Research &
Innovation
Centre

2022

Business Report

Talan

Contents

Preface

Talan is an international consulting group with more than 4,500 consultants providing technological expertise, working every day to develop a humanist approach to technology that will make the new digital age an era of progress for all.

Consequently, Research is a central element of our strategy, enabling us to achieve this objective by understanding the complex problems we face today, developing new ideas and putting them into practice to provide sustainable solutions.

This is why we attach great importance to environmental and human-oriented issues in our research vision.

This 2022 Business Report reflects our commitment to quality research and sustainable innovation. It provides an overview of our achievements and our prospects for the future.

Noteworthy for the strengthening of our research teams and an unprecedented number of publications in recognised journals and conferences, 2022 has shown we can produce recognised results by providing inspiration that makes a pragmatic contribution to the entire Talan group ecosystem.

The widely varying projects on which we work is another of our Centre's strengths. We can work on a range of topics, from environmental and human-oriented issues to advanced technologies. This variety ensures that we can meet our customers' needs and help them achieve their objectives.

We are proud of our team of talented and determined researchers, all deeply committed to providing innovative solutions for a better future.

Thank you for your interest in our work. We invite you to explore the pages of this report to learn more about our commitment to sustainable research.

Nicolas Recapet,
Group Executive VP HR, CSR & Transformation

Laurent Cervoni,
Research and Innovation Director

Key figures *2022*

12
Scientific conferences in 2022

27
Publications in 2022

Main research topics:

Artificial Intelligence, Managerial Practices, Environment, Blockchain, Fintech, Healthcare, Synthetic Data, etc.

+20
Current projects

3
Current CIFRE theses

approximately 10,000 days of research
INVOLVING MORE THAN
220 TALANs

14 PhDs
recruited in 2022, including **8** 'Young PhDs'

+40 Doctors
in the Talan teams

Review
& Outlook

A. Review of 2022

In 2022, Talan devoted approximately 9,000 days to Research. Of these, 69% were spent on projects initiated by the Research Centre or carried out in collaboration with our partners, while 31% correspond to subjects resulting from assignments for our customers.

As those working on projects usually do so for part of their time or for periods ranging from a few weeks to a few months, nearly 200 employees have been involved in our R&D projects.

The volume of our peer-reviewed publications or conferences underlines the quality of the work done by our research teams. It also confirms Talan's desire to actively contribute to the scientific community and provide practical insight into the subjects in which our researchers are involved.

With Talan recruiting around ten 'Young PhDs' in 2022, the year also marks a turning point in its approach to Research. The group is now seen as offering a year of valuable "post-doc" experience with attractive working conditions and rewarding career prospects. 2022 therefore enabled the entire group to firmly establish Research as a firm pillar of its corporate strategy.

B. Outlook for 2023 and beyond

2023 will provide opportunities for strengthening the international dimension of the group's R&D activities. One acquisition in particular, at the end of 2022, will enable it to extend its R&D business in Belgium.

The links it has established with the academic world will enable it to carry out new Research projects involving employees from Canada and Tunisia. Lastly, discussions between the group's different international entities will be organised to share their Research work and present its results to all the employees concerned.

Our policy of recruiting 'Young PhDs' will continue in 2023. It enables us to cover more new projects and, ultimately, offer our customers proposals ahead of the curve and expert employees able to meet special expectations in fields where strong expertise is essential.

This strategy offers Talan the opportunity to "open up" new projects consistent with market expectations and emerging technologies and methods.

At the same time, we will continue to produce our internal and external publications to provide employees and the scientific community with our insight into the fields covered by our R&D projects. However, we foresee reducing the volume of our publications, as two of our PhD students are completing their theses. Other CIFRE (industrial doctoral research) agreements will be offered to our academic partners.

Introduction

A. Objectives of the annual report

For the first time since its creation in 2019, the Talan Group's Research and Innovation Centre is presenting the following in its research report:

1 *The Centre's mission and vision, including a summary of what it intends to achieve and its long-term objectives.*

2 *The strategic objectives we have set ourselves for the current year and for the longer term, as well as a summary of the means used to achieve them.*

3 *The Research Centre's organisation, the way in which our teams work with the various entities of the group and their role in achieving the objectives.*

4 *Collaborations and partnerships with other organisations and a description of how we work together.*

5 *The scientific and non-scientific publications our researchers have produced during the year, including a description of their content and impact.*

6 *Events organised by the Research Centre, including "Research Tuesdays".*

This report – our first – provides a comprehensive view of our objectives and how we have achieved them, highlighting both our commitment to research and our ability to meet the needs of our customers and the scientific community.

B. Presentation of the Research Centre

The Talan Research and Innovation Centre was created in 2019. Led by Laurent Cervoni, an Engineer from the prestigious ESIEE engineering school with a PhD in Computer Science (Artificial Intelligence), its objective is to stimulate and support the group's technological and methodological innovation initiatives, particularly in the fields of Digital Transformation, Artificial Intelligence, Blockchain, Data Processing and their impacts on daily life. The Research and Innovation Centre aims to simplify collaboration between the group's entities, guide research processes and coordinate the resources involved.

It focuses on projects that bring technological, methodological and societal innovations to our customers, employees and partners.

One of its priorities consists in proposing projects that help improve the environment and anticipate changes related to digital technology. At the Talan Research and Innovation Centre, PhDs, PhD students and experts from all group entities work on a wide range of subjects, from management sciences to artificial intelligence. Its main purpose is to determine how to improve our daily life and protect our environment.

The Centre reports to the group's Organisation Division and operates cross-functionally with all Talan entities, including the international teams with which its liaises regularly.

C. International dimension

Although Talan France carried out most of the research, Tunisia and Canada actively contributed to several projects in 2022, confirming the group's international approach.

For example, the Tunisian teams carried out projects on the metaverse, artificial intelligence or blockchain, led by Imen Ayari. Rachi Friji, a PhD member of the Tunisian AI team, also sits on the Scientific Committee of the "ActuIA" journal, in which she regularly publishes articles.

In Canada, Helene Kyriakakis has established a close partnership with the University of Sherbrooke, jointly led by Tarek Fattouh, resulting in a Research Centre (the Talan Createch Research Centre) on smart organisations. The Centre's projects are mainly based on five areas of research:

- **Sensory marketing**
- **Business intelligence and analytics**
- **Digital transformation and smart operations**
- **Human-machine interaction**
- **Cyber security**

Strategic operations

A. The Centre's vision, mission and role in Talan

The existence of the Talan Research and Innovation Centre is part of the group's Purpose and its desire to be an innovative support firm.

The research produced by the Centre reinforces Talan's image as an innovative group that constantly monitors and anticipates changes in emerging technologies.

In addition, our research projects bring concrete value to the group's customers and internal activities by offering solutions to technological or methodological issues.

The Research Centre also aims to provide a meeting point for the Research teams from all countries in which Talan operates. It regularly liaises with Talan's entities in North America, Switzerland, Tunisia, Spain and the United Kingdom, enabling it to identify cross-functional research projects that will benefit all the group's customers and employees.

1. Vision

The Research Centre offers group employees, working alongside the Centre's PhDs, the opportunity to participate in research projects that improve Talan's offering and enable it to offer its customers disruptive and/ or innovative responses that are ahead of the curve in both technical and managerial terms and which take into account societal and environmental issues.

The Centre thus offers all employees the opportunity to regularly participate in research projects and so discover new working methods and help create new offerings or solutions.

It also helps attract new talent, 'Young PhDs' and PhD students in particular, but also future employees from the universities in which the Centre works.

B. Long-term objectives

Externally, the Research Centre aims to be recognised as a reliable and relevant player by the scientific community.

Through its publications, it therefore seeks to contribute to Research and improve the knowledge available in the fields in which it works. Within the group, it aims to enable Talan to offer new internal working practices, thereby strengthening its role as a digital transformation player.

C. Strategies for achieving objectives

To achieve this, the Centre regularly recruits 'Young PhDs' who work within it on defined projects during a "post-doc" year, in agreement with the group's entities.

During this year, the PhDs and PhD students lead the Centre's projects, following research projects with the aim of publishing articles, supervising other group employees (who do not necessarily have a PhD) and determining whether the projects meet market expectations.

Over the course of this year, the PhDs and PhD students manage research projects with the objective of proposing innovative solutions matching market expectations.

In these projects, 'Young PhDs' manage group employees (not necessarily PhD holders), publish articles and ensure that the project goes smoothly from its design through to its end. At the end of this year, the PhDs recruited by the Centre will join the different entities and so continue to provide us with their expertise.

Strategic operations

1. Methodological framework

In line with the Group's Purpose, the Research Centre promotes the dissemination of knowledge and, in particular, the results of its research work.

Consequently, it has proposed a charter on the use of open-source tools. This charter was published in 2022 and is available to all group employees alongside our other recommendations on the use of digital tools.

The Centre also developed a research charter in 2022 to define the doctrine and principles applied to it. Among other things, this charter ensures the freedom of researchers to conduct research, along with their security and independence.

This charter also confirms the special status of researchers, notably by providing for the implementation of the resources needed for the research to be conducted properly.

This charter forms part of the best practices recommended at the European level. It will be distributed to all researchers at the beginning of 2023.

Initiated and completed projects

A. List of current research topics

1. Environmental and societal issues

Environmental protection and societal issues are central aspects of many of the Research Centre's projects.

a) My Carbon Footprint – Mobility and the Environment

As part of its CSR (Corporate Social Responsibility) approach, Talan has committed to reducing the direct and indirect environmental impact of all its activities.

Accordingly, Talan conducted a comprehensive carbon audit to accurately identify the sources of CO_2 emissions related to its activities and also to set reduction targets and implement appropriate measures to achieve them.

This report shows that most of the group's carbon emissions in France in 2019 were linked with employees' business travel (commuting and business trips).
Employee commuting alone accounted for 42% of the group's carbon emissions.

Consequently, reducing the carbon footprint of commuting by the group's employees is a priority for Talan.

The Research Centre is developing a mobile application (iOS and Android) for this purpose, enabling employees to measure the carbon footprint of their business travel on a daily basis and so helping raise awareness and learning about best practices for reducing carbon emissions.

A research project, MonEmpreinte Carbone (in English, My Carbon Footprint), is therefore trying to build a business travel database and study the related behaviour.

This project is being conducted in partnership with researchers from the Universities of Bordeaux and La Rochelle. The data produced by the application is being analysed with these researchers in order to produce a quantitative behavioural analysis.

b) "Hope" carbon simulator

At the same time, the teams of the Research Centre are leading a project focusing on the carbon footprint of digital technology.

The project's primary objective is to develop AI solutions such as the Hope application for quantifying and reducing the environmental impact of Talan's activities and those of its employees.

A secondary objective consists in assessing the actual impact of environmental protection AI solutions, including taking into account the rebound effect (also known as the Jevons Paradox).

c) Sustainable models

Lastly, based on the observation that catering for environmental, social and societal issues is now a major imperative for most organisations, a third Research Centre project is focusing on sustainable economic models.

In addition to the implementation of CSR (Corporate Social Responsibility) strategies, some authors have raised the question of integrating these considerations into companies' business models, resulting in these models being updated or redefined.

In this research project, we are studying these particular companies to understand how their so-called sustainable business models work and examine their characteristics.

We are also interested in companies that are not naturally looking at these issues but which are trying to implement a sustainable approach and reduce their externalities. We therefore assume that these changes will cause a certain number of tensions that we will attempt to qualify.

2. Artificial intelligence – Data processing

Since its creation, the Research Centre has been conducting several projects implementing various digital or symbolic artificial intelligence and data processing technologies.

a) Synthetic data

Thus, in 2022, we conducted a study on Synthetic Data. In it, we explored potential applications of this new technology potentially benefiting customers: its use as an alternative to long-term data retention, for improving the anonymisation of personally identifiable information, for improving AI performance and for increasing the data.

b) Dataviz

Representing data visually, referred to as dataviz, is a central element of many decision-making processes.

Dataviz involves many cognitive biases potentially altering the reading and understanding of data. Consequently, the Research Centre is studying how these representations are perceived.

To perform our study, we have drawn on the scientific literature to build our investigation into how different visuals are perceived.
This will provide a basis for analysing other visual representations, including the use of virtual reality.

c) Computer vision – Functional Ability Evaluation (FAE)

In 2021, the Talan Research and Innovation Centre led a project that resulted in a healthcare system being created in collaboration with healthcare professionals to improve occupational health.

This system offers users a set of warm-up and joint exercises depending on their reported symptoms. Based on this, a new MOCA-FAE project begun in 2022 is aiming to improve the quality of life at work.

Its aim is to film users while they perform light warm-up exercises (generally in a work context) and then use an AI/ computer vision tool to find out whether they have been correctly carried out or not (i.e. whether the user has done the required number of repetitions, length of training, etc.).

d) Budget estimation

The budget estimation phase that a company carries out in year N may prove tedious and time-consuming for the managers responsible. In fact, they may sometimes be required to propose several versions of the provisional budget before submitting a final version at the end of year N-1.

We are trying to determine whether it is possible to develop a neural network model for use in proposing a corrected version of a provisional budget N based on the performance achieved in N-1 and predicting a month's performance in year N based on what was achieved in the previous months of the same year.

e) Computer vision – Root Cause Analysis (RCA)

For ITP-Interpipe in Tunis, a company specialising in designing, producing and assembling pipelines, we worked with its Quality department to develop a real-time solution for performing non-compliance inspections.

This solution consists of two parts:

1. A mobile app that helps take photos,
2. An AI engine for classifying them.

The AI engine compares the photos with assembly-line photos provided by ITP-interpipe, using image-processing algorithms and deep learning.

After the data preparation phase (data collection, annotation, labelling and augmentation), the AI engine is trained to segment the shape, detect and crop the area concerned and ultimately, classify the photo.

f) Computer vision & signal processing – Non Destructive Testing (NDT)

In collaboration with the Image and Form Research Group (GRIFT) division's Cristal laboratory of ENSI University (Tunisia) and ITP-Interpipe, we initiated a Master's project on detecting defective welds using ultrasound NDT scans based on computer vision and signal processing techniques.

This involved us working with the trainee on building a model from all the ultrasound scans. This modelling will be used to detect any anomalies viewed by the system and assess their severity.
The project has enabled us to validate the feasibility and suitability of a non-destructive testing tool for welds.

3. Management – Corporate organisation

a) Innovation and organisation

It is vital for businesses to innovate as this enables them to maintain their competitive advantage, satisfy the constantly changing needs of their customers and adapt to market changes.

Consequently, the Research Centre is interested in the link between the corporate organisation and internal innovations. Among other things, we are studying Talan's communities to see how they organise themselves and support innovative projects.

b) Caring management

In the literature, it is accepted that benevolent leadership has multifaceted positive effects on employees.

For example, it has a positive impact on organisational citizenship behaviour, the performance of subordinates or even emotional commitment and perceived organisational performance.

Although research on benevolent leadership has advanced our understanding of the concept, the models proposed in the 2010s do not incorporate all its aspects.

First, the widespread use of information and telecommunications technologies (ICT) has intensified the spatial mobility phenomena.

Employees can now work in different geographical spaces and this results in significant changes in interpersonal relations. Second, "despatialisation", the word used for the psychological impacts linked with physical distance in a subordinate relationship, has become an increasingly common phenomenon in companies since remote working relationships are mainly carried out using ICT.

We are supporting a CIFRE thesis on the perception of benevolent management and, more broadly, we are studying changes in managerial practices.

c) Cultural transformation and climate change

In the face of climate change, companies are adapting, changing their business models and anticipating changes in their markets. Talan is interested in these changes and the consequences for companies based on several criteria.

We are supplementing our knowledge on this subject by organising interviews that we combine with our research.
The purpose of this project is to be able to propose a model that can suggest adaptation strategies based on a company's characteristics.

This project is correlated with the sustainable model project.

4. Digital transformation

a) Metaverse

The metaverse seems to be one of the likely web developments, particularly with the evolution of immersive technologies such as virtual reality. This new paradigm could affect how we work together. As anticipating this transformation is vital to Talan, the Research Centre is interested in two aspects of the metaverse.

The first aspect is the accessibility of the metaverse: we want to produce a guide of recommendations for the creators of future worlds to make them more inclusive. The second is the metaverse's suitability for online meetings.

To provide a scientific answer to this question, we are currently conducting an experiment involving many group employees following a protocol including several meticulously observed approaches.

b) Meta – Talan

We have implemented a Talan metaverse. Talan employees have desktop and web access this universe, which is a replica of Talan Tunisia's premises, enabling them to attend business meetings and events as well as chatting with chatbots, attending public and private meetings and benefiting from new functionalities using artificial intelligence.

5. Industry-specific projects

a) Banking – Fintech

Many industries are now faced with the emergence of – often small – players that, although these will not result in the well-established companies disappearing, call into question their value propositions in certain markets and so are setting new operating standards.

This is true of the banking industry, where we have seen the emergence of start-ups called fintechs (combining finance with technology).

As well as studying the competitive positioning of these new players, this research project is also examining the various regulatory and technological transformations experienced by the banking industry with the aim of understanding how major banking groups adapt to these changes and adapt their business models.

Consequently, we can see that exploring new business models is a major issue for most major banking groups.

This is done by creating new internal innovation units such as incubators or studio start-ups, but also by creating start-ups with models similar to the operating models of new players.

We are supporting a CIFRE thesis in partnership with the Institut Polytechnique de Paris.

b) Logistics – Supply Chain – Blockchain

This project, which is based on the thesis of Mathieu Lesueur, a PhD student at Talan, aims to **understand and identify the determinant factors influencing blockchain adoption in the industrial sector**.

One of the main dimensions of the blockchain, which the project pays particular attention to due to its relevance to the supply chain, is that of interoperability.

The approach consisted of:

- Defining the blockchain and the notion of interoperability (communication or real interoperability);

- Performing a bibliographic quantitative analysis of the use cases of the blockchain;

- Benchmarking blockchains (which types of blockchain are mostly adopted in the supply chain sector or other sectors? What are the consensus algorithms, the types of smart contracts and common elements? What is the private and/or public major classification?).

- Specifying the issues/criteria related to the choice of blockchain.

c) Insurance customer experience

The customer experience is a traditional concern when selling tangible products (online or in-store purchases) or intangible products (telephone subscriptions, etc.).

In the insurance industry, it would appear that the customer experience is still poorly measured and poorly qualified. Although this would seem to be naturally founded on customer satisfaction, despite it being necessary, it is not enough to achieve a successful customer experience and so must be supplemented by other elements.

The issue is even more delicate because this experience is minimised in the insurance field and so may appear insufficient since it is not enough to create a real relationship that can develop an "experience" or an "emotion". In reality, the customer relationship is restricted to two events: when the contract is concluded, and when any claims are handled.

The objective of this research project is both to determine the drivers of the insurance customer experience and to subsequently propose a methodology for quantifying, monitoring and improving the customer experience in the insurance industry.

d) Healthcare

The Research and Innovation Centre has provided its Machine Learning expertise in two healthcare studies. Its first contribution is in the Programme for Motivational Optimisation in Health Sport (PROMESS) project[1] by both the Seine Maritime department and the Regional Institute of Sports and Health Medicine (IRMS2), and studies how to combat sedentary living and its consequences for health.

This mechanism offers free personalised support for taking up a physical activity for three months. Those registered are offered a personalised programme and will be able to use sports equipment. The Research Centre participating in analysing the results and building a model capable of predicting the maximal oxygen consumption (VO2) of patients.

Its second contribution is part of the end-of-study report from a physician who conducted a large survey of 1,827 Foot Five practitioners to identify factors contributing to the risk of injury. This survey highlighted some key indicators in the risk of injury such as the type of

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1   https://www.seinemaritime.fr/actualites/sante/avec-promess-faites-du-sport-sur-ordonnance.html

warm-up and the frequency of Foot Five sessions. To enrich the study data, the Centre developed a machine learning model using a Random Forest algorithm to predict the injury risk.

AiiNTENSE: Talan is conducting several research projects with the startup AiiNTENSE. These include the Neuromonitor and the Pupillometer.

The Neuromonitor project consists of developing a connected platform for managing patient records and utilising them in a decision-support solution.

The main objectives include developing a tool for extracting data from patient records, creating a decision support model, implementing the solutions on a shared platform, securing the AI models and creating the Health Data Warehouse.

In 2022, we made progress in creating a French-language NLP model for use in the medical field of patient reports.

- Furthermore, the Pupillometer project consists of developing a device embedded in a smartphone or connected device for measuring the patient's pupil diameter. This device can be used to monitor anaesthesia and pain during anaesthesia, detect internal bleeding and manage complications during resuscitation.

Existing pupillometers are expensive and underused. An initial prototype was developed at the end of 2020 to validate the device's medical interest and technical feasibility, as no tool currently exists that uses AI algorithms for pupil analysis in a medical context. This medical device using AI and thermal imaging to detect neurological lesions during pupil analysis is currently in version 2. The solution is currently being validated for use as a medical device (CE marking).

Initiated and completed projects

B. Some projects completed in 2022

Automatic document analysis:

This project was initiated to find an AI or digital solution for automatically classifying and retrieving information from a series of documents used in Talan's daily work, such as invoices, CVs, etc. An initial experiment was carried out to make CV analysis easier by detecting key information. An initial estimate of the performance of the different approaches was obtained in a comparison using Transformer algorithms.

Supervision & Security:

The project to examine AI's contributions to network supervision focuses on expanding on the work in a previous publication to assess different unsupervised learning algorithms against network data. Using these algorithms to optimise the grouping of network flows in different clusters is essential to improve network division in 5G networks.

Waste Detection:

This project arose from the stated need of a customer that wanted to use video recordings from cameras placed next to waste collection points to know when the images received contain waste in order to enable it to contact the collection services based on the rate of waste present. The project was conducted in two stages: detecting the presence of waste in images, and localising the waste in an image (by returning information on the waste presence rate). Both stages were carried out using convolutional neural networks (Faster R-CNN for localising the waste and Domain Adaptation for detecting it).

Project & Team Management Method:

R&D can be a catalyst in the emergence and management of innovative projects, particularly by including employees who can share their experience. However, conducting innovation or research projects may be difficult to organise for some companies, due to employee turnover, for example. The Centre has developed a project management method that can be adapted to teams whose resources change frequently and has assessed the performance of this approach.

C. Collaborations with companies and educational institutions

1. Educational institutions

Talan establishes many relationships with the academic and educational world, including:

University of Sherbrooke
As Talan's preferred partner in Canada, University of Sherbrooke runs the Talan Createch Research Centre, which offers many R&D projects in Management Science, Artificial Intelligence and Logistics. Talan, through its Canadian subsidiary, is an active sponsor of the University.
(link: https://www.centrecreatech-talan.recherche.usherbrooke.ca)

University of Bordeaux
Talan is a longstanding patron of the University of Bordeaux Foundation. In this context, Talan supports the Trusted AI Chair initiated in 2022 under the leadership of Professor Laurent Simon.

Lycée Paul Valéry, Paris
As part of the event celebrating the fiftieth anniversary of the Prolog language in 2022, Talan was asked to facilitate a series of introductory sessions on the language with the high school's NSI Final Year students. The programme's success has led to a request for its renewal in 2023.

National School of Engineering Sciences (ENSI), Tunisia
As part of the ENSI SMART bootcamp, Talan was asked to design and present three workshops on Federated Learning for ENSI's tutors.

As part of the Information Processing and Analysis: Methods and Applications (TAIMA) 2023 conference organised by the Tunisia Image and Form Research Group (GRIFT) division, Talan participated in the competition organised on the sidelines of the conference on the topic of "Segmentation of MRI images for the detection of brain tumours". The hackathon's problem was defined by the University of Poitiers XLIM-SIC Laboratory. Talan, with a team consisting of a researcher and an engineer, won the second prize.

National School of Engineers of Tunis (ENIT), Tunisia
The Talan Innovation Factory's Metaverse team held a seminar class on "Extended Reality Design and Development" for the ENIT's "Systems and Data Signals" Master's programme students.

2. Companies

Talan supports several startups through its StartUp Network (SUN).

In the Research field, Talan works with two SUN companies in particular:

- AiiNTENSE
- SKeewAI

These two companies specialise in healthcare, both in different fields.

With AiiNTENSE, whose mission is to optimise the medical care, prognostic assessment and hospital stay of patients by using cognitive decision-making assistants, remote expertise services and a platform promoting clinical and neuroscientific research, Talan has contributed to the Pupillometer and Neuromonitor projects (see above).

The Recov'up project led by SKeewAI was also supported by the Talan Research Centre, whose expertise provided an engine that uses artificial intelligence to generate self-rehabilitation exercises. This is because osteoarticular pathologies, and especially low back pain or ankle sprains, are a public health issue. Too little data describing the impact of therapies on the evolution of pathologies was available to envisage a self-learning process.

Consequently, the Research Centre helped design an application mainly based on medical consensus rules able to generate exercise sessions adapted to the patient's pathology and its development. The approach chosen, starting from the ankle sprain, was generalised to cover 12 pathologies.

Publications

A. Project contributions to the scientific community

With around ten scientific publications, the Talan Research Centre aims to actively contribute to Research and disseminate the results of its work as widely as possible.

In 2022, publications mainly focused on four main themes:

· Fintech, mainly in the associated CIFRE thesis
· Blockchain, mainly in the associated CIFRE thesis
· Artificial intelligence and related technologies
· Organisation and management

We have also selected three other publications supplementing these themes. These are positioned at the intersection between several subjects. All Talan Research productions are detailed below.

B. Publication details

1. Fintech

Type	Review/Conference	Author	Title/Subject
Scientific conference**	Business Model Conference	O. Chelbi	A journey for change: describing the evolution of the business model of an incumbent bank towards a data driven business model
Scientific conference**	R&D Management	O. Chelbi	The industry of third party providers in the quest of a level playing field
Scientific conference**	Continuous Innovation Network	O. Chelbi	Turning a Bank into a Platform? The journey of an incumbent bank in search of a platform business model
Scientific publication**	Journal of business models	O. Chelbi	The Creation Of Ecosystems as a Mean for Business Model Adaptation: How Banks Chose to Respond to The Rise of Fintech Startups
Scientific conference**	World Open Innovation Conference	O. Chelbi	Business Models of Banks in Front of FinTech competition: a coopetition perspective
Scientific conference**	15th Istec Paris research conference "Transformation of companies and their business models".	O. Chelbi	Will platforms prove to be more than buzzwords? An analysis applied to the banking industry

*peer-reviewed scientific journals
**peer-reviewed scientific conference papers

2. Blockchain

Type	Review/Conference	Author	Title/Subject
Scientific conference**	14th International Meetings on Logistics and SCM	Mr. Lesueur	Blockchain in river transport: an agency theory approach
Scientific conference**	1st Vietnam symposium on supply chain management	Mr. Lesueur	Impacts of blockchain in the organisation of river transport logistic chains: a network theory approach
Scientific publication*	French industrial management review	Mr. Lesueur	Thoughts on the use of blockchain for logistics and supply chain management: a forward-looking approach
Scientific publication*	Logistics and management	Mr. Lesueur	The issues and consequences of private consensus and "single-player" blockchains within logistics chains: a transaction cost theory approach
Scientific publication*	Supply Chain Forum	Mr. Lesueur	Impacts of blockchain in the organisation of river transport logistics chains: a network theory approach
Book contribution	Book 8th edition Reix et al. 2023 (Vuibert edition): Information systems and management	Mr. Lesueur	Blockchain adoption by a food distributor (case study)
Book contribution	Blockchain and Sustainable Development	Mr. Lesueur	Proofreading and correction of the Blockchain and Supply Chain chapter and Introduction chapter
Conference	CFIB 2022	A. Ben Rouha	What's new in Blockchain technology.

*peer-reviewed scientific journals
**peer-reviewed scientific conference papers

3. Artificial Intelligence

Type	Review/Conference	Author	Title/Subject
Lecture	Jussieu Source Codes Seminar	L. Cervoni, J. Brasseur	Logical Programming and Artificial Intelligence
Article	ActuIA no. 7	L. Cervoni, J. Brasseur, T. Farès	AI is also written in Prolog
Workshop	WAICF 2022	L. Cervoni	Prolog, 50th anniversary
Article	ActuIA no. 7	L. Cervoni	Logical modelling in building construction
Article	ActuIA no. 7	T. Farès	Symbolic Neuro AI
Article	ActuIA no. 8	L. Cervoni	The down side of the cards
Article	1024 SIF Bulletin	L. Cervoni, J. Brasseur	50 years of logical programming
Conference	Dataquitaine 2022	L.D. Tchala	CIVA, crowd-fed chatbot
Talan website	ActuIA no. 9	H. Canever	Developing best practices for assessing the usefulness of synthetic data
Article	ActuIA no. 9	L. Cervoni, K. Osanlou	Synthetic data: the future black gold?
Article	Talan website	H. Canever	What synthetic data generators mean for data protection laws
Symposium**	Gretsi	R. Friji	Geometric deep neural networks based on rigid and non-rigid transformations for the recognition of human action.

*peer-reviewed scientific journals
**peer-reviewed scientific symposium paper

Forum	IEEE GCAIoT	I. Ayari	Four focuses: • AI enhancing any other technology outcomes for business impact • AI relaying on data, but not only • Metaverse and Blockchain game changers for AI • AI as a foundation technology for humanity progress

4. Organisation, Management, Architecture

Type	Review/Conference	Author	Title/Subject
Scientific conference**	Software architectures conference – Vannes 2022	D. Abbad, D. Jacob, T. Farès	Implementation of a microservice architecture with Kafka
Scientific conference	WSIM 2022 London	Y. Arnaud, L. Cervoni	The first lessons of forced telework in the French banking sector
Scientific conference**	ICEdutech (Education + AI)	L. Cervoni, J. Brasseur	Prolog, a technological approach to teaching
Scientific conference**	ICETI 2022	J. Brasseur, L. Cervoni	The value of combining logic and imperative programming in teaching

*peer-reviewed scientific journals
**peer-reviewed scientific conference papers
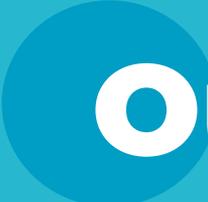
Our team

A. Research team and workforce in 2022

The Centre's research team consists of 'Young PhDs', PhD students and nearly 200 employees who work intermittently on projects throughout the year. Only details of the PhDs and PhD students are provided here.

Laurent Cervoni, *Director:*

An engineer from the École Supérieure d'Ingénieurs en Électronique et Électrotechnique (ESIEE) and a PhD in Computer Science from the University of Rouen, his professional career began as Deputy Department Director at ACT Informatique (a publisher of Artificial Intelligence software, including LISP and Prolog). He then actively contributed to the certification of the Prolog language, a key link in symbolic AI.

Deputy Technical Manager at Capgemini/ITMI (Industry and Smart Machine Technology) from 1990 to 1993, he was then a senior consultant at EDS Group until 1995.

The following year, he headed the new media development department at EDS France before setting up and running his own consulting firm **to support companies in their digital transformation.**

He was an **advisor to a ministerial office** (Victim Assistance Secretariat) before taking over as General Manager of Docaposte Localeo (La Poste group), a software publisher involved in modernising public action.

He has also been a member of the **Association des Docteurs de France** (ANDès) since 2015 and of the Board of Directors of **the Regional Institute of Sports and Health Medicine** in Normandy. He chairs the Scientific Committee of ActuIA, a journal specialising in Artificial Intelligence.

1. Principal Investigators in Tunisia

Imen Ayari:

Head of Talan Tunisia's Innovation Factory, its Business Research and Development (BR&D) department, Imen Ayari is an engineer, holds an Executive MBA and has more than 20 years of experience in Information and Communication Technologies.

Her experience covers a wide range of sectors, including banking, industry, retail, e-government and insurance. Imen is a firm believer in open collaboration and synergy between professionals, academics and students. For example, she coordinated testing of metaverse-related development during 2022.

Racha Friji:

Racha Friji is Head of AI Research and Development at the Talan Innovation Factory in Talan Tunisia, holds a PhD in Artificial Intelligence – Cristal lab/ENSI, teaches at INSAT (including in Computer Vision) and is a member of the Scientific Committee of the journal ActuIA. She has written several articles on deep learning and action recognition.

2. PhDs participating in the Centre's projects

Andrés Ladino, *researcher:*

Andrés is an engineer with a Master's degree in Electronic Engineering from the Pontificia Universidad Javeriana (Colombia) and a PhD in Automation and Production from the University of Grenoble Alpes (2018). His thesis focuses on topics related to the estimation and prediction of traffic variables on large-scale networks.

Antoine Garçon, *researcher:*

An engineer from the Ecole Polytechnique Fédérale de Lausanne, Antoine Garçon obtained his PhD in Atomic and Molecular Physics in 2020. He later completed a post-doctorate in Machine Learning and Deep Neural Networks. He is also an expert in the processing of data from laboratories, specialising in the modelling and detection of weak signals in rich and complex data sets.

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Damien Jacob, *researcher:*

Damien Jacob holds a PhD in Applied Physics from the University of Strasbourg. His thesis work focused on developing a digital model capable of simulating the evolution of Qatar's groundwater. This thesis combines Physics, Mathematics and IT.

Damien Jacob joined Talan in April 2022 as an R&D Engineer in its Research and Innovation Centre. He supervises research projects in AI, data visualisation and corporate metaverses.

Helena Canever, *researcher:*

Helena Canever obtained her PhD in Physiology and Physiopathology in 2021 with a thesis project on the analysis and modelling of the spatial-temporal migratory behaviour of epithelial cells.

She is currently working on AI projects related to synthetic data generation as an alternative to canonical storage and to the influence of digital and AI solutions on the carbon footprint of business practices.

As part of Talan's CSR policy, she has developed the Hope application for simulating the carbon footprint of the group's missions serving its customers.

Julien Brasseur, *researcher:*

Julien Brasseur holds a PhD in Applied Mathematics from the University of Aix-Marseille and the University of Milan (Italy), in collaboration with INRAE's BioSP laboratory in Avignon.

His experience includes work on finance-related artificial intelligence topics before joining the Talan Research and Innovation Centre in September 2021 as an R&D Engineer.

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Kevin Osanlou, *researcher:*

Kevin Osanlou holds a PhD in Artificial Intelligence from the University of Paris-Dauphine in 2021, specialising in Machine Learning and Machine Planning.

His thesis examines the contribution that machine learning can make to planning tasks in the context of autonomous vehicles in off-road situations. He also has a knowledge of natural language processing, teaching this course in a Master's 2 degree. He joined the Talan Research and Innovation Centre as a young R&D PhD to mainly work on the use of AI for generating synthetic data.

Nabil Omri, *researcher:*

Nabil Omri holds a PhD in Computer Science (specialising in Artificial Intelligence) from the FEMTO-st laboratory of the University of Bourgogne Franche-Comté. His thesis studied the extraction of knowledge from SME data to facilitate the adoption of AI in small businesses.

Ons Nefla, *researcher:*

Ons Nefla holds a PhD in Computer Science (specialising in Artificial Intelligence) from the University of Paris-Dauphine in co-management with Emlyon Business School. She has a solid knowledge of many fields aimed at improving the efficiency of businesses. These fields mainly include Artificial Intelligence, Data Science, Optimisation, Operational Research and Mathematical Modelling.

Rita Meziati Sabour, *researcher:*

An engineer specialising in Signal and Image Processing, Rita Meziati completed her PhD on the recognition of emotions and social stress based on the variability of the calculated, non-contact heart rate.

In her thesis, she applied statistical methods and machine learning algorithms to the descriptors read from these signals for the targeted emotion/stress recognition tests. She also used Recurrent Neuron Networks to segment the cardiac signals in order to define their noisy portions.

Rym Salhi, *researcher:*

Rym Salhi holds a PhD in Applied Mathematics from the University of Le Mans where she was of Lecturer-Researcher and subsequently, Research and Innovation Project Manager at the Le Mans Institute of Risk and Insurance. Her research focuses on the building of random models for financial and energy risk management.

Rym Salhi joined Talan in October 2022 to work as an R&D Engineer in its Research and Innovation Centre, where she oversees climate risk research projects in finance.

Tonie Farès, *researcher:*

After completing a Master's degree in Fundamental Mathematics at the University of Lille, Tonie Farès prepared and defended her thesis at the Lens Mathematics Laboratory in the field of functional analysis.

She joined Talan in 2021 as a researcher in its Research and Innovation Centre, specialising in artificial intelligence and change management projects. She participates in various research projects in fields ranging from identification to implementation and operational monitoring.

Yamina Hamidi, *researcher:*

Yamina Hamidi specialises in computer vision.
After a Master's degree in Applied Mathematics, she obtained her PhD at Paul Sabatier University in collaboration with the CNRM/Météo France. His thesis studied the automation of meteorological object detection in images.

3. PhD students supported by the Centre

Chaima Hafsi, *PhD student:*

A full-stack and blockchain software engineer at Talan Tunisia's Innovation Factory, holding a Master's degree in the Internet of Things from the National School of Computer Sciences (ENSI) and currently a PhD student at the RIADI/ENSI laboratory, she is interested in the use of blockchain technology in various fields, particularly in the financial sector. She is particularly interested in improving the security, compliance and digitisation of banking and insurance systems through the adoption of a decentralised system.

Mahrzia Jlassi, *PhD student:*

A full-stack and blockchain software engineer in Talan Tunisia's Innovation Factory, a holder of a Master's degree in Decentralised Identity and Self-Sovereign Identity, and currently a PhD student at the RIADI/ENSI laboratory, Mahrzia is interested in blockchain-related topics and particularly blockchain solutions for digital identification.

She also works on subjects such as proposing solutions for enhancing platform scalability in terms of improving transaction processing capacity in Layer2 solutions or focusing on the use of blockchain in fields such as the IoT, finance, industry, etc.

Mathieu Lesueur-Caze, *PhD student:*

Mathieu Lesueur-Cazé is a Management Sciences PhD student at the Centre for Research in Economics and Management in the University of Rennes. His work on coordination and trust between industrial players highlights the value of the cooperative link obtained by coupling traditional tools with blockchain.

Olfa Chelbi, *PhD student:*

Olfa Chelbi is a PhD student at the Institut Polytechnique de Paris and is working on her Management Sciences thesis at its Management Research Centre (CRG-I3). Her latest work at Talan focuses on business models and collaboration processes between large companies and startups in the banking industry, focusing on the metaverse's impact on creativity during the brainstorming process.

Yann Arnaud, *PhD student:*

Yann Arnaud is a PhD student at the Institute for Research in Organisation Management (IRGO) at the University of Bordeaux and is working on his Management Sciences thesis with the Talan Research and Innovation Centre. He is also a research assistant at CIRANO (Montreal, Canada) working on several healthcare economy-related subjects.

His latest work at Talan focuses on the social aspect of Corporate Social Responsibility (commitment, turnover, HRIS, etc.), the metaverse, climate change and the potential use of artificial intelligence in characterising exoplanets.

Other important information

A. Events organised by and with the Centre

The main events organised by the Research Centre, Research Tuesdays provide a forum for discussion between a personality and Talan employees on an innovative subject. The personalities speak in person or remotely for about an hour.

Five sessions were organised in 2022, bringing together up to 120 employees at a session.

Research Tuesday **1 February** Discussions on frugal AI with **Julien Brasseur** and **Laurent Cervoni**	Research Tuesday, **3 May** With **Souheil Hanoune**, PhD in Artificial Intelligence, Robotics and Cognitive Sciences and CTO from XXXI
Research Tuesday, **23 May** With **Thomas Solignac**, CEO and Co-founder of Golem.AI	Research Tuesday, **8 November** Officer General of the Gendarmerie Nationale and its Coordinator for Artificial Intelligence.

Research Tuesday, **6 December**

With **Blaise Vignon**, CPO of Alice & Bob, a Quantum startup.

The Research Centre has also actively participated in the fiftieth anniversary celebrations of the Prolog language, through events including the following:

- Workshop celebrating 50 years of the Prolog language at the first edition of the WAICF in April 2022,
- Lecturing to Final Year students in the Prolog courses at Lycée Paul Valery's FabLab in Paris,
- Participating in a round table discussion at the Prolog Day event in Paris in November 2022 and presenting Recov'Up (a medical device created in collaboration with the Research and Innovation Centre),
- Speaking at the "Source Codes" seminar in Jussieu on 9 June.

B. Various communications

Introduction to Deep Learning:
Lecturing to MBA students from the Institut Léonard de Vinci in the Paris region on the fundamentals and deployment of artificial intelligence, including deep neural networks.

Source codes:
as part of the Jussieu "Source Codes" seminars organised by LIP6, CNAM and CNRS on 9 June 2022, Julien Brasseur and Laurent Cervoni presented a session entitled "Logical programming and artificial intelligence: the fiftieth anniversary of Prolog".

IESF 2022:
On 3 February 2022, the Society of Engineers and Scientists of the Paris region (IESF) organised a conference on "the virtual engineer". Laurent Cervoni was invited to give the opening speech and take part in one of the round tables on the impact of teleworking upon employment contracts, company structures and management.
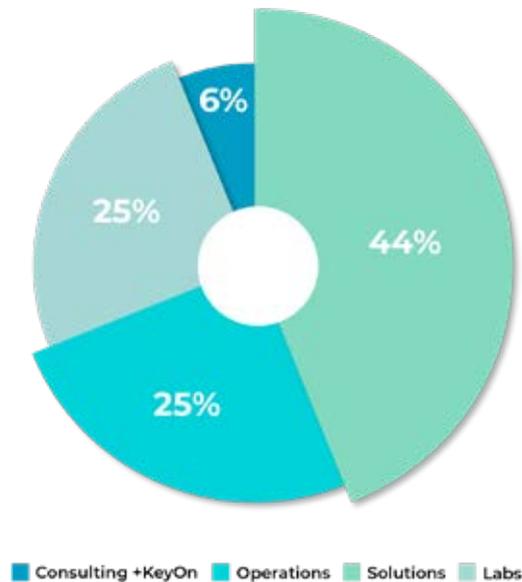
Internally, the Talan Research Centre hosted several events providing a better understanding of the group's motivations for Research, its identification of R&D projects and their organisation (research live event on 25 March and research events in the regions: Toulouse on 4 April, Nantes on 8 June, Lille on 14 June).

C. Contributions and coordination with other Talan entities

Research projects are mainly led by the 'Young PhD' team recruited by Talan. However, the contributors to the various projects come from all group entities.

In particular, the projects have involved the participation of approximately 190 group employees, mainly from Talan Solutions, Operations, Consulting and Labs. The breakdown between the entities is as follows:

Breakdown of R&D days by entity in France

■ Consulting +KeyOn   ■ Operations   ■ Solutions   ■ Labs

The Research Centre provides international "gateways" with the group entities conducting R&D projects. In 2022, the Talan Research Centre has particularly focused its efforts on Canada (Talan Createch Research Centre) and Tunisia (joint collaborations with the various Metaverse projects).

"By truly embracing a humanist approach to technology, we believe we can make the next digital age an era of progress for all."

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