From Data to AI-Based Discovery: The Maken Project at the National Library of Norway

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Abstract This chapter provides an overview of the National Library of Norway as well as an overview of the AI initiatives taking place at the library. The chapter presents details of a specific AI project, Maken. Maken is a discovery engine that finds similar books and images. For example, based on the pixels of a given image, Maken finds related images, or based on the text of a book, Maken finds similar books. The chapter provides insights into the needs for developing Maken, the actors involved in the project implementation and the challenges encountered. Finally, the chapter provides some insights into the value that such a project generates for different stakeholders, the lessons learned in the implementation phase and the skills that the library needs to adopt AI.

Keywords National Library · Norwegian National Library · Artificial intelligence · AI · Value creation

1 Introduction

The National Library of Norway (NLN) as we know it today was opened in 2005. The National Library of Norway counts about 420 employees and about 8.5 million items [1]. The University of Oslo Library functioned as both a university library and a national library from 1813 until 1989 when Norway established a repository in Mo i Rana as part of the national library.

The National Library of Norway has the mandate to preserve everything published within the country in compliance with the Legal Deposition Act [2]. In 1999, a new branch of the National Library was established in Oslo, and in 2005, the national library moved finally into a renovated building also located in Oslo. This marked the beginning of the Norwegian National Library as a new national

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institution, being the main source of information about Norway, Norwegians and Norwegian culture with bases in two locations: Oslo and Mo i Rana.

The National Library in Oslo is responsible for library activities aimed at the public, including reading rooms and research workspaces, as well as communication activities such as physical events and permanent and temporary exhibitions. The National Library's Repository Library is located in Mo i Rana where there is also a separate repository for storing archival materials from the National Archives of Norway [3]. The National Library in Mo i Rana has the responsibility of collecting, preserving and making available all material published for the Norwegian public, i.e. all legal deposit materials. In addition, cultural heritage materials from Norwegian archives, libraries and museums are also digitised and stored in Mo I Rana.

The Ministry of Culture and Equality maintains the overall national responsibility for archives, libraries and museums in Norway according to the government of Norway's official Web site "Government.no" [3]. According to such a Web site, one of the main tasks of the National Library is "*to secure and preserve legal deposit materials and other collections, and to encourage interest in and the use of these collections. The National Library also has the task of strengthening libraries as promoters of literature, knowledge and cultural heritage, as well as digitising document-based cultural heritage from Norwegian archives, libraries and museums*" [3].

AI Applications in NLN's AI activities are centred in the AI-lab that was formally established in 2018. The AI-lab at the National Library of Norway explores the potential use of AI in Libraries, including Archives and Museums. The AI-lab is involved in research and development as well as building resources, datasets and models and making them available to the public [4]. According to the director of the AI-lab, the AI-lab deliverables include "experiments, pilots, and demonstrations; support for internal workflows; internal and external knowledge; training datasets based on NLN's collections; fully trained models for free use across modalities; services and APIs; collaboration, networks such as 'ai4lam', 'CENL AI group'; research" [5].

Examples of such deliverables include: (1) Data sets such as the Norwegian Colossal Corpus which is a collection of multiple smaller Norwegian corpora suitable for training large language models; (2) AI models for various purposes that are often based on the combination of NLN's digital collections; an example is NB-Whisper for Norwegian Bokmål and Nynorsk; (3) AI tools tried in real contexts including user experiences/services, components in internal library workflows, or AI services for library services. Examples of applications include Maken, a recommendation system based on the content of books and images and described below and the Sami Bibliography Assistant. The Sami Bibliography holds publications relevant to the Sami community in Norway, and it is maintained by a special office at the National Library of Norway. The Sami Bibliography Assistant is based on a model trained on content and metadata both from inside and outside the existing

Sami Bibliography and has the purpose to assist the workflow in the Sami Bibliography office by suggesting material to be included in the Sami Bibliography based on analysing the content of the digital versions of the items.

This chapter investigates how the National Library of Norway developed and implemented the AI-based solution Maken. The chapter first introduces the project, including needs behind the implementation and actors involved. Then it presents the results, including the challenges faced in implementing the project, the value created and the skills that national libraries need to embark on the AI journey. Finally the last session provides some concluding remarks.

2 Description of the Project

One of the AI-based applications developed by the AI-lab is Maken, a recommendation system based on the content of books and images. Maken is an experimental new service that uses artificial intelligence to find books or images that are similar to each other. Given the immense collection of the NLN, it is sometimes hard for library users to find relevant related content when they navigate through the main site. Maken should help to make the search easier (Maken—AI-lab (nb.no)). As the director of the library and the director of the AI-lab respectively state:

> *Maken, which means "similar", which we put into production, is a vectorising of our digitised books and our digitised images where AI gives you samples of something that is similar to the picture or the book you have chosen. There is no human in this loop. It's only the analysis of the vectorised space that gives you this. If you find a picture of a mountain, you'll find a lot of mountains. If you find a book, you can see what AI thinks the book is to be compared to. This is put into production. (NLN Director, Interview 1)*

> This is not based on metadata at all. There is no metadata supporting this. The way this is done is that we vectorise the content that is producing a numerical mathematical representation of the content, the text itself, and then we have a large numerical space. You can look at this space as your room and the content is spread around in your room. …. This enables navigation in a collection without caring about the description of the content. (Director of AI lab, Interview 3)

The project is still at the experimentation stage, and a demo has been launched on the Web [1].

2.1 Need(s) Behind the Implementation

The primary need to start this project was the increasing difficulty in discovering the digital material of the library both due to the increasing amount of material and potential lack or insufficient metadata. The NLN possesses a huge and growing digital collection of every item published in the two official Norwegian Languages,

Norwegian and Sámi, including media, books and TV programmes. As de la Rosa et al. [6] write in a presentation given at the "Fantastic Futures 2021" conference:

> As such collections grow, discoverability becomes harder. Metadata may be missing or insufficient, and it may be difficult to search within the actual content. We wanted to see if AI could help make this experience more useful, interesting, or fun. So, we started building Maken. [6]

It was the NLN top management that started the initiative to look into this issue in 2020. The main idea was that Maken had to apply some of the knowledge that the AI Lab had acquired over several years of experimenting, prototyping and tool-building with AI. As a team leader states:

> *Let's say you go into our digital collection online and you select a book on flowers. You could, in the traditional method, just search for flowers and see what content shows up in your search table. But using this one is more like Spotify or Netflix or other content platforms where you use a bit of content as an entrance to show something to navigate and be presented with other content that is similar in some way. That is an interesting new way to discover digital content on our platform. (Team leader, interview 5)*

2.2 Actors Involved

The director of the library initiated the project. The main actors involved at the beginning of the project were the AI lab and the library's top management. Later, other stakeholders, external to the library (see below), were involved such as the library users.

2.3 Organisational Level

The Maken project was supported directly by the director of the NLN and the AI-lab director. The project aligns with the digitalisation strategy of the NLN [6].

2.4 External Actors

The project was initiated by the NLN, but the AI lab collaborated both with other internal teams, the users/patrons and other external actors in implementing, designing, producing and testing the recommender system. Maken was implemented by the AI-lab in collaboration with an internal team called Digital Outreach and a specialised IT consulting company, Dekode Interaktiv AS [7]. As an AI Lab Research Scientist states:

> We work in projects. Depending on the scope of the project we define who's going to be involved or not. For example, we're now working on language models and we are—the AI Labs is a unit, so we have different units… So, we do this cross-sectional work together. When we built Maken, we work together with a team called digital outreach, and that team already includes a few designers, a few frontend developers because we don't know how to make websites. So, we have to work with other teams if we want to deliver a product that is public-facing… (AI Lab Research Scientist, Interview 4)

The users had an essential role in developing the AI system both directly and indirectly. In fact, in parallel to developing Maken, the AI-lab tried to understand how the digital services were used by diverse types of users through data collection and analytics from the NLN's digital services and user surveys and by involving the users in testing the system:

> In parallel to developing Maken, we worked to understand how of our digital services were being used, in particular The Digital Library. Through data collection and analytics from our digital services, user surveys, and also some user testing, we had a general understanding of our user segments. [6]

Therefore, co-production characterised the development and implementation of Maken, and the co-production activities are summarised in Table 1 by following Mergel et al.'s phases of the co-production process [8].

Table 1 Co-production activities in the development and implementation of Maken at the National Library of Norway

Co-commissioning	*Prospective co-production phase*	The director of the Library initiated the project idea and involved the director of the AI lab
Co-design	*Concurrent co-production phases*	Maken was designed by the AI-lab in collaboration with an internal team called Digital Outreach and an external consulting company called Dekode Interaktiv AS
Co-implementation		The AI-lab, the Digital Outreach Team and Dekode Interaktiv AS implemented Maken by involving also other external actors such as the library users, which were involved, for example, in testing the system
Co-delivery		Maken is presently a library service offered by the library and used by the public to retrieve books online the same way as if the users were in the physical library
Co-assessment	*Retrospective co-production phase*	The AI Lab and the Demo users were the main actors involved in the co-assessment of the service in the initial implementation phase. Presently, on the Web page of the service there is a link where the service users can send messages to the Maken team with feedback about the service

2.5 Challenges

In the implementation of the Maken project, NLN has encountered several challenges. The main challenges were GDPR and privacy issues, Data Protection Impact Assessment and consent for the interviews [6]. In fact, they had to make sure to collect only the data they needed, that they respected the data protection law of the people they interviewed and the future user of the service, get the informed consent to record, store and analyse the data collected through interviews and workshops as well as respect the user rights and privileges.

3 Results

This paragraph depicts the main results of the study. It touches upon the value that AI has generated at the organisational and societal level, the main lesson learned and the new skills that libraries need in the era of AI.

3.1 Organisational Level

The implementation of Maken has generated a number of important organisational values for NLN. The main value generated by Maken consists of making easier to access and retrieve similar kinds of books and images to the broader public, thus contributing to accomplish the library mission. Another important value that Maken has generated for NLN is its contribution to the library strategy of experimenting with AI. Finally, Maken contributes to the administrative value of the library as it makes it unnecessary to generate (certain) metadata of the books and images in order to find the ones that are similar to each other.

3.2 Lessons Learned

The two most important lessons that NLN has learned from the Maken project are the key importance of involving users in the process as early as possible as well as the importance of understanding the digital changes that are affecting libraries. This is pointed out by a team leader and the library director, respectively, for example, in the following two quotes:

For the next AI project, we want to be even more aware of bringing in the people who are eventually going to use it. … So, that is the key thing, I guess. I keep coming back to it. It sounds like a cliché, but it really is true from our experience. The technology is there to serve humans and bring humans along the way. It's always the way to go. (Team leader, interview 5).

So, we need a digital change in libraries, on how you focus. (NLN Director, Interview 1)

3.3 Value Created and Co-created

Experimenting with AI at the AI-lab and specifically the Maken project generates potential and realised value for society. The most important societal value is the democratic value. This is enacted by the easier access to digital books and images for the library users, thus getting new insights into the country's cultural history as shown by the following quotes:

The value, for example… Using this system, they (final users) are able to find related documents that they could be interested in. We run user testing with different user profiles and user stories, and they all found the service really useful. (AI Lab Research Scientist, Interview 4)

We don't want to sell a service and earn cash. We just want to provide value in the form of people getting new insights into the cultural history that we have. (Team leader, interview 5)

3.4 New Skills

There are several skills and competences that are needed to embrace AI in NLN. Some skills are more general; others are more specific to the responsibility/ the role that an employee has in the library. As the director of the AI Lab states, first, everybody in the library needs to have a minimum understanding of AI technology, and then there is the need for more specialised competences.

We have realised that we need to build internal, I would say, capacity in terms of understanding, but also brain muscles to do work in this field. We need to educate a lot of people up to a minimum level. (Director of AI lab, Interview 3)

At a more specific level, AI skills are extremely important as also pointed out by the AI lab director:

Definitely, in our library we need extremely good people on AI to be able to understand AI and the potential of AI. (Director of AI lab, Interview 3)

In addition, it is pointed out that leadership capable of understanding the strategic significance and implications of AI is also important for national libraries in the AI era:

In the other end, we need a director with a good enough knowledge about the potential of both AI and the potential of the digital collection in the library used by AI. That is about strategy. So, it is about the politics, it is about the purpose of the library, the director level. (Director of AI lab, Interview 3)

The skills of the librarians must change from cataloguing skills to be organisers of knowledge in the digital world and being able to generate metadata about the material as the library director states:

The role of the librarian needs to change…. instead of doing what the librarians have been doing in the past couple of centuries, which is based on physical books needing to be found on shelves and a hierarchy of knowledge based on that as Dewey, you need to move into being the best organisers of knowledge in the digital sphere, in your digital collection… (NLN Director, Interview 1)

Another important skill that national libraries need in the future is data analysis skills. These are necessary both to understand the data and to understand how machine learning algorithms use the data.

For finding the good data, if you could choose from a buffet of what knowledge or competence you need, then data analysts will be really, really useful to have because, of course, you need someone who knows the ins and outs of machine learning as a subject. (Team leader, interview 5)

Also design thinking defined as "a human-centred innovation process that emphasizes observation, collaboration, fast learning, visualisation of ideas, rapid concept prototyping, and concurrent business analysis" [9] could be an important skill because it is important to understand the process and what the library users want as a team leader points out:

Design thinking could be useful. There are a lot of ways to facilitate the process, but the process is important. So, someone with a good understanding of what the process looks like is important. (…) From there, it's just testing, testing, testing and have the end user in the loop. (Team leader, interview 5)

4 Conclusions

The National Library of Norway as we know it today opened in 2005. It has the responsibility of collecting, preserving and making available all the material published in Norway, which is all legal deposit material, to the Norwegian public. In addition, the library stores all cultural heritage material from Norwegian archives, libraries and museums.

The National Library of Norway is very advanced in experimenting with AI. The main AI activities are centred on the AI lab, established in 2018, and include (1) data sets such as the Norwegian Colossal Corpus; (2) AI models for various purposes such as NB-Whisper for Norwegian Bokmål and Nynorsk; and (3) AI tools tried in real contexts including user experiences/services, components in internal library workflows, or services for services as Maken. Maken is an experimental new service that uses artificial intelligence to find books or images that are similar to each other.

There were two main needs for starting this project. The first was the increasing difficulty in discovering the digital material of the library both due to the increasing amount of material and potential lack or insufficient metadata. The second was NLN's wish to apply some of the knowledge that the AI Lab had acquired over several years of experimenting, prototyping and tool-building with AI on real-life applications.

Several internal and external actors were involved in the project, including the director of the library who was responsible for starting the project, a team called Digital Outreach as well as the users of the system.

The project was not free from challenges that included GDPR and privacy issues, Data Protection Impact Assessment and consent for the interviews [6].

The project has created several organisational and public values. The main value generated by Maken at organisational level is its contribution to accomplish the library mission, by making it easier to access and retrieve similar kinds of books and images to the broader public. The most important value generated for society is the democratic value. This easier access to the library material also generates democratic value for society as it makes it easier to get new insights into the country's cultural history.

In the process of developing and implementing AI in the library, NLN has also learned some important lessons; the most important are user involvement in projects and the importance of understanding the digital changes that are affecting libraries.

Finally, NLN points out new skills that national libraries need in the era of AI, including general AI knowledge for all employees in the library, good leadership skills, design thinking skills, data analysis skills and librarians' skills on how to generate metadata in the digital world.

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Appendix

See Tables 2 and 3.

Table 2 Overview of the Maken project at the National Library of Norway

Case and project name			
National Library of Norway/Maken project			
Country	**Number of employees**	**Type of AI solution**	**Year and maturity level**
Norway	420	Recommendations system based on the content of books and images	Experimental stage/demo launched on Web site
Project description			
Maken is a discovery engine to find similar books and similar images. Based on the pixels of the images, Maken finds related images. Based on the text of a book itself, Maken finds books that have some resemblance to each other			
Need(s) behind implementation	**Actors involved**	**Challenges**	
Increasing difficulty in discovering the digital material; increasing amount of material; potential lack or insufficient metadata	Top management, AI-lab, users, external digital agency	GDPR and privacy issues, Data Protection Impact Assessment, consent for the interviews	
Results			
Organisational level	**Value created and co-created**	**Lesson learned**	
Importance of involving users in the process and the importance of understanding digital change in the libraries	Democratic value enacted by the easier access to digital books and images for the library users, contribution to the library strategy of experimenting with AI	Importance of involving users in the process and the importance of understanding digital change in the libraries	

Table 3 Overview of interviews at the Norwegian National Library

Number	Position	Interview date	Interview length
1	Director of the Library	13-03-2024	1 h
2	Director of AI lab	22-02-2024	1 h 20 min
3	Director of AI lab	27-02-2024	1 h 30 min
4	AI Lab Research Scientist	06-03-2024	1 h 20 min
5	Team Leader	09-04-2024	1 h 40 min

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