct business success criterion.

# 4.    Project Life Cycle

After use case selection and definition of business success criteria, a typical project life cycle continues with a 'Proof of Concept' (PoC). The purpose with a PoC is to demonstrate the feasibility and practical potential of the use case, and when often performed on historical data and with a limited amount of resources, you can effectively get great confidence in taking the next step to prototyping. A 'Prototype' step typically adds hardware and integrations to other systems to start collecting data and test the whole implementation of the solution. Next step is a 'Pilot' which is usually performed in a production environment, exposing the solution to real users to validate the expected value creation, and then finally, the 'Production' launch, the beginning of business value creation.
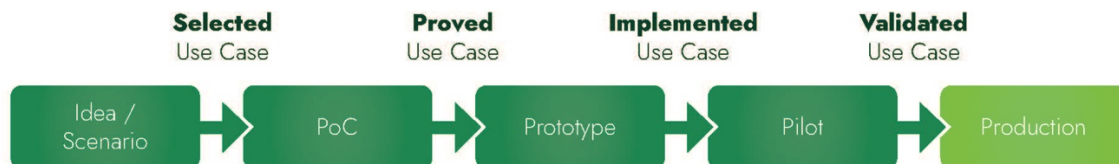
Figure 3 — Typical steps in Project Life Cycle.

# 5. CRISP-DM Refined

Structure given in a well proven process helps to create machine learning value in an effective and high-quality way and supports the alignment on business success criteria throughout a project. A good example is CRISP-DM which stands for Cross Industry Process for Data Mining. The original CRISP-DM manly targets cloud solutions. To get an increased alinement of the process to Edge ML, Ekkono has created a refined version including steps for Application Integration and Quality assurance.
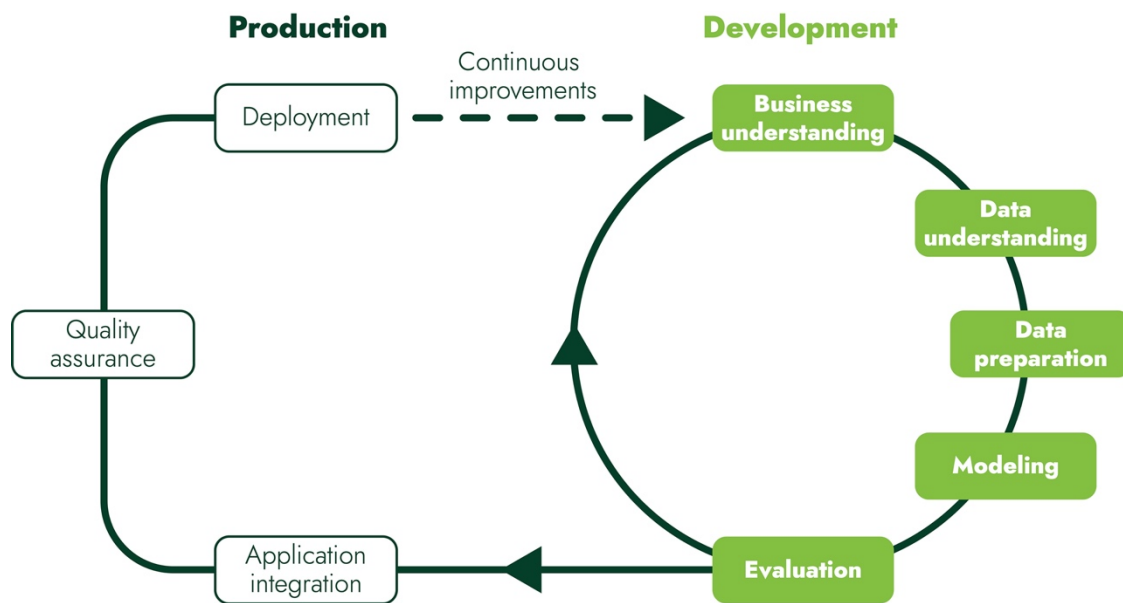


Figure 4 — CRISP-DM Refined

The Development part is typically used for PoC and Prototyping and the Production part is used by the Pilot and full Production launch in the project life cycle. The circle in the Development phase points out the iterative way of working when going from Business Understanding to Evaluation and back. Several laps are often needed until a sufficient solution is developed.

# 6. Conclusions

Edge ML is a thrilling and emerging field with enormous potential. Here is our summary on how to get started:

o  Select a suitable use case: Invest time in selecting the right one.
o  Start with current state: Do not go for full autonomy as a starting goal.
o  Start off with proving the use case: You can get quite far with limited amount of recourses.
o  Work in a structured way: Select a well proven process.

***

*Ekkono #openfika is a short open, online fika[+] session, hosted by Ekkono, on hot, contemporary and relevant topics, where a 15 minutes presentation is followed by discussion and Q&A. Keep an eye on www.ekkono.ai and LinkedIn for the next #openfika session.*

*Ekkono Solutions AB is a software company that develops Edge Machine Learning. Our product is the result of seven years of research at the University of Borås, Sweden, and assists product OEMs in different industries to rapidly develop smart features onboard their products, using machine learning to make them self-learning and predictive. For more information, visit www.ekkono.ai.*

---

[+] fika (wikipedia.org); Swedes have fika (pronounced [ˈfiːka]), meaning "coffee break". The tradition has spread throughout Swedish businesses around the world. Fika is a social institution in Sweden and a common practice at workplaces in Sweden. Fika may also function partially as an informal meeting between co-workers and management people, and it may even be considered impolite not to join in.