DigInTraCE

D4.5 Financial Toolkit v1

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DigInTraCE

A Digital value chain Integration Traceability framework for process industries for Circularity and low Emissions by waste reduction and use of secondary raw materials

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List of abbreviations and acronyms History

Abbreviation	Meaning
DPP	Digital Product Passport
AI	Artificial Intelligence
WP4	Work Package 4
T4.3	Task 4.3
D4.5	Deliverable 4.5
D2.9	Deliverable 2.9

D4.9	Deliverable 4.9
D4.6	Deliverable 4.6
D4.3	Deliverable 4.3
BOLL	Bollinger Bands
EMA	Exponential Moving Average
MACD	Moving Average Convergence Divergence
RSI	Relative Strength Index
DMI	Directional Movement Index
ADX	Average Directional Movement
SQL	Structured Query Language
AWS	Amazon Web Services
UC	Use Case

Executive Summary

The Financial Services and Price Definition tool (Financial Toolkit) aims to create a comprehensive set of financial services designed to assist stakeholders in the secondary raw materials market. The objectives include:

➢ developing strategies to hedge against the risk of price fluctuations in secondary raw materials
➢ incorporating currency exchange considerations into cross-currency transactions of secondary raw materials
➢ employing technical analysis techniques to highlight key price trends and predict short-term price movements of secondary raw materials
➢ identifying and displaying the relationships between secondary raw materials and other internationally traded assets, as well as major economic indexes and indicators
➢ creating and defining financial derivatives based on secondary raw materials.

The first version (v1) of the financial toolkit contains the following functionalities:

✓ Financial charts for secondary raw materials visualization
✓ Technical indicators for key price trends and predict short-term price movements
✓ Strategies based on technical indicators
✓ Dynamic correlation matrix for identifying and displaying the relationships between secondary raw materials and other internationally traded assets, as well as major economic indexes and indicators
✓ Currency pairs prediction mechanism for incorporating currency exchange considerations into cross-currency transactions of secondary raw materials

The final version of the financial toolkit will contain:

✓ Definition of financial derivatives with underlying assets secondary raw materials
✓ Pricing of financial derivatives with underlying assets secondary raw materials
✓ Hedging (*) strategies with the usage of financial derivatives to hedge against the risk of price fluctuations

(*) Hedging, in finance, is to take an offsetting position in an asset or investment that reduces the price risk of an existing position. A hedge is therefore a trade that is made with the purpose of reducing the risk of adverse price movements in another asset. Normally, a hedge consists of taking the opposite position in a related security or in a derivative security based on the asset to be hedged.
Source: Investopedia

1. Introduction

The DigInTraCE project is focused on developing a Decentralized Traceability platform that is both transparent and interoperable, utilizing cutting-edge tracking, sensing, and sorting technologies. It aims to continually update Digital Product Passport (DPP) schemes to facilitate certification and ensure product quality. The project incorporates AI-driven decision-making to enhance process and lifecycle efficiencies. It is committed to improving the use of secondary raw materials by promoting up-cycling, reuse, and enhancement technologies, alongside contributing to standardization to guarantee the openness and accessibility of data. DigInTraCE also looks to foster economic growth, advance digital competencies, and meet local social requirements by exploring innovative business models.

One of the important objectives of the project is to make crucial secondary raw material information more accessible through the use of smart tags, smart contracts, financial services & tools, hedging strategies, and immersive technology.

More specifically, the Financial Services and Price Definition tool is a part of the project's Work Package 4 (WP4) "Digital tools and platform development" and belongs to the Task 4.3 (T4.3).

T4.3 aims to create and refine a suite of financial services designed to assist stakeholders in the secondary raw materials market. These services are intended to help stakeholders to:

- design and model financial derivatives that are based on secondary raw materials and to develop strategies for hedging against the risk of price fluctuations

- incorporate considerations of currency risk in planning trades of secondary raw materials across different currencies

- utilize technical analysis techniques to identify significant price trends and predict short-term price movements of secondary raw materials

- discover and illustrate the correlations between secondary raw materials and other assets traded on international exchanges, as well as with major macroeconomic indexes and indicators

T4.3 also identifies market needs specifically related to pricing decision support. Based on these needs, services are developed to enable the visualization of historical prices and trends of materials, as well as to offer prediction tools and services for assessing and protecting against fluctuation risks (hedging).

1.1. Purpose of the deliverable

The current deliverable is the first version (v1) of the Financial Services and Price Definition tool that provides functionalities that have to do with charting, technical analysis, trading strategies, correlation between assets and currency pairs predictions.

The purpose of a document that describes the software of a Financial Services and Price Definition tool is to provide a comprehensive overview of the software's

functionalities, features, and user interaction mechanisms. This document serves as a crucial blueprint for stakeholders, and potential users, detailing how the software operates, its intended use cases, and the problems it aims to solve within the DigInTraCE platform. By outlining the software's capabilities in defining and analyzing prices, hedging strategies, and market trends, the document facilitates a common understanding among all parties involved, ensuring alignment with business objectives and user needs. Additionally, it guides users that trade secondary raw materials in making informed decisions, and assists them in leveraging the tool effectively.

Moreover, this document acts as a reference point for future upgrades, maintenance, and troubleshooting, contributing to the software's lifecycle management and its adaptation to evolving market demands.

1.2. Intended audience

The primary audience for this document includes anyone tasked with trading secondary raw materials, such as recycled metals, plastics, and paper. These materials are integral to various sectors, including Pulp & Paper and Chemicals. These users will be able to take advantage of the visualization part of the Financial Toolkit and to see how they can use the charts and the technical analysis indicators in order to make more informative trading decisions.

They will also be able to see signals produced by strategies based on different combinations of the technical analysis indicators. These strategies are commonly used by professional & institutional traders in the industry of financial markets.

Users will have the capability to examine the intricate relationships highlighted by the correlation matrix, which maps out the interconnections between secondary raw materials and various financial assets. Such analyses are routinely leveraged by seasoned professionals and institutional investors within the financial markets sector, enabling them to craft sophisticated strategies that capitalize on the subtle interplays between assets. By understanding these correlations, traders can better predict market movements and optimize their investment approaches, taking advantage of synergies and hedging against potential risks.

Within the financial toolkit designed for commodities trading, users will gain access to predictions for currency pairs, a feature of paramount importance. This functionality enables traders to forecast future movements of currency pairs, which is crucial when dealing with commodities priced in different currencies.

1.3. Structure of the deliverable and its relation with other work packages/deliverables

This deliverable is structured to provide a comprehensive overview and detailed insights into the development, functionalities, and applications of the DigInTraCE Financial Toolkit Version 1 (D4.5). It is meticulously organized into several sections, each designed to cater to the diverse needs of its intended audience, ranging from

developers to stakeholders in the financial and commodities markets. The structure is outlined as follows:

- **Executive Summary:** This segment offers a concise summary of the financial toolkit purpose, key findings, and significant conclusions, serving as a primer for the detailed content that follows.
- **Introduction:** Delving deeper, the introduction outlines the deliverable's objectives, its target audience, and the structural organization, including its interrelation with other work packages and deliverables within the project.
- **DigInTraCE Financial Services and Price Definition Tool:** This core section provides an extensive exploration of the toolkit, including user profiles, technical specifications, operational and structural characteristics, external dependencies, and the technological choices underpinning its development.
- **Use Cases:** A series of use cases demonstrate the toolkit's practical applications, ranging from account creation and user login to more sophisticated functions like chart analysis, technical indicators, strategy formulation based on technical indicators, correlation matrix analysis, currency pairs prediction, account management, and user logout.
- **Conclusions:** The final section synthesizes the findings, emphasizing the deliverable's contributions to the field and its implications for future development and research.

Each section is carefully crafted to guide the reader through the deliverable's complex details, ensuring a thorough understanding of its capabilities, applications, and the value it brings to stakeholders in the financial services and commodities markets.

The current deliverable (D4.5) is linked with several other work packages and deliverables within the DigInTraCE project:

- **D2.9 Specifications Definition and Architecture of Digital Tracing v1**: D4.5 relies on the foundational specifications and architectural framework established in D2.9. This deliverable provides the structural blueprint and technical guidelines that inform the development of the Financial Toolkit.
- **D4.9 DigInTraCE Platform and System Integration v1**: The Financial Toolkit's functionalities are designed to integrate seamlessly with the broader DigInTraCE platform, as detailed in D4.9. This deliverable focuses on the system integration aspects, ensuring that the Financial Toolkit interoperates effectively with other components and modules within the platform.
- **D4.6 Financial Tool FINAL**: D4.5 serves as the initial version of the Financial Toolkit, laying the groundwork for the final version documented in D4.6.
- **D4.3 Blockchain and Distributed Ledger v1**: The integration of blockchain and distributed ledger technologies, as explored in D4.3 is a concept that will be developed in the final version of the Financial Toolkit and has to do with the financial derivatives (definition and pricing) and the hedging strategies.

2. DigInTraCE Financial Services and price definition tool

2.1. Introduction

The Financial Toolkit is designed to offer an extensive array of financial services to support those involved in the secondary raw materials market. Its goals are to:

- Formulate strategies that mitigate the risks associated with price volatility in secondary raw materials.
- Integrate considerations of foreign exchange in the trading of secondary raw materials across different currencies.
- Utilize techniques of technical analysis to discern crucial pricing trends and forecast imminent price shifts in secondary raw materials.
- Map out and visualize how secondary raw materials correlate with other assets traded on the global market and with key economic indicators and indices.
- Develop and specify financial derivatives that are tied to secondary raw materials.

The current release (version 1) of this toolkit introduces several key features:

- Visualization tools in the form of financial charts for secondary raw materials.
- Technical indicators designed to track significant pricing trends and forecast near-term price fluctuations.
- Strategies derived from technical indicators.
- A dynamic correlation matrix to map out and showcase the connections between secondary raw materials, globally traded assets, and significant economic indicators and indices.
- A prediction tool for currency pairs to help account for foreign exchange factors in cross-currency trading of secondary raw materials.

Charts play a pivotal role in the analysis of financial assets, serving as indispensable tools for investors and analysts alike. By visualizing price movements over time, charts offer a clear and immediate depiction of market trends and patterns. This graphical representation enables analysts to identify trends, ranging from short-term fluctuations to long-term performance, facilitating the prediction of future movements based on historical data. Charts also aid in the recognition of technical indicators and patterns, such as support and resistance levels, which are crucial for making informed trading decisions. Furthermore, charts allow for the comparison of financial assets and the observation of correlations, assisting investors in diversifying their portfolios and managing risk. The use of charts in financial analysis not only enhances the understanding of market dynamics but also supports strategic decision-making by providing a solid foundation for technical analysis methodologies and forecasting.

Technical analysis indicators are vital tools in the toolbox of traders and analysts for assessing financial assets. These indicators, which include a variety of mathematical calculations based on the price, volume, or open interest of a security, help in identifying market trends, momentum, volatility, and potential reversal points. For instance, moving averages can smooth out price data to reveal a clearer long-term trend, while oscillators like the Relative Strength Index (RSI) and

MACD indicators help in identifying overbought or oversold conditions that may indicate a potential reversal. Bollinger Bands provide insights into market volatility. By applying these and other indicators, analysts can make more informed predictions about future price movements, enhancing their decision-making process. The strategic use of technical analysis indicators facilitates the identification of profitable entry and exit points, risk management, and the optimization of investment strategies, making them indispensable for those looking to navigate the complexities of financial markets effectively.

Trading strategies that are based on technical indicators play a critical role in the financial analysis of assets by offering systematic methods for interpreting market data and making informed trading decisions. These strategies leverage a variety of technical indicators, such as moving averages, RSI, and MACD, to identify potential entry and exit points in the market. By analyzing past price movements, traders can detect trends, momentum, and market sentiment, allowing for the anticipation of future price movements with greater accuracy. The utilization of these strategies enables traders to mitigate risks and enhance the profitability of their investments by capitalizing on market inefficiencies. Furthermore, strategies that combine multiple technical indicators amplify the effectiveness of financial asset analysis by integrating various data points and analytical perspectives into a cohesive trading approach. By merging indicators that measure different market aspects—such as trend direction, momentum, and volatility, traders can achieve a more nuanced and robust understanding of market conditions. This multifaceted approach reduces the reliance on a single indicator, which can sometimes give misleading signals when used in isolation. For instance, combining moving averages with oscillators like RSI or MACD can help confirm trend strength and signal potential reversals more reliably. The synergy of these indicators provides a comprehensive analysis framework, enabling traders to make more informed decisions with increased confidence.

A **correlation matrix** that encompasses secondary raw materials alongside other assets like commodities, major stock indices, and currency pairs is an indispensable tool for traders and investors aiming to diversify their portfolios and manage risk effectively. This matrix quantifies the degree to which different market segments move in relation to one another, offering insights into potential hedge strategies or opportunities for arbitrage. By understanding these relationships, investors can make informed decisions on asset allocation, identifying which investments tend to move together and which provide a counterbalance during market volatility. For example, if secondary raw materials exhibit low or negative correlation with other commodities, they could serve as a valuable hedge against stock market downturns. The correlation matrix thus becomes a critical analytical tool, facilitating a strategic approach to investment that leverages the interconnectedness of global financial markets to enhance portfolio performance and resilience.

A **prediction tool for currency pairs** is a strategic asset for traders and investors dealing with secondary raw materials in a cross-currency context. This tool leverages historical data, market trends, and machine learning algorithms to forecast future movements in currency exchange rates. By providing insights into how currency pairs may fluctuate, this tool enables market participants to anticipate and hedge against potential foreign exchange risks that could affect the profitability of trading secondary raw materials across different currencies. It helps

in making informed decisions about the timing of transactions, optimizing the conversion rates for buying or selling materials, and implementing strategies to protect against adverse currency movements. Furthermore, such a tool can uncover opportunities for hedging where discrepancies between predicted and actual market rates exist. In essence, a currency pair prediction tool empowers traders and investors to incorporate foreign exchange considerations seamlessly into their broader trading strategy, enhancing the efficiency and financial outcomes of cross-currency transactions in the volatile arena of secondary raw materials.

2.2. Users

The Financial Toolkit designed for the secondary raw materials market caters to a diverse user base, encompassing commodity traders, recycling companies, investment analysts, and environmental strategists, among others. These users share a common interest in leveraging detailed financial data and analytical tools to make informed decisions about secondary raw materials. Their characteristics often include a strong understanding of market dynamics, a keen interest in sustainability and circular economy principles, and a necessity for accurate, real-time data to navigate the volatile commodities market.

To accommodate these needs, the Financial Toolkit offers a web application that ensures secure and easy access to its resources. Users typically register by providing basic information (username, email address, and password) and verifying their identity to maintain the platform's integrity and security. Once signed in, they gain access to a comprehensive suite of tools. These tools are meticulously designed to analyze market trends, predict market movements, and develop effective strategies for hedging and trading in secondary raw materials.

2.3. Technical requirements

The technical requirements of the Financial Toolkit web application are specifically designed to address the unique challenges and functionalities required for the secondary raw materials market. This includes a focus on the financial data processing, analysis, and trading capabilities essential for users in this sector.

Operational characteristics ensure the application's performance, usability, and reliability meet the demanding standards of financial data processing and analysis specific to secondary raw materials. These characteristics include high-performance data processing, where the application must process large volumes of financial data, ensuring timely analysis and decision-making. Advanced visualization tools are necessary for creating detailed financial charts and graphs to visualize historical prices, technical indicators, and correlations specific to secondary raw materials. Additionally, predictive analytics involves algorithms for forecasting price trends and currency movements, tailored to the volatility and specific patterns of the secondary raw materials market.

Structural characteristics shape the application's architecture, emphasizing configurability, seamless integration with other systems, and portability. These features include customizable analysis tools that allow users to configure various aspects of the analysis tools to suit their specific trading strategies and

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requirements within the secondary raw materials market. Seamless integration is required for the application to integrate effortlessly with external financial data providers, currency exchange rate feeds, and other DigInTraCE modules. Scalability ensures the application can support increasing numbers of users and data volumes without performance degradation, accommodating market expansion and increased usage in the secondary raw materials sector.

Cross-cutting characteristics ensure the Financial Toolkit web application meets top operational standards for security, interoperability, and accessibility. These include robust security measures for data storage to protect sensitive information related to secondary raw materials trading. Interoperability ensures compatibility with various financial systems and platforms used by users in the secondary raw materials market. Accessibility involves designing the application to be accessible to all users in compliance with accessibility standards.

Together, these technical requirements form the backbone of the web application, ensuring it delivers a robust, secure, and user-friendly experience specifically tailored for analyzing and trading financial data related to secondary raw materials.

2.3.1. Operational characteristics

Operational architecture characteristics for the Financial Services and Price Definition tool ensure the smooth functioning and resilience of the system, specifically tailored to the secondary raw materials market.
Availability pertains to the system being operational 24/7, as financial data for secondary raw materials must be continuously available to support trading and analysis. Provisions must be in place to quickly restore functionality in case of failure, ensuring uninterrupted access to market data.
Continuity involves robust disaster recovery capabilities to swiftly recover from disruptions or catastrophic events. Given the volatility of the secondary raw materials market, any downtime can result in significant financial loss, necessitating a reliable recovery plan.
Performance includes stress testing and peak analysis tailored to the high-volume data processing needs of secondary raw materials trading. This involves assessing the frequency of financial data queries, ensuring the system can handle the required capacity and maintain optimal performance under various market conditions.
Recoverability addresses the need for rapid restoration of system functionality in case of a disaster. This is critical for financial applications where continuous access to market data and trading capabilities is essential. Backup strategies and duplicated hardware are necessary to minimize downtime.
Reliability/Safety involves ensuring the system is fail-safe, given its mission-critical role in financial market analysis for secondary raw materials. Stringent reliability and safety measures are essential to prevent data loss and ensure accurate and timely information.
Robustness refers to the system's ability to handle errors and boundary conditions specific to financial data processing, such as sudden spikes in data volume during market events, internet connection failures, power outages, or hardware malfunctions, without compromising its functionality.
Scalability assesses the system's ability to handle increasing numbers of users and data volumes specific to the secondary raw materials market. The tool must

accommodate growth in market participants and data sources, ensuring seamless operation and performance as demand increases.

2.3.2.Structural characteristics

Structural architecture characteristics for the Financial Services and Price Definition tool encompass essential capabilities that define the design and adaptability of the system, specifically designed for the secondary raw materials market.

Configurability allows users to modify various aspects of the software configuration to suit their specific tools and analytical requirements within the secondary raw materials market. This enhances flexibility and customization, enabling users to tailor the tool to their unique needs, such as adjusting technical indicators or changing the parameters and the criteria as they use the Correlation Matrix and the Currency Pairs Prediction tools.

Extensibility refers to the ease with which new pieces of functionality can be seamlessly integrated into the existing system. This is crucial for accommodating future expansions and enhancements specific to secondary raw materials trading, such as adding new financial models, integrating additional data sources, or implementing advanced analytics features, without disrupting the overall architecture.

Portability ensures that the system can run on multiple platforms, facilitating compatibility and ease of deployment across different operating environments. This is important for users who may need to access the tool from various devices, ensuring they can analyze and trade secondary raw materials from anywhere.

Maintainability assesses the ease of applying changes and enhancements to the system. Efficient maintenance and updates are essential to address the evolving needs and technological advancements in the secondary raw materials market, such as incorporating new market data, updating algorithms, or improving user interfaces based on feedback.

Installability evaluates the ease of installing the system on all necessary platforms. Ensuring smooth deployment and minimizing installation-related challenges for users is critical for quick adoption and effective use of the tool. This includes providing clear installation instructions, support for multiple operating systems, and automated setup processes to get users up and running quickly.

2.3.3.Cross-cutting characteristics

Cross-cutting architecture characteristics for the Financial Services and Price Definition tool encompass diverse capabilities that ensure the overall effectiveness and compliance of the system, customized for the secondary raw materials market.

Accessibility ensures access for all users by designing the application to comply with accessibility standards. This is crucial for accommodating a diverse user base and ensuring that all users can effectively use the tool.

Authentication involves robust security measures to verify user identities, safeguarding against unauthorized access and ensuring data integrity. This is vital for protecting sensitive financial data and maintaining trust among users in the secondary raw materials market.

Authorization encompasses security measures to control and restrict user access to specific functions within the application. By safeguarding sensitive information and resources, the tool ensures that only authorized personnel can perform critical operations, thereby enhancing security and data protection.

Legal addresses legislative constraints or regulations governing system operation, reservation rights, or application development, ensuring compliance with legal obligations. This is essential for maintaining regulatory compliance and avoiding legal issues related to data handling and financial information.

Privacy focuses on the ability to conceal transactions from internal company employees, protecting sensitive information and maintaining confidentiality. This is particularly important in financial markets where transaction data must be kept secure to prevent unauthorized access and misuse.

Security encompasses encryption needs for data in the database and network communication, as well as authentication requirements for remote user access. Ensuring data confidentiality and integrity is crucial for protecting financial data and user information in the secondary raw materials market.

Usability/Achievability evaluates the level of user training required to effectively use the application, ensuring it is user-friendly and accessible for all users. This includes providing comprehensive documentation, intuitive interfaces, and support resources to facilitate easy adoption and efficient use of the tool.

Interoperability assesses the ease of integration with other systems, enabling seamless data exchange and interoperability within the broader technological ecosystem. This is essential for connecting with various financial data sources, currency exchange rate feeds, and other DigInTraCE modules, ensuring a cohesive and efficient workflow for users.

2.4. External dependencies

External dependencies are critical for the seamless operation and integration of the Financial Toolkit within the DigInTraCE platform. These dependencies encompass the necessary external systems and integration points with other modules to ensure comprehensive functionality. Key external dependencies include:

- **Data Feeds**: Market prices and historical price databases for secondary raw materials are essential for accurate charting, technical analysis, and price forecasting.
- **Currency Exchange Rates**: Access to up-to-date currency exchange rates is crucial for transactions involving secondary raw materials across different currencies, enabling accurate predictions and analyses.
- **Integration with Other DigInTraCE Modules**: The Financial Toolkit must seamlessly interoperate with the rest of the modules of the DigInTraCE platform so all the system's modules are under the same platform. This integration ensures a holistic approach to data analysis and decision-making.
- **Technical Infrastructure**: Reliable cloud and database technologies are necessary to support the toolkit's infrastructure, emphasizing scalability and performance to handle large volumes of data and future growth.

By addressing these external dependencies, the Financial Toolkit can provide stakeholders with accurate, timely, and actionable insights, enhancing their ability to make informed decisions and effectively manage risks in the secondary raw materials market.

2.5. Technological decisions

In the development of DigInTraCE's financial toolkit, a comprehensive approach to technological decisions has been adopted to ensure robustness, scalability, and efficiency. The toolkit leverages a combination of cutting-edge technologies tailored to meet the specific needs and objectives of the project.

React: The frontend of the financial toolkit is built using React, a popular JavaScript library for building user interfaces. React provides a highly responsive and interactive user experience, enabling dynamic data visualization and seamless navigation within the application.

.NET Core: The backend infrastructure of the financial toolkit is powered by .NET Core, a cross-platform, open-source framework for building scalable and high-performance applications. .NET Core offers robust support for developing web APIs and services, ensuring efficient data processing and management.

SQL Server: As the primary database management system, SQL Server is utilized to store and manage the vast amounts of financial data generated and processed by the toolkit. SQL Server provides reliability, security, and scalability, enabling efficient data retrieval and analysis.

AWS Lightsail: The financial toolkit is hosted on AWS Lightsail, a simple cloud platform that offers cost-effective and scalable cloud computing solutions. AWS Lightsail provides the necessary infrastructure and resources to ensure the availability, performance, and security of the application.

Python: Python is employed for various backend data processing tasks, calculations, models, and machine learning algorithms within the financial toolkit. Python's versatility and extensive library support make it well-suited for implementing advanced analytical functionalities, including predictive modelling and data analysis.

By incorporating these technological decisions, DigInTraCE's Financial Toolkit is equipped with the necessary tools and capabilities to effectively address the complexities of financial data analysis and decision-making in the context of secondary raw materials markets. These technologies collectively contribute to the development of a robust, scalable, and innovative solution that meets the evolving needs of stakeholders in the industry. The detailed system architecture and the architectural diagram of the Financial Toolkit are presented in the deliverable D2.9 Specifications definition and architecture of digital tracing v1.

3. Use Cases

In this section, the use case scenarios of the DigInTraCE financial toolkit application are presented one by one. Each use case scenario also includes the implementation screen of the application.

3.1. Use Case 1 – Account Creation

Use Case Scenario ID	UC1
Use Case Title	Account Creation

The screen of the DigInTraCE financial toolkit application implementing the above use case scenario is shown in the **Figure 1** which is the main page of the system:

Figure 1 – Main page

User clicks on 'Create account' link and the screen of the **Figure 2** will appear:

Figure 2 – Create account screen

After completing the details successfully, the following confirmation screen of **Figure 3** will appear:

Figure 3 – Verification message

To complete the verification process, it is essential for the user to log into the specified email account. Upon logging in, the user should look for the verification email that has been sent. Within this email, there will be a verification link. Clicking on this link is a crucial step for the user to verify their account and ensure full access to the services provided. If the email is not found in the inbox, it is recommended to check the spam or junk folder, as it may sometimes be redirected there. This step is important for securing and verifying the user's account. The verification email is presented in the **Figure 4**:

Figure 4– Verification email

Following the completion of the verification process, the user is then able to log into their DigInTraCE account. This step ensures that the user's identity has been securely confirmed, allowing them full access to the features and services offered by DigInTraCE. It's a pivotal moment that unlocks the user's ability to interact with the platform, setting the stage for a secure and personalized experience. Logging in post-verification is straightforward and signifies the start of the user's journey with DigInTraCE, where they can explore, engage, and utilize the platform to its fullest potential.

3.2. Use Case 2 – User Login

Use Case Scenario ID	UC2
Use Case Title	User Login

The screen of the application that implements the above use case scenario is shown in the **Figure 5**:

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Figure 5 – User Login screen

User fills the *Email address* and the *Password* and click on the blue '*Log in*' button. If the credentials are not correct, user is notified with a message as the **Figure 6** presents:

Figure 6– Login error message

If the user provides the correct credentials, the system opens the main page of the financial toolkit as the following figure presents:
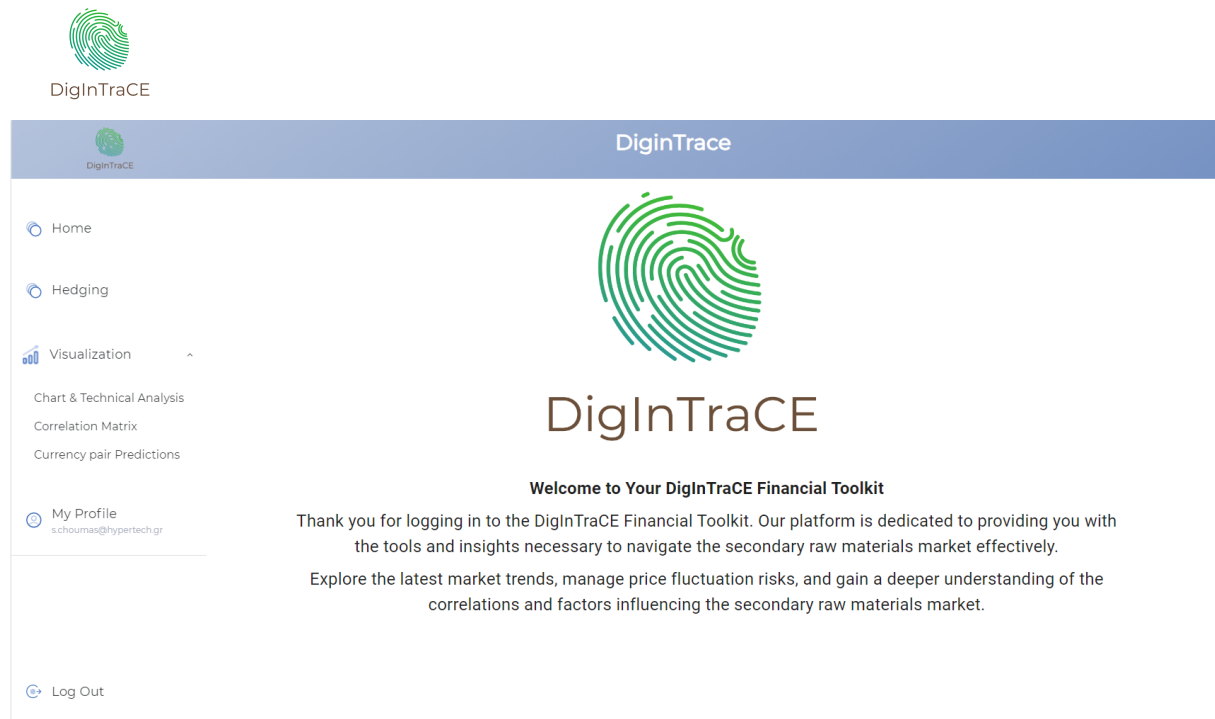
Figure 7: Main Page

3.3. Use Case 3 – Charts

Use Case Scenario ID	UC3
Use Case Title	Charts

User clicks on the *Visualization* button on the left of the screen. User can see a drop-down list for selecting the Secondary Raw Material and the chart that appears below as the **Figure 8** presents:

Figure 8– Financial chart of a selected secondary raw material

The chart presented offers a comprehensive visualization of the time series data for secondary raw materials, utilizing various graphical representations to convey the fluctuations and trends over time. The "*Solid*" line provides a clear, uninterrupted view of the material's performance, offering a straightforward interpretation of its overall trajectory.

The "*Stroke*" line, with its distinct dashes, highlights specific periods of interest or anomalies within the dataset, drawing attention to potential outliers or significant changes.

The "*Up Stroke*" and "*Down Stroke*" lines add further depth to the analysis, with upward strokes indicating positive growth or recovery phases, and downward strokes signaling declines or downturns, thus offering insights into the material's cyclical nature.

Additionally, the "*Area*" aspect of the chart fills the space beneath the line, accentuating the volume and magnitude of changes over time, giving a more pronounced sense of the material's market presence and stability.

Together, these diverse graphical elements provide a multifaceted view of the secondary raw material's market behavior, enabling a nuanced understanding of its time series data.

3.4. Use Case 4 – Secondary Raw Materials Price analysis & forecasting with Technical Indicators

Use Case Scenario ID	UC4
Use Case Title	SRM Price analysis & forecasting with Technical Indicators

In enhancing the analytical depth of the chart for secondary raw material, users have the option to apply a range of technical indicators that offer various insights into market dynamics.

Bollinger Bands (BOLL) provides a visual representation of volatility and price levels, delineating upper and lower thresholds around the price movement.

The Exponential Moving Average (EMA) offers a smoothed perspective on price trends, prioritizing recent prices to quickly respond to market changes.

The Moving Average Convergence Divergence (MACD) serves as a momentum indicator, highlighting the relationship between two moving averages of the material's price, enabling users to discern potential buy or sell signals.

The Relative Strength Index (RSI) is a momentum oscillator that measures the speed and change of price movements, identifying overbought or oversold conditions.

Lastly, the Directional Movement Index (DMI) provides a systematic method to determine the direction and strength of a trend.

By applying these technical indicators, users can gain a more detailed and nuanced understanding of the market behavior of the secondary raw material, facilitating informed decision-making based on comprehensive analysis.

The **Figure 9**, shows the chart with technical indicators:

Figure 9– Financial chart with Technical Indicators

3.5. Use Case 5 – Strategies based on Technical Indicators

Use Case Scenario ID	UC5
Use Case Title	Strategies based on Technical Indicators

The platform offers users a suite of trading strategies designed to navigate the complexities of the market for secondary raw materials, each equipped with specific signals that guide decision-making. The MACD Strategy leverages the Moving Average Convergence Divergence indicator to signal potential buy or sell opportunities.

Similarly, the RSI Strategy uses the Relative Strength Index to identify overbought or oversold conditions, providing visual cues through arrows for optimal entry or exit points.

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The ADX Strategy employs the Average Directional Index to gauge trend strength, with signals indicating trend continuations or reversals.

The EMA Strategy utilizes the Exponential Moving Average to detect price trends and momentum shifts, offering timely signals for market actions.

A combination of indicators, such as the MACD/RSI Strategy and MACD/ADX Strategy, amalgamates the strengths of individual indicators to provide more refined signals for trading decisions.

The Bollinger Bands Strategy uses the bands to identify volatility and price levels, signaling when prices are likely to revert to mean.

Each strategy not only presents up/down arrows for clear action signals but also annotates the date of each signal's occurrence, providing users with a chronological context for their strategic moves, enabling them to align their trading actions with market dynamics effectively.

All strategies are marked by up or down arrows and the day they occur as the **Figure 10** presents:

Strategy Name	Date	Signal
MACD Strategy	05-01-2024	ⓘ ↓ Sell
RSI Strategy	13-01-2024	ⓘ ↓ Sell
ADX Strategy	26-01-2024	ⓘ ↓ Sell
EMA Strategy	28-01-2024	ⓘ ↓ Sell
MACD/RSI Strategy	08-11-2023	ⓘ ↑ Buy
Bollinger Bands Strategy	13-01-2024	ⓘ ↓ Sell
MACD/ADX Strategy	06-06-2023	ⓘ ↓ Sell

Figure 10– Strategies based on Technical Indicators

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3.6. Use Case 6 – Correlation Matrix

Use Case Scenario ID	UC6
Use Case Title	Correlation Matrix

User clicks on the '*Correlation Matrix*' link on the left bar under the *Visualization* section (see **Figure 11** below)
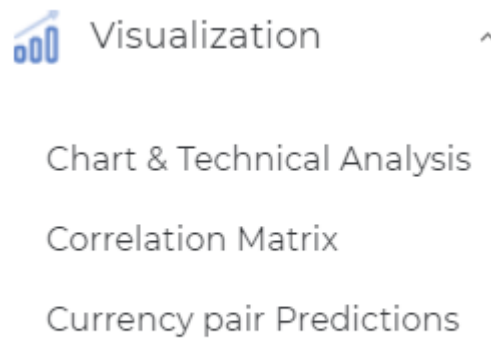

Figure 11– Visualization bar

The Correlation Matrix screen appears as the **Figure 12** presents:

Figure 12– Correlation Matrix – Periods and Assets

The correlation matrix is an important analytical tool that presents a comprehensive view of the interrelations between secondary raw materials, major indices, commodities, and currency pairs. By quantifying the degree to which these financial instruments move in tandem or opposition to one another, the matrix offers insights into potential diversification strategies and risk management.

Users select period (50 days, 100 days, 200 days and 500 days) and assets (2-10 selections). The result is presented in the **Figure 13** below:

	Plywood	Urea	EURUSD	EURGBP	SP500	NIKKEI225	GOLD	CRUDE OIL	COPPER
Plywood	-	0.2715	0.0387	-0.0406	0.0661	0.1359	-0.2547	-0.1042	-0.1610
Urea	0.2715	-	0.0224	-0.0392	-0.2979	-0.0413	-0.1305	-0.0085	-0.1463
EURUSD	0.0387	0.0224	-	0.1629	-0.0772	-0.0919	0.1987	-0.0611	0.1113
EURGBP	-0.0406	-0.0392	0.1629	-	0.1220	-0.0054	0.0418	-0.0369	0.0000
SP500	0.0661	-0.2979	-0.0772	0.1220	-	0.1230	-0.1539	-0.1557	-0.0711
NIKKEI225	0.1359	-0.0413	-0.0919	-0.0054	0.1230	-	-0.2046	0.1035	0.0690
GOLD	-0.2547	-0.1305	0.1987	0.0418	-0.1539	-0.2046	-	-0.0007	0.2948
CRUDE OIL	-0.1042	-0.0085	-0.0611	-0.0369	-0.1557	0.1035	-0.0007	-	0.2558
COPPER	-0.1610	-0.1463	0.1113	0.0000	-0.0711	0.0690	0.2948	0.2558	-

Figure 13– Correlation Matrix – Results

Each cell within the matrix displays the correlation coefficient, ranging from -1 to 1, where a value closer to 1 signifies a strong positive correlation, indicating that the instruments tend to move in the same direction. Conversely, a coefficient near -1 denotes a strong negative correlation, highlighting assets that typically move in opposite directions. Values around 0 suggest little to no linear relationship. This tool allows users to identify patterns and connections across different market sectors, aiding in the formulation of strategies that leverage these interdependencies. Whether aiming to hedge against market volatility or seeking arbitrage opportunities, users can rely on the correlation matrix to make informed decisions by understanding the complex dynamics between secondary raw materials, global indices, various commodities, and diverse currency pairs.

3.7. Use Case 7 – Currency Pairs Prediction

Use Case Scenario ID	UC7
Use Case Title	Currency Pairs Prediction

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User clicks on the '*Currency Pairs Prediction*' link on the left bar under the Visualization section. The screen that appears is presented in the **Figure 14**:

Figure 14– Currency Pairs Prediction

In commodities trading, currency risk, also known as exchange rate risk, plays a pivotal role in shaping investment outcomes. This risk arises from the fluctuations in the value of currencies in which commodities are priced and traded globally, predominantly in U.S. dollars. For traders and investors dealing with commodities, from oil and gold to agricultural products and secondary raw materials, changes in currency values can significantly impact the cost basis, profit margins, and overall returns. For example, a strengthening dollar makes commodities more expensive for holders of other currencies, potentially dampening demand and affecting prices. Conversely, a weakening dollar can lower the price of commodities in foreign markets, possibly stimulating demand and driving prices up.

Understanding the interplay between currencies and secondary raw materials is crucial for traders aiming to navigate the volatile landscape of commodities trading successfully. By effectively managing currency risk, commodities traders can protect their investments from exchange rate volatility, enhancing their ability to achieve profitable outcomes in the complex and interconnected global market.

Currency pairs prediction functionality stands as an essential tool for traders of secondary raw materials due to the intrinsic link between currency valuations and commodity prices. Given that most commodities, including secondary raw materials, are traded internationally and priced in U.S. dollars, fluctuations in currency values can significantly affect the trading dynamics and profit margins for these materials. Here are several reasons why currency pairs prediction is crucial for these traders:

➢ **Cost Prediction and Management**: Predictive insights into currency movements allow traders to better estimate future costs of raw materials that need to be imported or converted into different currencies. This capability aids in budgeting and financial planning, ensuring that traders can hedge against potential increases in costs due to unfavorable currency shifts.

➢ **Profit Maximization**: By leveraging predictions about currency pairs, traders can time their transactions to capitalize on favorable exchange rates, maximizing the profitability of trades. For example, purchasing secondary raw materials when the domestic currency is strong or selling when it is weak can enhance revenue and margins.

➢ **Risk Mitigation**: Currency risk poses a significant threat to the profitability of trading in secondary raw materials. Accurate and timely predictions of currency pair movements enable traders to employ hedging strategies more effectively, protecting their investments from adverse shifts in currency values.

➢ **Competitive Advantage**: Traders equipped with predictive insights into currency fluctuations can make more informed decisions faster than competitors who do not utilize such analytics. This advantage can be crucial in markets for secondary raw materials, where timing and price sensitivity are key to securing the best deals.

➢ **Strategic Sourcing and Sales**: Understanding future trends in currency valuations can influence strategic decisions regarding sourcing materials from foreign markets or choosing the optimal time to sell. Traders can identify opportunities to secondary raw materials more cost-effectively or to enter markets where currency trends increase the competitiveness of their offerings.

➢ **Global Market Analysis**: Currency pairs prediction functionality helps traders comprehend broader economic and geopolitical trends that influence global markets. This understanding is crucial for anticipating shifts in supply and demand for secondary raw materials on a global scale, allowing traders to adjust their strategies accordingly.

In summary, currency pairs prediction offers traders of secondary raw materials a critical edge in navigating the complexities of international markets, enhancing their ability to manage costs, mitigate risks, and seize opportunities in a competitive landscape.

Users select currency pair and prediction date and click on 'Prediction' button. The prediction appears as the following **Figure 15** presents:
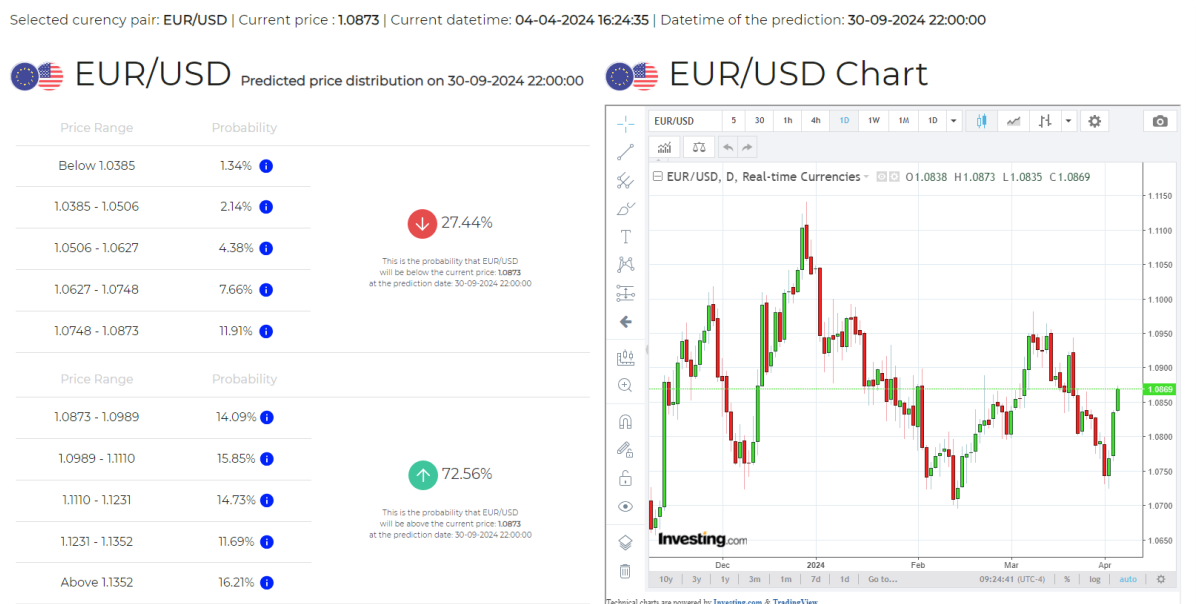

Figure 15– Currency Pairs Prediction result

The outcome of the currency pairs prediction showcases a comprehensive table that clearly distinguishes the bandwidth/probability, offering insights into the expected range of movement for the currency pairs. Additionally, it presents the cumulative probability for potential upward or downward trends in relation to the current market price, providing traders with a probabilistic understanding of future movements. Accompanying this data is a detailed price chart of the selected currency pair, visually representing historical and current price trends. This

integration of quantitative probability analysis with visual price trends equips traders with a robust analytical tool, enhancing their ability to make informed decisions based on a blend of statistical probability and market performance.

3.8. Use Case 8 – User Account Management

Use Case Scenario ID	UC8
Use Case Title	User Account Management

User, by clicking to "*My Profile*" link on the left bar. The screen of the following **Figure 16** will appear:

Figure 16– User Account Management

The user account management screen is thoughtfully designed to provide users with a seamless and efficient way to maintain and update their personal and account information. Through this intuitive interface, users are empowered to edit their first name, last name, residential address, and the country and city in which they reside, ensuring their profile reflects their current situation accurately. Additionally, the functionality extends to updating the zip code and telephone number, further enhancing the personalization of the account.

Security is also a paramount concern, allowing users to change their password as needed to maintain the integrity of their account. Moreover, users have the flexibility to select or alter their base currency, tailoring the financial aspects of the service to better suit their individual needs and preferences.

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This comprehensive array of editable fields makes the user account management screen an essential tool for users to keep their personal and account information up-to-date and aligned with their preferences and requirements.

3.9. Use Case 9 – User Logout

Use Case Scenario ID	UC9
Use Case Title	User Logout

User clicks on the 'Log Out' link on the left bar. The system logs out the user by returning to the Login screen.

4. Conclusions

In conclusion, the delineation of the version one of the DigInTraCE Financial Services and price definition tool within this document offers a comprehensive understanding of its multifaceted utility and strategic positioning within the project's framework. Through an exploration of its purpose, intended audience, and structural integration with other work packages and deliverables, a nuanced comprehension of the tool's significance emerges. The meticulous examination of its technical requirements, encompassing operational, structural, and cross-cutting characteristics, not only elucidates its operational dynamics but also underscores its adaptability and resilience in navigating the complexities of the secondary raw materials market.

Furthermore, the highlighting of the tool's technological decisions unveils the deliberate considerations and strategic choices underpinning its development. By leveraging cutting-edge technologies such as React, .NET Core, SQL Server, AWS Lightsail, and Python, the tool is poised to be delivered as a robust, scalable, and innovative solution that aligns with the project's objectives and stakeholder expectations.

The exploration of various use cases underscores the practical application and versatility of the tool across diverse scenarios, ranging from user account management to currency pairs prediction. This analytical approach not only showcases the tool's functionality but also highlights its potential to drive operational efficiency, informed decision-making, and strategic insights within the secondary raw materials market landscape.

Ultimately, this document serves as a foundational resource, offering stakeholders a comprehensive roadmap for the usage and utilization of the DigInTraCE Financial Services and price definition tool. By fostering a deeper understanding of its capabilities, limitations, and strategic implications, stakeholders are empowered to leverage the tool effectively, thereby maximizing its impact in addressing the evolving needs and challenges of the secondary raw materials market.

In the forthcoming final version, the DigInTraCE Financial Services and price definition tool will undergo significant enhancement with the inclusion of comprehensive definitions of financial derivatives, the pricing models, and advanced hedging strategies centred around these derivatives. This pivotal addition represents a significant stride in equipping stakeholders with a sophisticated understanding of derivative instruments and their role in mitigating risk and optimizing financial positions within the secondary raw materials market. By untangling the intricacies of derivative pricing models for options, alongside elucidating various hedging strategies tailored to specific market conditions, the final version of the tool aims to empower stakeholders with the knowledge and tools necessary to navigate the complexities of financial markets of the secondary raw materials with confidence and agility. Through this strategic augmentation, the tool evolves into a fundamental resource, poised to drive informed decision-making, enhance risk management practices, and unlock new avenues for value creation within the dynamic landscape of secondary raw materials trading.

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