

CASE STUDY: NN INVESTMENT PARTNERS AND THE T-SHAPED TEAM AT WORK

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Company Background

NN Investment Partners (also known as NN IP) is a Netherlands-based asset manager operating in 15 countries in Europe, Asia, and the Americas. A global active asset manager for institutional and wholesale investors, it manages €300 billion in assets for pension funds, insurers, family offices, independent financial advisers, banks, and private individuals.

NN IP offers a diverse range of funds within fixed-income, equity, multi-asset, and alternative investment strategies. Fixed-income strategies account for almost two-thirds of the firm's assets under management.

Investment Philosophy

NN IP believes that markets are complex and not fully rational. The market ecology has shown to be more complex in nature, and while the efficient market hypothesis (EMH) remains vital, there are pockets of opportunities for active asset managers to exploit inefficiencies driven by the complex and evolving environment. NN IP has adopted tenets of the adaptive market hypothesis (AMH) as a foundation of its investment philosophy. The AMH not only offers an extension of the EMH that integrates the benefits and tools of modern finance theory, but it also adds insights that allow one to look at the market as an evolving entity within a complex and adaptive system. NN IP complements and enriches its investment philosophy with the application of artificial intelligence, such as machine learning and NLP, as well as traditional and alternative structured and unstructured datasets. This helps the firm capture the fast and slow regime shifts, new drivers of factor premiums, and timely insights on economic activities and nonfinancial factors, such as ESG factors.

The Organizing Framework

The information and technological age has begun to dominate parts of NN IP's communication. This age, along with improved data storage, computing power,

and the rise of open-source licensing, is causing exponential advancement in the area of big data and AI technologies.

Using data in new ways is essentially about augmenting the firm's experience with data. It is achieved by using advanced algorithms to unearth new patterns and nonlinearities and by implementing behavioral insights when working with information. In order to identify and democratize access to the sources of alpha derived from ESG factors, big data, AI, and behavioral science, NN IP brings people with domain knowledge and technical expertise together to work around three core objectives.

The first core objective is related to data. Getting access to datasets, including new and alternative data sources that have potential to bring fresh insights to the investment function, is the crucial first step. This also means making sure that internally generated data are more readily available and are in an accessible format. Accessibility and usability of data allow for faster cross-fertilization of ideas and insights.

The second objective relates to the technological environment. Advancing technologies, such as AI, will be disruptive to the asset management industry. To that end, the innovation platform and investment team work together to build new data engineering and computing capabilities and new analytical competencies. A scalable tech environment that can handle structured and unstructured data is very important for AI/big data-related work.

The third objective is related to research and experimentation. To make sure NN IP is continuously learning and challenging existing processes, models, and techniques, it has taken a more strategic perspective on all the research efforts within the company. This allows the firm to focus and unlock knowledge in the areas of data, technology, and

behavioral science. Moreover, experimenting with applications of emerging technology and working with new behavioral science hypotheses within investing are also crucial aspects to build organizational knowledge.

To keep up with the pace of advancement and leverage upon it, an effective change management process is also crucial for organizations to experiment with and adopt AI and big data in their investment decision-making processes.

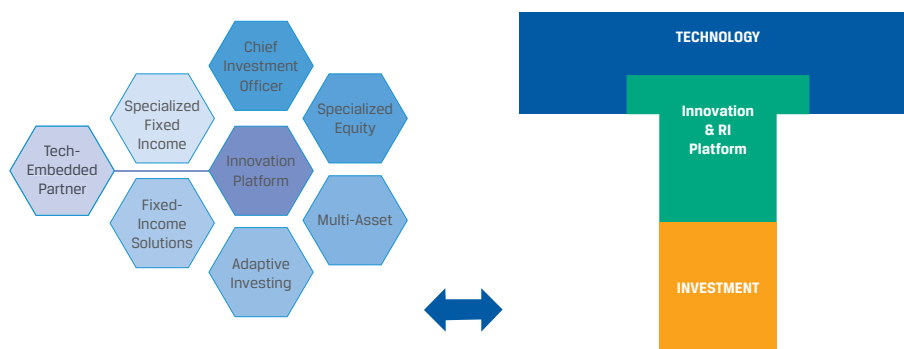
NN IP describes its way of working as inspired by the idea of working on the edge of chaos. That is, by combining the right level of chaos with structured checkpoints and methods, NN IP aims to control its innovation projects in the most efficient manner.

As part of NN IP's strategic direction, it reoriented the structure of its investment organization by placing ESG specialists and technologists (data scientists and engineers) in each investment team, as opposed to an earlier structure of a centralized team. This decentralization helped create both technological focus and ESG expertise within each investment team. It also accelerated the application of new data, technology, and research in investment processes. Another strategic step was to establish a centralized innovation and responsible investing (RI) platform. This way of structuring helped the firm build a T-shaped organization in its true sense. At the organization level, the innovation and RI platform is the linking pin between the technology and operations (Tech & Ops) department and the investment department (see **Figure 6**).

The Innovation Team

NN IP's innovation and RI platform sits in the middle of a beehive structure, which enables the investment teams to embrace responsible investing and new and

FIGURE 6. NN IP INVESTMENT TEAM STRUCTURE AND EMBODIMENT OF THE T-SHAPED STRUCTURE



emerging technology, understand the latest big data and alternative data trends, and think critically about their own investment decisions. The innovation team was created to bring people and technology together by inspiring, facilitating, and creating smart investment solutions for its clients and colleagues.

To provide and maintain an appropriate level of support across all investment functional areas, the innovation function is divided in two layers—the management team and the solution team—as shown in **Figure 7**.

The management team consists of senior managers from both the investment department and the Tech & Ops department, program managers, and subject matter experts of various investment strategies. This group of people operates across the functional area within the organization and serves as a center of excellence with a focus on the following:

1. Providing thought leadership, vision, and direction
2. Establishing and maintaining the NN IP innovation ecosystem
3. Establishing best practices to adopt AI and big data
4. Overseeing all innovation programs/projects executed and assisted by the innovation platform
5. Supporting colleagues to gain either technical skills or investment skills through education and training

The solution team consists of innovation drivers and subject matter experts from both technology

(e.g., data engineers, data scientists, software engineers) and investments (e.g., portfolio managers, analysts). The solution team works on various data, data science, and tooling-related projects.

Upon setting up the innovation team, it has been agreed with the CIO and the COO (chief operations officer) that the innovation team should consist of colleagues from both technology and operations, as well as investments, to bring combined domain knowledge to the table to develop the best solutions. In the management team, the head of innovation and innovation area leads come from the investment department, while the tech lead and program leads come from the Tech & Ops department. Similarly, in the solution team, innovation drivers and tech members come from Tech & Ops, while senior users are portfolio managers and analysts of different investment teams, who are responsible for bringing the business perspective to the projects.

The innovation team in itself is a T-shaped team that combines different skills, including domain, innovation, and technology expertise. **Table 2** highlights how the team members of the innovation and RI platform represent the skills in accordance with the T-shaped skills spectrum. The innovation team brings in deep knowledge about the investment domain, data science, and technology infrastructure to build scalable solutions. Combined with NN IP's way of working based on design thinking, lean start-up, and agile methods, this provides just enough structure to be focused on business value while allowing for creativity and adaptiveness. This combination of

FIGURE 7. INNOVATION FUNCTION



Source: NN Investment Partners.

TABLE 2. THE T-SHAPED INNOVATION AND RI PLATFORM

	Technical Skills	Innovation Skills	Investment Skills
Tech & Ops Department	<ul style="list-style-type: none"> • Software Engineers • Data Engineers & Scientists • Scrum Masters 		
Innovation Platform	<ul style="list-style-type: none"> • Technical Lead • Technical Members 	<ul style="list-style-type: none"> • Program Leads • Innovation Drivers 	<ul style="list-style-type: none"> • Head of Innovation • Innovation Area Leads
Investment Team	<ul style="list-style-type: none"> • Quantitative Researchers 		<ul style="list-style-type: none"> • Head of Investment Team • Portfolio Managers • Analysts & Strategists • Economists

skills helps connect the investment and technology functions of the company efficiently. The T-shaped innovation and RI platform focuses on inspiring new ideas, facilitating cross-team projects, and creating innovative solutions to enable NN IP to adopt AI and big data in its investment processes at scale.

Roles and Responsibilities

The head of innovation and RI is part of the investment management team and is responsible for the overall innovation portfolio and responsible investing. The technical lead brings a wealth of technical knowledge and expertise in managing the technical team. The technical lead has the technical knowledge of the solution and is able to identify potential technological gaps and risks in the solution. Along with the innovation area leads, the technical lead guides the product backlog prioritization and actively participates in the definition of the new innovation product strategy with the product owner.

In order to enable efficient collaboration and creation of practical yet innovative solutions, the innovation team works closely with an internal business sponsor. The business sponsor reports to the CIO and is a senior investment professional and head of an investment team. The business sponsor brings additional thought leadership and business perspective to the innovation function by covering the innovation project cost, bringing in insight specific to the investment process, and often providing resources from his or her team to jointly work on the project. Priorities within the innovation project are set by the executive sponsor.

To bring process innovation and practice leadership to the investment processes, the innovation area

leads, program leads, and innovation drivers play a key role. An investment process has many components that are needed for an investment strategy to be successful. However, if one looks at a meta level, it takes only two inputs: information and experience with the information. The information could be about traditional indicators and financial factors or even big data factors. Experience refers to the understanding of the information and its application in making informed decisions. Here, AI and advanced analytics can help in augmenting human experience when engaging with traditional or new datasets. AI and machine learning techniques can identify the nonlinear relationships between the datasets and provide additional insights on the characteristics of the datasets. In order to integrate big data and advanced technology in investment processes, program leads and innovation area leads, such as the strategic R&D (research and development) lead and the investment science lead, bring their cross-functional skill in investment, technology, and innovation methods to identify the right approach to achieve investment process innovation with AI and big data.

The strategic R&D lead owns the research agenda of the investment engine, thereby having a complete overview of all the research activities. This helps in identifying areas of synergy within all the hives where big data and AI are being investigated. Since the collaboration between investment and data science functions is challenging, the R&D lead also leads the community of data scientists embedded in the hives to facilitate knowledge exchange in the areas of AI, machine learning, and big data and their applications in investing. The R&D lead's responsibility is not only coordinating the research agenda but also communicating the progress

back to the C-suite and the management team of the investment function. More importantly, he or she leads the discussion around which competencies within AI adoption the company should focus on and prioritize. He or she is also responsible for getting the management team, data scientists, and data engineers to contribute to the discussion in a productive way. Thereafter, the R&D lead incorporates a cross-functional AI competency and is responsible for its overall success. In short, the R&D lead sets the strategic direction of the research activities around AI, machine learning, and big data adoption in investment processes, acts as a translator, and leads new AI competency development within the company.

The investment science lead manages the technical members, such as the data scientists and data engineers, of the innovation team. Jointly they focus on using AI, machine learning, and big data to develop novel investment solutions that investment professionals in the rest of the organization can use to improve their investment processes. These improvements typically come in the form of efficiency gains or enhanced alpha potential. Being part of the innovation and RI platform, special attention is given to responsible investing-related opportunities, which account for more than half of the investment science portfolio of innovation initiatives. Furthermore, he or she plays a crucial role in further scaling up the AI competencies prioritized as the strategic direction. He or she is also responsible for actively gathering insights from internal experiments and sharing these broadly with investment professionals, thereby inspiring them to adopt emerging technologies in their investment processes. More importantly, he or she also plays an important role as innovation ambassador, working together with other senior investment professionals in the sourcing of new ideas and distribution of the insights. The actionable and innovative solutions developed by the technical members of the team under the direction of the investment science lead enhance the investment processes of the teams by providing fresh insights on efficiency gains and alpha opportunities.

Both the innovation area leads are subject matter experts and thus function as knowledge engineers who bring in their investment expertise and insights

on the emerging industry trends and translate these into action points that enable adoption of AI, machine learning, and big data in the investment processes.

Program leads are T-shaped professionals who have sufficient knowledge and understanding of both technology and investment. They are also experts in innovation methods and project management and work closely with the innovation area leads to ensure the function operates in an efficient and structured manner. They are responsible for managing and executing the specific elements within the innovation process. The program leads and the innovation area leads also actively engage in stakeholder management.

The Innovation Process

All big data and AI projects at NN IP follow the innovation process, which typically includes the following steps:

- Ideate
- Explore
- Experiment
- Execute
- Business-as-usual (BAU)

Figure 8 depicts this process.

Ideate

The amount of data and tooling in the industry is huge, growing, and mostly too immature to directly embed in investment processes. At the same time, many internal ideas and initiatives are somewhat fragmented and not yet aligned with the strategy. Ideation happens mostly within the investment hives themselves, where portfolio managers and analysts, together with technologists in the teams, sketch an investment idea or define an investment challenge. Such an idea or challenge will be brought to and centralized with the program leads of the innovation platform.

Explore

The idea/challenge will be explored, a team formed, the vision and mission of the team defined, and the scope

FIGURE 8. THE NN IP INNOVATION PROCESS



set. These decisions are made within the management team of the innovation platform. Further, this phase will result in a set of assumptions about the investment idea/challenge faced by investment professionals and the opportunities for the innovation platform to address this challenge. It is then determined whether resources and expertise can be allocated to experiment with the idea.

Experiment

The goal is to find a solution that fits the problem. When developing new ideas, the solution team tries to find, via experiments, whether the solutions are feasible, desirable, and viable. Continuously checking with senior users whether the solution can actually solve their problem is key. Using the build-measure-learn approach and allowing to tweak, pivot, and kill solutions, the team can easily adapt the solution as necessary.

In this phase, the solution team starts with a proposition in the form of a prototype and will seek to further develop it into an MVP (minimum viable product).

Execute (Pilot, Implementation)

The pilot phase is a test phase and delivers a lot of lessons that are essential to implement innovation in practice. The solution team is running the MVP in a pilot environment to collect feedback from the investment professionals. Before starting the pilot, the team creates success criteria, which need to be met in order to develop the product/algorithm further after the pilot. After the pilot, the team can further develop the project based on the feedback of the users. During the implementation phase, the product/algorithm is integrated into the business operations of NN IP. By making products fit the requirements of the ongoing business, the implementation is streamlined. During this phase, the innovation platform is still in the lead of the project.

Business-as-Usual

After the solution has been implemented, the project can no longer be seen as an innovation platform project. Depending on the nature of the project, it is handed over to either the investment or technology function.

The Stage-Gate Process

To keep a fast pace and a short time to market, NN IP works with a stage-gate process. A stage-gate is a meeting with the team and decision makers and is used to "unlock" the gate to the next stage. The stage-gate is used for three purposes:

1. Fail fast, following the agile innovation approach. This way, the team keeps up its fast pace.
2. Create transparent decision making by clear agreement of "definition of done" with the innovation platform and users.
3. Prioritize through scarcity; this will breed creativity and better results. This means that along the way, the firm explores/experiments with many ideas while only the strongest will follow through to the phase in/out stages.

During a stage-gate, an innovation team presents its innovative project to the leadership team and the business sponsor. After the presentation, the panel is able to ask questions about the project and decide whether the project receives a "go" to the next stage or a "no go." Stage-gates are organized with a certain frequency.

Impact of Innovation Process: Enhancing Existing Processes

The team has identified opportunities across the organization where AI and big data technologies can be used to improve current investment processes or develop new methods. Below are a couple of examples where the objective was primarily to enhance existing processes.

Scout

The idea originated out of a separate study of anomalies. Whenever an algorithm points to anomalies, it is not clear what exactly the firm is dealing with. It can be a data problem, something naturally fat-tailed, or it can be an interesting investment case. To figure this out, the firm needs input from an expert. On top of the algorithm on anomaly detection, the innovation platform developed a front-end process that enables analysts to inspect the latest batch of (securities) candidates and supply their opinion. To decrease overload, security characteristics that may be driving the candidacy are highlighted. In addition, analysts

do not need to go through thousands of securities. Selection logic by the analysts is then imprinted in the model to improve the candidate generation process.

ImpuNet

In the world of financial data science, a good data source without missing values is an exception rather than a rule. This is especially the case within alternative data and unstructured data. The NN IP team proposed a new algorithm for estimating missing values, which is based on the idea of denoising autoencoders. Autoencoders are a family of unsupervised techniques in machine learning based on neural networks. In general, an autoencoder aims to learn the underlying structure of the dataset (e.g., relationship between features) without assuming simple linearity. Depending on the exact architecture, an autoencoder can, for instance, convert a big set of (potentially correlated) characteristics into a smaller representation that still retains the bulk of information about the observation (think, for instance, of a data compression task). Another popular flavor of autoencoder, called a denoising autoencoder, can reconstruct the missing data with imputed values. The approach can benefit from accelerated computing and therefore scale better to large datasets with a lot of samples and/or features. Second, by applying a generative model to produce realistic missing value patterns during training, we can relax the assumption of randomness in data gaps and increase out-of-sample accuracy.

Impact of Innovation Process: Exploring Emerging Technology and Experimenting

Below are a couple of examples where the objective was primarily to develop capabilities that previously did not exist at NN IP.

Building NLP Competency to Unlock Value from Unstructured Text

Until recently, most decision makers primarily relied on structured and organized datasets to

reach their decisions. This was mainly due to the difficulty in processing unstructured data to derive meaningful insights. With the recent acceleration in new technology and processing capacity, most organizations are embracing advanced technologies to engage with 80% of this bulk. And those who fail to invest in such tools and technologies will face the 80% blind spot while making crucial decisions.

NN IP is building its competency in NLP technology to manage and analyze such datasets in efficient and scalable ways. Such competency will transform NN IP's capabilities to translate the 80% blind spot to 80% fresh insight. The NLP competency is being executed by a cross-functional team involving technologists, subject matter experts, and five different investment teams.

Super Forecaster App

Human predictions are inherently noisy.²² Some people overestimate while others underestimate the probability that some future event will happen. When aggregating a sufficiently large number of individual forecasts, these errors tend to cancel out. This phenomenon is called "the wisdom of the crowd."

By tracking individual forecasts, it is possible to identify the "superforecasters" in the group. By giving a greater weight to their forecasts, collective forecasts can be made even more accurate. Moreover, through training and feedback, individuals can improve their forecasting skills over time.

Applying these insights, NN IP has developed a novel "Super Forecasting" app. Using this app, the investment professionals at NN IP will be making regular forecasts about various market-relevant topics. Furthermore, users will receive feedback about their performance and learn how to become better forecasters over time. The forecasts that are harvested with this app will be used as inputs in the investment process of various NN IP teams.

²²See, for example, Mellers, Stone, Murray, Minster, Rohrbaugh, Bishop, Chen, Baker, Hou, Horowitz, Ungar, and Tetlock (2015).