Mindhive Pty Ltd

R&D Innovation Strategy Investor Update

July 2018 - 30 June 2021

2018/01: Design and development of an improved platform utilising artificial intelligence and machine learning to connect users in a fast and efficient way

Objectives of the project

Mindhive Pty Ltd (Mindhive) is a Brisbane-based company incorporated in 2014 and is known for designing and developing the world's first crowdsourced consultancy (Mindhive 1.0). Mindhive 1.0 functioned as a consultancy collaboration network so businesses could propose questions to a broader network of collaborators to solve more complex strategic, business and policy problems more efficiently than via public engagement or via traditional management consulting.

Before Mindhive 1.0, if a business were faced with a highly complex business, policy or strategic issue, it would need to outsource the work to a third-party consultant that would best serve the requirements at an agreeable price. This process would often have several limitations, such as being very time consuming, i.e. requiring research to find an appropriate consultant then communicating and coming to an agreement on terms and specifications. While this issue was somewhat overcome by Mindhive 1.0, several issues were identified, including:

- The matchmaking process was too slow and inefficient at accurately providing the correct information to the right people
- There were issues with how the platform could scale with additional engagement without resulting in problems with security
- Generating insight was a manual and slow process as the platform could not intelligently extract or highlight insights from user's contributions
- Lack of insight volume and inability to attribute insights to users in a scalable way.

As a result, Mindhive identified a gap in the market for a faster, more streamlined and scalable crowdsourcing network solution, offering a network of innovative consulting minds to provide tools for rapid insight and innovation in a manner not previously achieved anywhere in the world.

Noting the above, this R&D innovation project aims to develop Mindhive 2.0, an innovative platform with improved efficiency and crowdsourced consultancy capabilities coupled with a novel form of digital insight tracking and attribution.

In order to achieve a state-of-the-art crowdsourcing policy development platform, Mindhive needs to develop and implement the following technologies:

- Novel machine learning algorithms to convert dialogue into insight based on the challenge generation methodology. In-house NLP algorithms will be designed for this purpose
- Tools to facilitate insights identification through community-driven interactions, including targeted content highlighting, sentiment reaction and defined-option selections. This will include new algorithms to construct an insight's 'DNA' by tracking how insight is generated throughout the collaboration lifecycle
- An API ecosystem to allow the import and adoption of other proprietary and open-source tools to provide additional functionality beyond insight generation (e.g. reporting, data visualisation, big data referencing), experimentation with different machine learning algorithms, and an avenue to facilitate collaboration with new technologies (e.g. virtual reality)
- Tokenisation of insight combined with blockchain technology to reward, attribute and track unique insights
- Gamification of the contribution lifecycle, generating more dialogue and in turn making the AI/ML algorithms more robust in its insight-generation capabilities, ultimately leading to increased participation
- In-platform recognition ability to identify members as experts or influencers in relevant fields.

If successful in this innovation strategy, Mindhive will offer a unique digital mechanism to connect a network of innovative minds while providing rapid, rewarding insight generation and innovation tools.

New Knowledge

In addition to the limitations mentioned above with Mindhive 1.0, other available crowdsourcing consultancy and idea management solutions do not offer the full suite of services that the proposed Mindhive 2.0 platform provides. From an overarching perspective, Mindhive seeks to achieve a one-stop and unique crowdsourcing consultancy network that is capable of providing all of the following capabilities:

- Tools marketplace for new novel approaches of insight analysis and reporting
- Rapid insight generation and automation
- Internal and external crowdsourcing
- Knowledge output through an online academy model
- An intelligent platform that can encourage, recognise and reward insight creation
- Insight tracking from creation to potential commercialisation.

No other competitor has been able to achieve this before. Existing solutions do not provide intelligent matchmaking between their experts and enterprises that Mindhive's Artificial Intelligence (AI) algorithms will facilitate. They also do not apply artificial intelligence /Machine Leaning to the creation of their insights. In summary, other platforms do not become smarter over time (not scalable). Whilst tokenisation is utilised across different industries, Mindhive's intention to use it for insight tracking is a novel experiment and a potential problem-solving methodology.

If the series of Mindhive experiments are successful, it will culminate in an industry-leading insight development and generation platform at the forefront of technology innovation.

Following investigations in the 2018FY and research and development activities undertaken up to April 2019, Mindhive attended the inaugural global BOLD Awards held at one of the most impactful innovation hubs in Europe, 'H-FARM'. At this event, Mindhive CEO Bruce Muirhead received an award for the boldest crowdsourced online platform. This award recognised the innovative nature and potential of the project.

Knowledge Gap

Following extensive background research, competitor analysis and consultations with fellow industry experts, it was determined that no other crowdsourcing network had offered the multitude of functionalities to be incorporated in Mindhive 2.0. Furthermore, existing solutions cannot leverage user actions and sophisticated decay logic via implicit and explicit metrics to fully automate matches through data-driven and matchmaking AI. They can also not leverage the potential of blockchain to create a novel form of digital IP for insight generation.

Therefore, after comprehensive scoping and planning of how to potentially achieve the technical objectives of this project, it was determined that Mindhive could not determine whether the proposed functionality could be achieved without impeding on other aspects of performance such as security of stored data and processing speeds of less than 200ms. Another critical performance aspect is categorising client data based on user-specific characteristics and establishing a sufficient volume of baseline data and metrics to enable measurement from which the success or failure of the learning mechanisms can be evaluated.

As a result, Mindhive will need to undertake a systematic progression of work, proceeding from hypothesis through experimentation and analysis of results to overcome the encountered technical uncertainty. Such developmental work will be based on the principles of computer science and software engineering first principles.

Core Activity

1.1 Development of novel consultancy platform incorporating advanced Artificial Intelligence matchmaking functionality

July 2018 – June 2021

Before this R&D project and this core activity, Mindhive undertook considerable development activity in developing and delivering Mindhive 1.0/1.5. This included the collection of supervised training data – however, no conclusive artificial intelligence algorithm existed for the specific insight generation, classification or even coordination that Mindhive is seeking. Following this, Mindhive was left with the following technical questions and uncertainties, which form the basis of this core R&D activity. These questions include:

1. By connecting human and artificial intelligence, can Mindhive become a smarter and, therefore, scalable platform over time? In particular:
2. Would AI materially improve the efficiency and accuracy of the matchmaking process between enterprises and experts?
3. Can Mindhive incrementally scale an insightful community over time?
4. Can Mindhive develop novel methodologies for testing predictive insight experiments?
5. What are the most effective workflow processes and data capture layers to produce sufficient data, to provide data-driven insight as a precursor to producing automated intelligence reports, followed by automated AI/ML-driven insight generation?

Noting the above, the overall aim of this core R&D activity is to design and develop a novel data capture layer and semi-automated matchmaking functionality that will insightfully identify and match data between users with a problem and experts using the Mindhive platform.

Mindhive aims to develop and successfully assimilate this automated AI/ML-driven insight generation functionality within Mindhive 2.0 to be able to achieve the following effectively:

Match skills and expertise of platform participants to relevant challenges

- Automatically identify and insight based on a set of user-specific parameters without significant human intervention
- Self-structure data for use in machine learning algorithms within the overall platform.

Specifically, Mindhive hypothesised that improved data capture and classification layer would semi-autonomously extract points-of-interest (through highlighting) and insights from user-generated dialogue and provide an expansive data matrix. In addition, it is hypothesised that the data matrix would determine both user-specific capabilities to aid in a robust matchmaking algorithm to effectively pair experts and challenges while coupling an expansive labelled dataset of user-generated dialogue and insight to teach the AI algorithm.

If Mindhive is successful, it is hypothesised that an AI algorithm based on seq2seq mapping will be effective in self-extracting insights from user-generated dialogue given the expansive labelled dataset the Mindhive platform will generate on an ongoing basis. Additional avenues of exploration will include utilising deep generative models, which is theorised to create insight given a problem statement automatically.

Furthermore, it is hypothesised that the novel algorithms will improve the efficiency and accuracy of the matchmaking process between enterprises and experts, creating at least three quality insights per day whilst still achieving processing speeds of less than 200ms. If this hypothesis is proven, the latency of insight creation will be reduced from 14 days to three days.

To prove the above hypotheses, Mindhive will undertake the following experimental methodology:

Initial design and scoping of the experimental process and development of data capture and classification layer, including the design and development of first iteration insightful matchmaking functionality.

In the 2020FY, this has included:

- Design and development of a script that can extract relevant information from the database to create a data matrix for each approach i.e., matchmaking and insight generation
- Separately manage matchmaking and insight generation implementations following six significant phases.

Internal testing and deployment to trial customers. This included testing of the real-time insightful highlighting and matchmaking capabilities based on specific user:

- Skills and interest
- Prior challenge behaviour
- Keywords and tags within the data.

Testing and re-development of the solution to ensure it achieved targeted design criteria and performance benchmarks based on the architecture of the platform and its ability to sustain technological advancements such as the aforementioned data-driven intelligence and its technical performance whilst trying to maintain said technologies.

Live demo releases every two weeks and beta testing for stakeholders and customers to test the functionality within the improved data capture and classification layer. Mainly testing for the ability for the functionality to effectively match users with experts using the platform and rapidly (within 200ms) and insightfully identify and highlight meaningful data as a precursor to the algorithm development.

Towards the end of the 2019FY, Mindhive developed and integrated novel data capture and classification layer incorporating new Machine Learning (ML) algorithms and Natural Language Processing (NLP) tools. However, although the ML algorithms and NLP tools were able to identify areas of interest, they could not provide the hypothesised insightful creation, separating insight from popular commentary.

During the 2020FY, Mindhive 2.0 was released to the public. However, during this process, Mindhive undertook a range of testing, including penetration testing and data capture for AI and improved matchmaking and beta testing.

Specific observations/conclusions from the year included:

- To tackle the matchmaking approach using in-house data, Mindhive needed an algorithm that groups its data and finds logical relationships and patterns. Mindhive experimented with Unsupervised Machine Learning Algorithms which are used to group the unlabelled data via the presence of comparable features. Leading state-of-the-art options can be evaluated among different models such as K-Mean, Gaussian Mixture, Hidden Markov, Neural Networks, and Hierarchical clustering, etc.

- On the other hand, an insight generation approach requires an algorithm able to process natural language. Therefore, Mindhive experimented with deep learning techniques that are a subfield of machine learning concerned with algorithms inspired by the structure and function of the brain called artificial neural networks. Here, cutting-edge techniques includeSequence-to-Sequence Learning with Neural Networks, Neural Machine Translation, Convolutional over Recurrent Encoder for Neural Machine Translation, Google's Neural Machine Translation.

Mindhive is specifically developing a novel algorithm, termed Wildcard algorithm, which identifies and connects individuals with a high probability of meaningfully contributing (insight, perspective) to unrelated problems, i.e. not matched based on collected data. The algorithm identifies community members whose in-platform network, discussion input and discussion interactions would help facilitate, seed or antagonise further conversation – in turn, creating an environment from which deep insight is surfaced. It also allows for the accurate prediction of groups of individuals whose interaction synergy lead to more significant and more profound insight generation. The effectiveness of the new algorithm will be demonstrated through the effective connection of members to unrelated problems that result in solutions that would not have otherwise been found within a predicted community, i.e. a tattoo artist solving an oil spill problem.

The algorithm is scalable and applicable to any matchmaking industry where alignment of unconnected pairings provides a competitive or synergistic advantage, e.g. dating, recruitment, specialised services (team composition in armed forces or protective services, creative pairings of creative directors and copywriters, teams for scientific research or social policy). Given recent advances in natural language processing, it has the potential to significantly contribute to the Wildcard algorithmic understanding of how members from a different language, education and cultural backgrounds to unfamiliar problem spaces – or vice versa can be connected by translating the problem question through the cultural lens for a different perspective.

The approach involved the following in training, evaluating and developing, where necessary, unsupervised machine learning models for matchmaking and deep learning models for NLP insight generation:

Objectives and expectations:

- Matchmaking will identify the most suitable pair between challenges and experts
- Insight Generation will assist in automatically creating insight.

Data Processing
After previous data examination, Mindhive divided this step into four:

1. **Collect the raw data.**

    Matchmaking:
    Skills, Job title, Industry, Interests, Curious about, challenge title created by the user.

    Insight Generation:
    Challenge title, Posts, Comments, Highlights, Ideations, votes, insights.

    Identify the feature and label sources:
    Matchmaking needs user profile information; insights generation needs discussion records

2. **Select a sampling strategy**

    Split the data – The dataset was split 80/20% for training and testing, respectively.

3. **Data Preparation**
    Still, in progress, the process is described below:

For unsupervised learning (Matchmaking)

- Rows are observations (individuals), and columns are variables
- Any missing value in the data must be removed or estimated
- The data must be standardised (i.e., scaled) to make variables comparable. Recall that standardisation consists of transforming the variables such that they have a mean of zero and a standard deviation of one.

For deep learning, Natural Language Processing follows the following steps:

- Split the text into tokens such as words, sentences or even paragraphs
- Convert all the words into the lower case because the machine reads "Man" and "man" differently
- Remove the punctuation from each token
- Filter the remaining tokens that are not alphabetic
- Remove the stop words
- Reduce the word to its root example.

4. Modelling

For Matchmaking Mindhive is planning to train the cutting-edge unsupervised learning techniques for clusterisation – these include K-Mean, Gaussian Mixture, Hidden Markov and Hierarchical clustering

With Insights Generation, the deep learning techniques for NLP include Sequence-to-Sequence Learning with Neural Networks, Neural Machine Translation and Convolutional-over-Recurrent Encoder for Neural Machine Translation

When assimilated with the wildcard algorithm, the aim is to train and experimentally attain the targeted insight generation.

In the upcoming years and through further experimentation, Mindhive seeks to develop further the highlighting of insights capability (using AI) to allow multi-user selection upon which a richer analysis of what content is marked as 'valuable' and when, how often and in what context. Referenced against user data will provide an additional demographic layer upon which insight can be further defined.

Supporting Activities

1.1.1 Background research, project administration, planning and scoping, and preparation of substantiating documentation

Supporting activities undertaken for the dominant purpose of supporting the experimental activities of this project included:

- Project management and coordination activities including feasibility analysis, project scoping, scheduling, document control, financial management and coordinating with key stakeholders. This also involved preliminary coordination and consulting with internal management and creative staff to gather opinions, objectives, project direction and expectations
- Project administration activities include but are not limited to management of contracts and human resources (staff and contractors), as well as training and education of the technical staff
- Research activities such as market reviews, literature reviews, analysis of existing solutions and consultation with potential clients. This included preliminary research and consultation with experts to identify existing knowledge on Artificial Intelligence (AI) and Machine Learning (ML) algorithms

- Utilising a design director, strategy manager, senior product manager, technical director and internal resources from Mindhive to validate screen mock-ups, carried out brand and market research, swot analysis, interviews with current and potential customers to design and test response to the altered workflow and features. The design sprints and user tests initially fleshed out the design before development commenced and were followed by ongoing two weekly demo and feedback sessions. The purpose of these sessions was to provide the necessary feedback loop to the designers and developers so that changes could be made along the way
- Initial design and scoping of required system architecture. This also included supporting code development
- Preparation and storing of various types of contemporaneous documentation to substantiate the R&D activities conducted (E.g. Reports, timesheets, emails, meeting notes).

Preliminary research and feasibility analysis activities are required to determine the gaps in currently existing technologies to determine the critical technical goals, client needs and product benchmarks that must be met.

To ensure the project's success, it must be sufficiently planned, managed, and tracked with sufficient supporting documentation. Further, the development teams must be staffed and supported through the various administrative duties.

Mindhive ITeam

Matias Cecchetto
Lead Engineer
Mindhive Pty Ltd

In Adepto, Matias leads the integration with 3rd parties (particularly SAP Fieldglass and Burning Glass). The integration with SAP helped the company secure most of its big customers (ATOS, AECOM, Queensland Gov and Cisco) and meant they made it through successful Series B, securing 3 million GBP.

Adepto
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TECHO
Technological University of Argentina)

Dony Wiranata
Software Engineer (Backend and AI)

Dony is a data expert with experience working at the most prominent e-commerce tech company in Indonesia, with a strong engineering background and a data-driven decision mindset. He designed and analysed an award-winning chatbot product, saving millions of dollars in company operational expenses. Dony graduated from the 8th best university globally, with a predicted grade of either first or upper-second class, studying applied machine learning and engineering.

University College London,
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Rendy Permana
Front End Developer

Rendy is an experienced Frontend Developer with a demonstrated history of working in the internet industry. JavaScript enthusiast and experienced with VueJs. He is passionate about data visualisation and creating cool user interfaces.

Indonesian Computer University
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MediawaveReza Prabowo
Front End Dev

Reza is an experienced Frontend Developer with websites and mobile apps. He's a JavaScript engineer, primarily working with ReactJS, VueJS, React Native, and Electron. He is passionate about UI/UX and visualisation, code structures, and efficiency.

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