

DEPARTMENT OF ELECTRICAL ENGINEERING

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Confidentiality Restrictions Applied

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Interim Report - Morgan Stanley

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# 1 Technology at Morgan Stanley

The culture of work at [Morgan Stanley](#) during the pandemic has been to follow its core values of "doing the right thing" and "leading with exceptional ideas" [1] [2]. I particularly enjoy the fact that my ideas are taken into account and that my team takes time answering all of my questions regarding Technology. I believe that this culture has led me to be more comfortable networking and asking for help.

Whilst remote working is an obstacle when building confidence as an intern, the company's value helps me solve problem faster as I am allowed to make mistakes and try new things.

[Morgan Stanley](#) being a financial institution, technology is one of the biggest branches of the firm. It is used as an addition to all teams for creating tools used by traders, researching ways to win over competitors and general technical support. Innovation office and Automation center of excellence are part of technology transformation initiative.

## 1.1 Team overview

[Technology](#) at Morgan Stanley is separated into several branches. I am spending the next 6 months working with the **Innovation Office** as well as the **Automation Centre of Excellence**. Throughout the placement, I have the opportunity to work with both Labs and Innovation teams, on automation and Machine learning projects. The main role of Innovation is to facilitate the introduction of new technologies in the firm. As an investment bank, Morgan Stanley invests in new technologies to stand out from its competitors and keep up to date. They evaluate technology from an investment viewpoint to compute the added value and possible gains from bringing it inside the firm. Innovation provides trade life-cycle transparency, workflow, front to back trade closing and managed to increase the secondary trade volume growth of 30% without increasing headcount. It is interesting to be part of this team currently as it is expected to grow greatly this year. Indeed, there has been interest from the news [3] [4] as the Automation Center of Excellence is growing. As this is a complex task, innovation is split into three teams.

Figure 1: Overview of Innovation team structure and roles



1. **Labs** provides support for those technologies. They manage all physical and non physical assets. Their mission is to "provide rapid, safe, quantified transformation of technology into business value". By bringing solution through direct services, labs directly interacts with internal and external clients to help deliver the new technology.

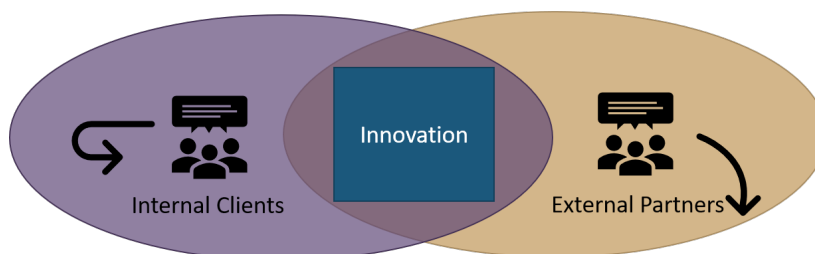
2. **Innovation Program** is the worldwide team to promote a culture of innovation across the firm. For example, they provide development and testing environment to try out facilitate the experimentation of new technologies. This demands a solid technical understanding, coupled with a knowledge and familiarity of the organisation to connect people together. Some example of technologies are Machine learning, AI or quantum technology.
3. **Emerging Technologies** team assesses and tests technologies that have never been implemented before. Their role is a technical one, similar to a technology consultancy service. They make a decision based on how mature the new piece of software or idea is, who would be the best partner for Morgan Stanley and how to leverage within their internal operations.

As Innovation team is relatively new to the firm, it is going to grow in size during my placement and I will have the opportunity to see its roles evolving too. As Machine Learning, electronics or GPUs switched from a technical application to a more general usage, Innovation was put in place to use those tools [11] [5] [6] [7]. This team is also interesting as technologies that grow in use and influence end up being a new team at Morgan Stanley. For example, the AI/ML team can build machine learning models for predicting market sentiments.

Though my manager is a Vice President in the Innovation Program, I am able to work with the Labs and Automation programs as well. One main challenge with this variety of client is working worldwide. Most of my team is based in America, I therefore have to adapt and be autonomous more often than not.

## 1.2 Clients

Figure 2: Hybrid Clients in innovation



As mentioned above, innovation brings new technologies into Morgan Stanley. Due to the confidentiality restrictions that come with an investment bank, they work with the technology providers during a long period to build a business relation as well as getting all the technical benefits. During my placement, I will be working with [Ui Path](#), an automation platform. This platform builds robots that can run unassisted to complete tasks like reading and writing email, web-page scraping, in a similar way to a python script.

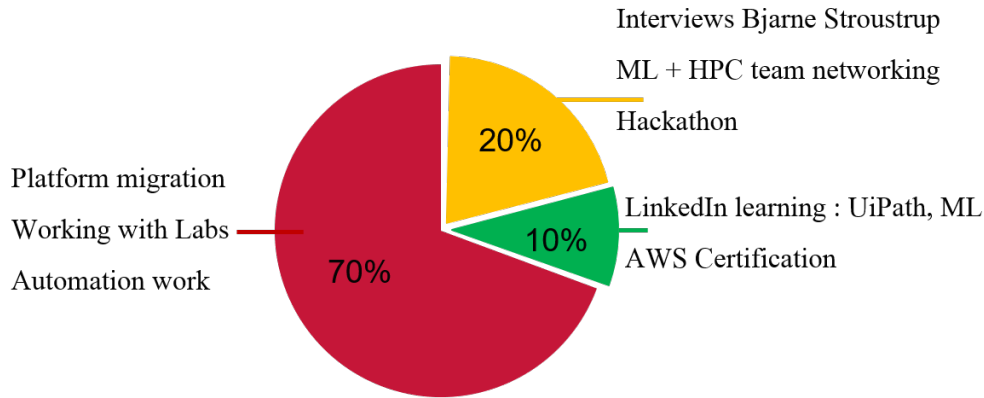
As I have completed my first project before the deadline, I also had the opportunity to promote it to [ReadyWorks](#), another external client that provides an asset management platform for monitoring, tracking assets being used in the firm.

## 2 Projects and Professional Development: 70% -20%-10%

### Learning and development plan

During my time at Morgan Stanley, I will be splitting my time based on the 70-20-10 leadership and development rule [13]. Figure 12 in the appendix display a projected GANTT chart for my work.

Figure 3: Splitting workload during the placement



Most of the day, I work on projects by using new tools or a new technology, tackling a new problem, learning from my peers through teamwork, or working with other departments. This is my added value to the firm as I complete the tasks assigned by my manager or clients. This is explained in section 2.1

Morgan Stanley's culture highly emphasises personal development, hence 20% of my time is spent through 'social learning'. By networking, being part of volunteering projects and Women in Science communities, I can learn a different set of skills. This is developed in section 2.2. As I will be returning to the office, I am also hoping to increase my network with people in London.

The last chunk of time is spent learning new skills, as details in section 2.3. I follow formal training courses or pass certifications. Recently, I have completed a UiPath training, signed up for AWS Quant qualification and machine learning training programs through LinkedIn. This formal learning allows me to take various projects.

### 2.1 Projects - 70%

As an intern, I can bring my skills to the firm through the completion of projects shown in figure 4. In Center of Excellence for Automation, my tasks consist of automating long processes through a piece of software. I mainly work on [ReadyWorks](#), an asset management platform and Jira, a project management tool.

Figure 4: Project GANTT chart (extract from appendix 12)

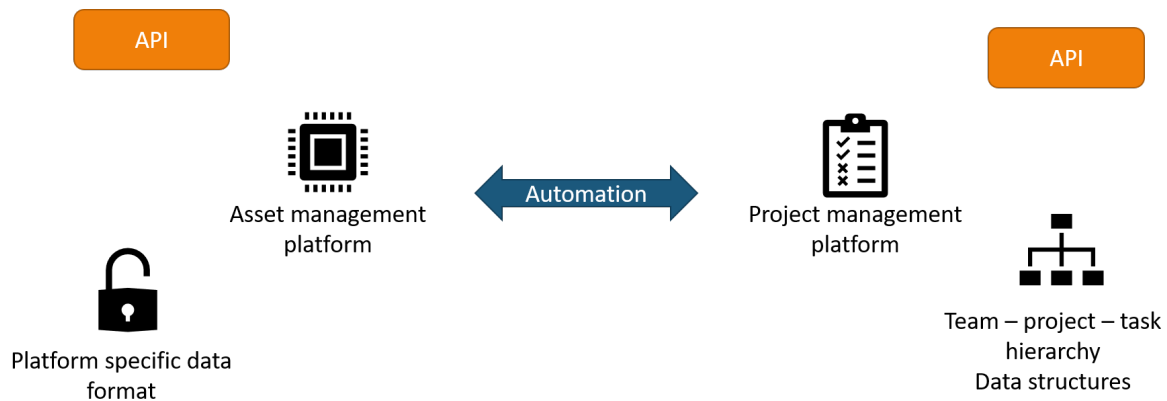
TASK	PROGRESS	START	END	4/5	4/12	4/19	4/26	5/3	5/10	5/17	5/24
<b>Projects</b>											
Platform merging automation Labs	90%	7-Apr	15-May								
Optics checkout automation Labs	20%	12-May	11-Jun								
ML for data sorting optimisation Labs	3%	15-May	24-Jun								
Projects CoE (undeteftined)	0%	24-Jun	22-Sep								

### 2.1.1 Automation work on merging platforms

This month, I have completed my first project for Labs. This project migrates data from Morgan Stanley's project management platform to their asset management one. This saves them a minimum of one hour a day through automation. Reduces 3-4 hours out of the executive director's time per month as well as opening another's team ability to report differently on their asset utilisation. Labs main roles are displayed on figure 6.

Appendix 11a displays my approach for sequentially testing each function. Green epics and tasks related to the project management whilst blue tickets are created on the asset side. Figure 5 provides an overview of the project.

Figure 5: High-level overview of the platform connector.



*Deliverables* - my role was to automatically perform the following actions:

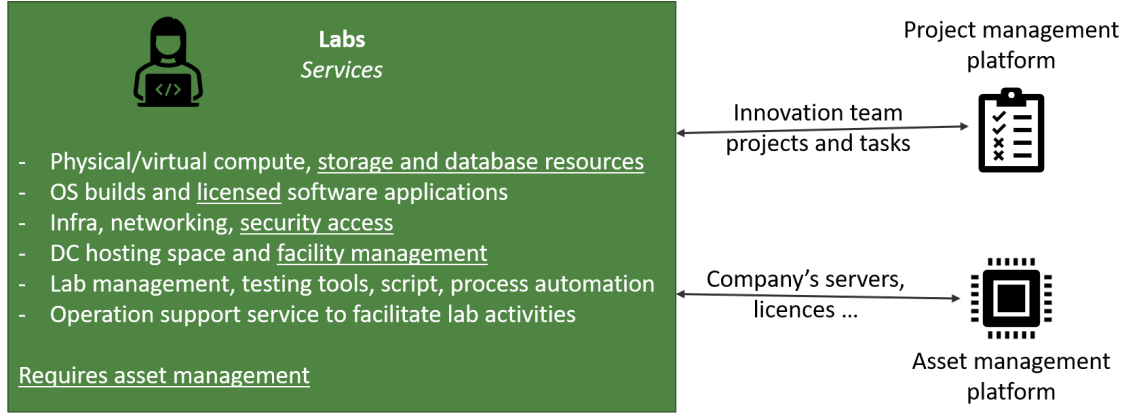
1. Link a task or project to the asset management platform so it appears on the asset interface. This is displayed on the orange arrows on the left side of appendix 11a.
2. Add linkage by displaying the asset url on the project platform and project url on asset platform. This corresponds to blue arrow on the left side of appendix 11b.
3. Make use of the hierarchical data in the projects to link assets in linked projects on the asset management side. That is, mapping the existing relationship on appendix 11c with the orange ones in order to create the new relationship from 'ticket A' to 'Asset I' and 'Asset II'.
4. Whilst the initial project was meant to be a regular program ran every hour, I took the initiative to add a front-end that allows the users to add/remove features and trigger the project migration between platforms depending on their needs. This involved the creation of an API to read and write to a shared document.

*Purpose of the project* - adding linkage between these two platforms not only automates a costly process done by human hand, it also provides Labs team with new information about their assets.

For a given project in the asset managing tool (blue boxes on appendix 11a), they can see all the assets used. For example, ticket A will display Assets I and II, which it didn't before. This gives insight as to where the servers or parts are located, who is using them. A history of asset usage per project or per user can then be generated with more accuracy.

On the project management side, users will also be more likely to link their project to the asset tool. As the corresponding tickets are automatically created, it is easier for them to only link an asset rather than going through the process of creating, than linking a project on a different platform. Figure 6 displays some roles of Labs team in order to give an insight on how the two platforms are used.

Figure 6: Overview of Labs specific tasks related to my first project.



The main challenges of this project were to understand the needs and requirements of the team. On one hand, the projects have a hierarchical structure of sub tasks within each project. Each project belongs to a team. Tasks have various field to describe and track their projection, see who works/watches them. On the other hand, the assets are initially sorted by types (e.g servers, networks ports, SSL certificates, subnets...).

The assets are supervised by a Configuration Management Database ([CMDB\[8\]](#)) ITIL-like database with a front end that allows to display their relations to location, projects and users.

I learned about API calls and spend some time working on code optimisation as I had to find an optimal way to scan both endpoints and perform a full update regularly without overflowing the server. I therefore did some code restructuring, structure charts and modular coding to get to a lower latency.

<i>Key</i>	<i>Risk</i>
A	Substantial deal breaker
B	Causes disruption to project timeline/delivery/budget
C	Inconvenient

Table 1: Legend for table 2 and 4

<i>Risk Type</i>	<i>Description</i>	<i>Time Risk</i>	<i>Cost Risk</i>	<i>Legal Risk</i>	<i>Mitigation</i>
Standards	Morgan Stanley's licensing and entitlement for software language, getting the right licences and permissions	B	B	A	Using examples from past projects for proper software usage, having a direct contact with my manager to get added to the right permission groups.
Skills	Having the python, API skills for completing the project smoothly	A	B	C	Pre-learning, revising python, building a network of teammates to support me throughout the building process.
Storing data	Finding the right place to store project code, files and information	B	C	A	Connection to a remote shared space with restricted access. Documentation of my projects for the data to be easily found.
Project deployment risk	Breaking tests or one of the platforms in use by deploying an outdated project.	C	B	B	Maximise the usage of test environments to try out the code with no risks of interference with the client's platforms. Prime testing, writing tests or using automated tests.
UI deployment risk	Leaking substantial information outside of the firm by deploying a website and API.	C	B	A	Internal development and deployment only - the tools created will only be accessible by Morgan Stanley employees connecting for a corporate machine.

Table 2: **Contingency plan** for the platform automation project. Please see table 1 for the legend.

### 2.1.2 Report management for ENS Optics

On the 12<sup>th</sup> of May, I started a project to facilitate process of checking out of a part within a server on the asset platform. *Purpose:* The process for assigning optics to a someone at Morgan Stanley used to be undefined. Emails would be sent to the person in charge, responsible for:

1. Checking for availability of an optics for the user requesting it,
2. Updating the corresponding resources and platforms to propagate the request,
3. Interacting with those who physically install the optics
4. Link the optics to the user who requested it and update its location to the latest one on the asset management platform.

As the process described below was difficult to track, there were risks of loss of data. Furthermore, this process was not guaranteed if the one responsible for this was away or would leave the firm in the future. It was therefore deemed useful to team up and automate most of this process, with the support of the asset management platform team, for whom I will write a piece of software.

As this project is still at an early stage, the main challenge is to understand and define it. In order to minimise this challenge, I presented the project to a senior member in the team and to ensure my understanding was correct. I also wrote a template code to gain time and provide the team with a baseline to work from. Several people within the team will be working on it and it will



be interesting to be part of a bigger project, having more opportunities to network and understand what the others do. Table 4 displays risks that may arise during this work and how to mitigate them.

*Deliverables* - Consists of two phases: work within [Morgan Stanley](#) (1) and building a powershell script to automate, working with [ReadyWorks](#) (2).

1. Creating a report of available inventory
2. Creating automation of ServiceNow ticket opening, tracking it until it is close and updating inventory records automatically.

<i>Risk Type</i>	<i>Description</i>	<i>Time Risk</i>	<i>Cost Risk</i>	<i>Legal Risk</i>	<i>Mitigation</i>
Team work	Project carried by the whole team. This requires everyone to work synchronously and be aware of what the others are doing.	A	B	B	Regular catch-ups with the rest of Labs team through daily standups. Checking and updating regularly the project's documentation and updating the Jira's board.
External	Some of the functionalities will be implemented by an external company.	B	C	A	Being careful with our data security, clearly define the tasks performed by both parties.
Purpose	This project serves a very particular case, the written automation would be useless if it is not general enough to be used by other teams.	C	A	C	Dynamic coding, general functions and using existing code within the firm.

Table 3: **Contingency plan** for the optics asset project. Please see table 1 for the legend.

### 2.1.3 Smart Data Cleanup with Machine Learning

I started another project for [ReadyWorks](#), working with their team to build a combined machine learning model from their data to cleanup redundancies and duplicates. *Deliverables* - Using a text classification deep neural network to merge assets in [ReadyWorks](#).

<i>Risk Type</i>	<i>Description</i>	<i>Time Risk</i>	<i>Cost Risk</i>	<i>Legal Risk</i>	<i>Mitigation</i>
Software skills and data	Having sufficient skills to build a machine learning model. Collecting enough data from pasted merged asset to train an efficient model.	A	C	C	It is possible to create 'fake' data with data augmentation. The model will keep training as more assets are manually merged. I will follow a linkedIn learning path on general classification problems in machine learning.

Table 4: **Contingency plan** for the optics asset project. Please see table 1 for the legend.

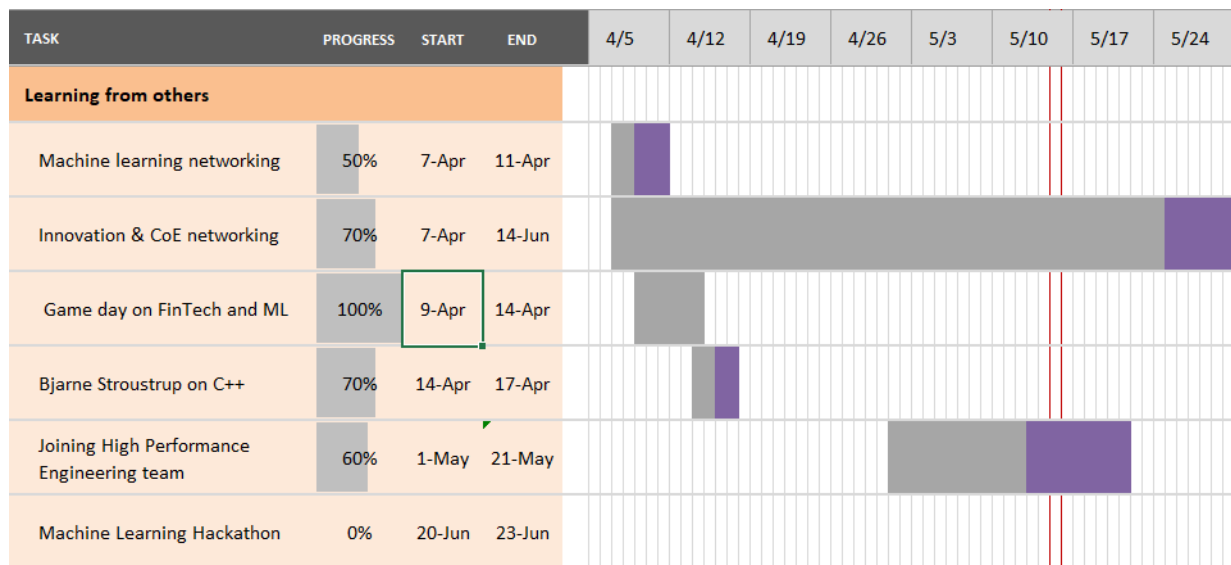
## 2.2 Learning from others - 20%

Being part of Innovation office allows me to get a wide exposure to different technologies and teams. As a result, one of my goals is to learn about the technical jobs in an investment bank. Figure 7 displays the corresponding GANTT chart.

So far, I learnt about the process of creating a software language by interviewing [Bjarne Stroustrup](#), the creator of C++ as he has worked for Morgan Stanley for 7 years.

I also understood how to use FPGAs to speedup trading process by listening to the High Performance Engineering (HPE) team executive director. With Vivado, they pipeline their trading process in a similar way to the way a CPU is pipelined in order to obtain the lowest latency possible. This is an interesting challenge. Improving trading speed by microseconds allow them to make gains on the 'bottom of the trading curve', after the rest of their competitors have just made a trade. I learned about further added values from this type of projects and enjoyed it. [9], [10]

Figure 7: Network GANTT chart (extract from appendix 12)

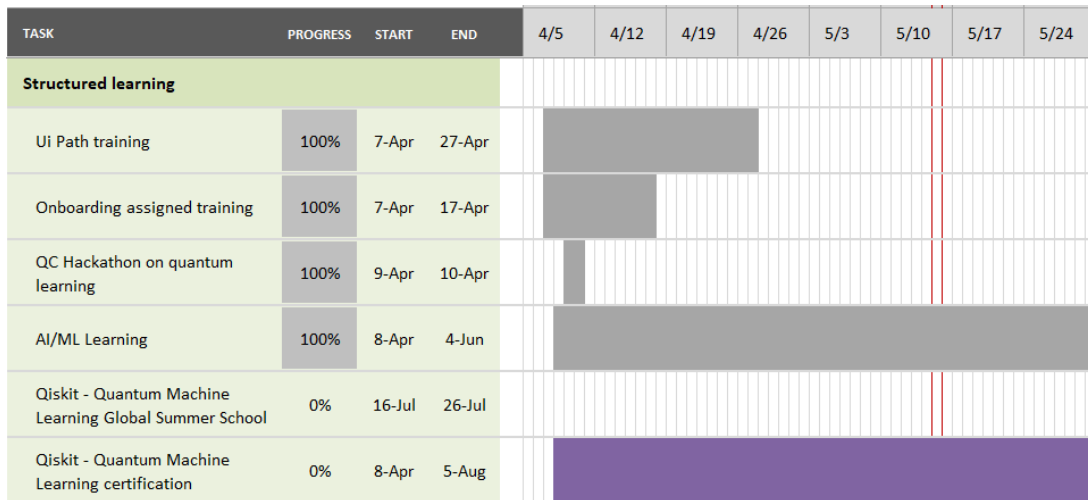


Meeting different technical teams is important to me as it displays various uses of the skills I earned at university. By networking, I have secured an offer in Labs and a job interview for HPE after my degree. [11]

My goals for the rest of the placement is to meet more people with Machine Learning and Artificial Intelligence to learn about the applications of these technologies in Finance. I also would like to shadow someone in High Performance Engineering in order to get a better understanding of their daily tasks.

## 2.3 Structured learning - 10%

Figure 8: Personal learning GANTT chart (extract from appendix 12)



As part of the placement, I get assigned a linkedIn learning profile as well as a learning budget. One of my goals is to get a Quantum Computing AWS certification. To reached this goal, I attended a [Quantum Coalition Hack](#) and hope to work on some related projects. I will also attend their summer school in June. I am following the Quantum Hacking program provided by Amazon. I also have completed a [Ui Path training](#) and hope to expand my machine learning knowledge by completing further programs.

## 3 Challenges and opportunities

### 3.1 Challenges

Challenge	Solution	Measures for the future
Narrow down my in-terests to find a path	Network, have a variety of projects	Try to obtain an offer for <a href="#">TAP</a> program at Morgan Stanley after my Masters
Onboarding process	List of useful resources for each problem	Document my problems on Morgan Stanley's documen-tation website for the others
Writing data from a hosted website	Creating an API.	Documenting and adding the API link on the UI for future interns

Table 5: **Challenges** - Overview of challenges faced to this date and the measures so they could be solved.

My biggest challenge throughout this placement is to learn and discover what I enjoy and would like to do in the future. Being opened to electronics, computing, front-end and back-end development is a strength as an intern in Innovation office, but I would like to refine my skills.

Meeting people from different teams and expertise is a double edge sword as each of them displays interesting areas work, related to skills I have gained from university and expand the pool of my interests. By the end of these 6 months, I would like to have a better idea of Technology in a firm and what roles are interesting to me.

Another challenge related to working in a financial company is the on-boarding process. Due to strict security rules, programming is done differently. Installing packages, applications, accessing web pages, making requests, is not possible without specific authorisation or virtual environment.

Learning where to find the right resources, who to ask for help and how to setup as a developer was frustrating. For example, I spent my first weeks learning how to load python modules instead of working on the project itself. Every new task comes with a very specific workflow, and this challenge is due to the nature of [Morgan Stanley](#).

A technical challenge related to the one above was finding solution to data storage problem. Creating an User Interface for the platform automation project was relatively easy. Accessing, reading and writing a file from this interface was a complex problems. After trying to use several resources, I ended up creating my own API to make queries and write to a document shared by the main script and the user interface. This was an unexpected challenge as I ran into permission problems and learnt everything about API headers.

### 3.2 Goal tracking

<i>Goal</i>	<i>Description</i>	<i>Measure taken</i>
AI/ML	Apply and develop my machine learning knowledge	Work on sentiment prediction project or data organisation using machine learning
Big Data	Manipulate, sort, order and present data in a smart and useful way that makes sense for the clients using software.	Use machine learning and database knowledge from 2 <sup>nd</sup> and 3 <sup>rd</sup> year EIE.
Low latency automation + scripting	Become comfortable automating complex processes, having an overview of what can be replaced by a piece of software and the best way to do it.	Use latency analysis from EIE courses. Network with Bjarne Stroustrup to get his guidelines on low latency problems.
Quantum Technology	Learn about quantum programming	Pass a AWS certification
Electronics	Learn all the applications of my electronics modules	Visit electronics labs if possible, learn about HPC and learn new skills like creating an API.
Communication skills	Improve my confidence presenting	Joining communication groups, regular project presentation via zoom and in person
Networking	Meet people from different background and positions	Set up time with senior members and Women in Technology

Table 6: **Goals** - Overview of skills I want to get from the placement and how I plan on doing it.

I intend to spend the next 6 months focusing on my technical and communication skills. The technical skills I would like to improve are mainly software based, such as Artificial Intelligence, overall knowledge about web services and data manipulation. These can be learnt through projects and personal learning.

The other main area that I wish to focus on is communication and networking. My main goal is to gain confidence in the workplace and be able to present my work to people from various background. Similarly, I hope to network and meet people from different divisions in [Morgan Stanley](#) in order to learn about the roles of Technology and the ways I can apply my knowledge from third year Electronics and Information engineering.

## References and Links

- [1] Morgan Stanley Website, core values since 1935.
  - 1. Do the right thing
  - 2. Put clients first
  - 3. Lead with exceptional ideas
  - 4. Commit to diversity and inclusion
  - 5. Give back

<https://www.morganstanley.com/about-us/morgan-stanley-core-values>
- [2] Research Paper from Morgan Stanley, *ESG and Sustainable Investing Report, Active Fundamental Equity, Global Opportunity Team*, pub. Feb 2021 by Investment Management. Displays the role of sustainability in investment  
<https://www.morganstanley.com/im/publication>
- [3] *Morgan Stanley establishing automation knowledge center*, by Budapest Business Journal, 29 Apr. 2021, NICHOLAS PONGRATZ. [BBJ Article on Morgan Stanley Automation Knowledge Center](#)
- [4] *Morgan Stanley to set up new knowledge center in Budapest*, by Hungarian Insider, 29 Apr. 2021, [Hungarian Insider article on Morgan Stanley Automation Knowledge Center](#)
- [5] Alan Turing Institute on Machine learning in finance challenges and key roles  
<https://www.turing.ac.uk/research/research-programmes/finance-and-economics/machine-learning-finance>
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- [7] Machine learning in UK financial services, pub. 16 October 2019, Bank of England publication.  
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- [8] Overview of Configuration Management Database (CMDB) <https://www.atlassian.com/itsm/it-asset-management/cmdb> Source: Atlassian
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- [10] How High performance engineering and Artificial Intelligence can improve financial services.  
<https://www.intel.com/content/www/us/en/financial-services-it/article/ai-hpc-banking.html>
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[https://www.researchgate.net/publication/319494787\\_High\\_Performance\\_Computing\\_in\\_Finance](https://www.researchgate.net/publication/319494787_High_Performance_Computing_in_Finance)
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- [13] The 70-20-10 Model for Learning and Development *January 28, 2014*, Training Industry <https://trainingindustry.com/wiki/content-development/the-702010-model-for-learning-and-development/>
- [14] Jira software used for project management. Issue and project tracking software.  
<https://www.atlassian.com/software/jira>
- [15] Readyworks software used for asset management. Work management for IT teams.  
<https://www.readyworks.com/>

## 4 Appendix

### 4.1 70-20-10 Rule

Figure 9 display the learning curve of using the three components of learning at work for personal and professional development. The base constituent is the structured learning, continuing the learning I have from university. Networking and peer learning is built upon this base knowledge. I can then complete projects using technical skills learnt in phase 1 and the soft skills from networking.

Figure 9: Visualising the 70-20-10 time splitting rule for my development as a growth model

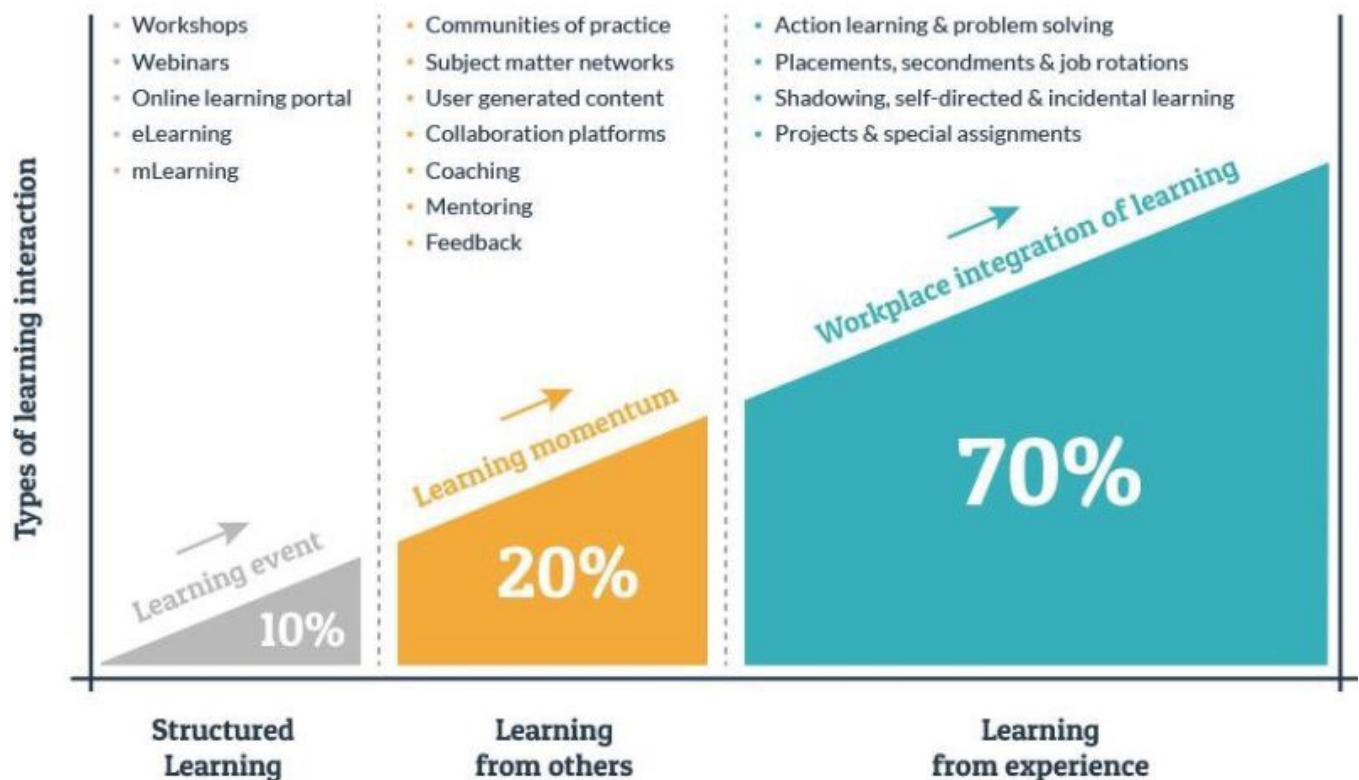
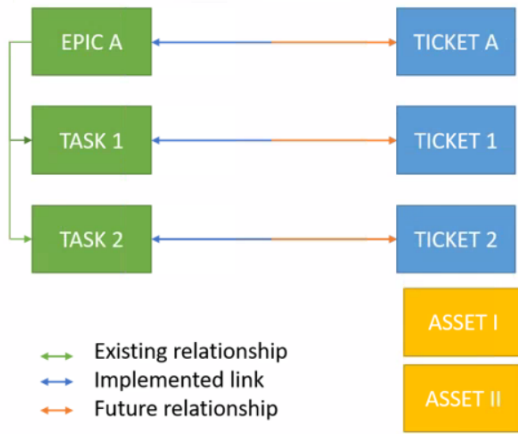


Figure 10: Visualising the 70-20-10 time splitting rule for my development as a cycle

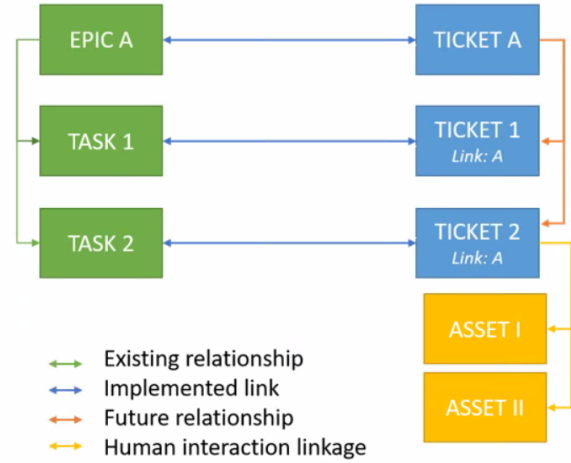


## 4.2 Automation work on merging platforms

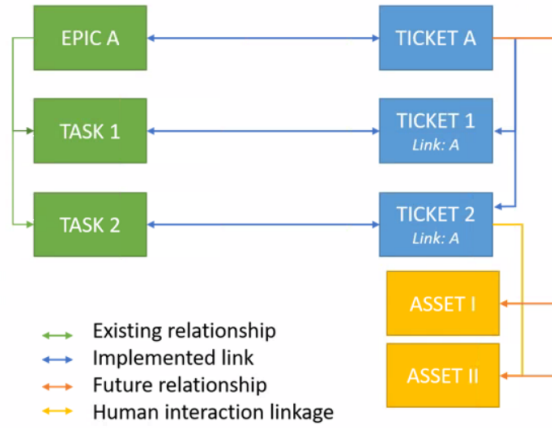
The figures below display the steps taken to fully automate the migration of projects to assets and assets to project. Section 2.1 details the exact implementation of each of those steps.



(a) Link from project to asset



(b) Link from asset to project



(c) Hierarchy mapping (green and orange arrows)

Figure 11: Merging asset management and project management platform flow.





4.3 GANTT Chart

Figure 12: Provisional GANTT chart for the next months

