

Expired Medicines - 19 billion going up in flames

Abstract - About €19.5bn worth of medicines are going to waste in Europe alone each year. Besides the negative effects on environment and health, this represents a significant cost factor for the healthcare system. A solution that is compliant with the strict regulatory standards for pharmaceuticals could produce significant savings. Can a blockchain based solution help?

Customer pain point - Global businesses are losing about 11.7% of their sales to the ghost economy¹. This adds up to an estimated \$1.75 trillion annually whereby about a third can be contributed to overstocks alone. The definition of ghost economy entails the categories out-of-stock items, overstock items and unnecessary returns which all produce about an equal amounts of cost. In the EMEA² Region the cost from overstock including spoilage can be quantified to about \$137.5bn annually³ with the 3 biggest culprits being a) not-connected data and inventory systems, b) personnel issues when handling the IT systems and c) process failures. Using the IMF database⁴, we determine a European share of 85% or \$117.8bn in this economic loss. If we would be able to prevent only a portion of this through a solution that builds on already available technologies, the impact for the European Union as a whole could be significant. Figure 1 outlines the potential stages of a complete project based on B²IMS.

The innovation - We seek to develop a **blockchain based inventory management system that connects multiple participants** within an industry. This innovation will connect inventory stockholders in like-minded groups so that information about what they hold in stock, what expires when and additional logistical details can easily be exchanged with the objective to avoid spoilage of stock. Such a solution would enable all businesses holding inventory stock to better manage and prevent dead-stock buildup and thereby eliminate unnecessary economic cost on an European level. We believe that an interconnected and distributed database solution (blockchain) can present this solution and increase business efficiency significantly in inventory related problems by connecting counterparties that until now operate separately in similar or identical industries. The effectiveness of this solution is amplified through the strengths of the blockchain technology.

Blockchain-based solutions provide the following **benefits**:

- **Trust** is derived from the technological aspects of the system to a very high degree, so that no direct trust between participants is necessary ('trustless' system)
- **Unchangeable** and byzantine fault tolerant entries allow seamless documentation and audits, eliminating the worries that the owner and administrator of a central database can change or delete entries that might later on be of interest to the participants
- **Distributed** architecture of the blockchain network and state-of-the-art encryption create high reliability, data security and decrease the vulnerability to cyber threats as entries into the blockchain database are stored on a large number of servers (nodes) with individual backup.
- **High capacity**, fast transactions and easy access allow for flexible usability and high user acceptance. These features provide the necessary foundation for broad applications on one hand while they also guarantee a pleasant user experience that invites mouth-to-mouth marketing for others to join in using the solution.

Market - While inventory management is an optional package in most software solutions of the [large providers](#) of ERM Systems⁵ (the likes of SAP, Oracle, IBM), a few solutions for inventory management exist [standalone](#) (ABC Inventory, Canvas, Delivr, inFlow, Odo, RightControlLite). All have in common

¹ Study by US based think-tank IHL Group (ihlservices.com).

² EMEA - Europe, Middle East, Africa with Europe having the largest economic impact by far.

³ TradeGecko and IHL Group calculations (tradegecko.com, ihlservices.com).

⁴ See <https://www.imf.org/external/datamapper/NGDPD@WEO/EU/MENA>.

⁵ ERM -Electronic Resource Management Systems.

that they are specifically designed to work for one client alone and don't provide interaction capabilities to securely exchange information on an group- or industry-wide level. In our opinion, it is this feature that will provide a quantum leap in efficiency as the market sized to share dead-stock inventory is multiplied.

Risks and opportunities - We see great opportunity in this large market. The sheer size and large number of potential clients in the hospital space alone combined with new and innovative technology and a small number of player provide ample opportunities. However, these are counterweighted by a number of risks:

- Targeted sales prices / subscription rates could not be reached which would lead to slower growth in profitability.
- A high number of players could enter the market, leading to smaller market share for each and compressed margins (stronger increase than factored in the initial business plan).
- Hospitals and potentially other inventory- holders could display unexpected barriers to try out a new approach that will lead to slower penetration rates, thus delaying profitability of the project and in turn requiring more external financing during the first year.

Approach

We suggest to conduct a feasibility study with the goal to determine which industry group and market segment can economically profit the most from a blockchain-based inventory management system in order to commercially develop such a solution in a second phase.

We suspect that large inefficiencies exist in the healthcare industry where hospitals keep a large number of pharmaceuticals on stock that go to waste because of expiration. On the other hand, a majority of the costs are born by the health insurers. While we realize that there are a number of legislative reasons for this we still believe the optimization potential to be significant. Logically, the healthcare market (including hospitals and health insurances) will be a focal point of our study. We focus on the broader healthcare sector because efficiency gains in this industry come with a double-impact: not only will economic benefits ultimately lead to higher welfare for European citizens but also will we be able to create benefits for the patients by providing better access to needed drugs at a lower overall price.

Why now - The software market is just starting to apply blockchain technology to economically viable use cases. Some singular approaches to the broader supply-chain-management topic can be identified (like Skript, Omnichain, IBM, SAP) but no inventory specific solution seems to be implemented in life-production as of today. At the same time the topic of "blockchain" finds interested listeners in almost every industry. Albeit high regulation and tendency to react slowly, the healthcare industry in general and the hospitals and insurers in particular seem to be a natural target for our business idea.

Current development stage - We currently have a working prototype of a blockchain-based distributed database that can be the technological backbone of a future solution. Industry-specific requirements must be collected to develop the data-design and required user-interfaces to create a minimum viable product.

However, it will be crucial to continue the development into the direction with appropriate customer appetite and market potential so that specification of the solution can be as close as possible to a broad future application. To achieve a feasibility study which yields results upon which a business can potentially be built we look to employ a highly structured methodology as outlined in the work package description below.

Future stages and commercialization - After finalisation of the feasibility study (including the identification of suitable markets we will identify what additional technologies are required to build an efficient solutions. For example, this could include the need for sensors that report the temperature of goods to be transferred (if need to be cooled) or GPS data recording to track the logistics and give better access to insurance policies when transporting very valuable goods.

2. Impact

Entering the market

Targeted users and customers market conditions - While the possible applications for B²IMS are broad and can produce substantial benefits in many industries we will focus on the hospital market at first. Hospitals and their management of pharmaceutical and technical inventory are currently clients of existing software providers but the market is very fragmented. To our knowledge, there exists no solution that provides interoperability and connection of multiple users. We therefore understand ourselves to be operating in a new market.

We currently have singular data points of very positive feedback from C-Suite operatives from different industries including healthcare. Participants of this small field test have quickly grasped the concepts and magnitude of potential benefits that a blockchain solution can provide and have transferred its application to their respective fields immediately. It is therefore to be expected that more specifically targeted interactions in the healthcare industry and amongst hospital will grant similar results.

The value of disposed drugs is not well documented and numbers are hard to collect. A study by the German workers union [verdi](#) from 2007 shows that about 10% of medicines expire and are subsequently thrown away. That number confirms the IHL study and translated to cost of EUR 3.4 bn for the German market alone. In turn, just inflating this number from 2007 to 2018 gives an estimated EUR 4.2 bn of expired medicines in Germany alone. By scaling this number with Germany's IMF based [share](#) of the European Union's GDP (21%)⁶ we estimate the **European cost of expired medicine to be around EUR 19.5bn** annually.

Potential market share - As the market is not well known or developed we assume that first-movers with a working solution will have a significant competitive advantage and make a conservative estimate that costs of expired medicines can be at least reduced by a quarter over 5 years and that we can achieve a **25% market share** from the first mover advantage. Our business model will be subscription based so that customers pay a small fee for every package of drugs that can be sold on before expiring and being expunged. Assuming an initial 10% fee (decreasing yearly as the market matures) we have **potential for about EUR 50 Mio. in revenues annually** after 5 years of being in the market. However, the business model and price elasticities will have to be evaluated closely during the feasibility study as well as during a later stage.

Main competitors - We directly compete with existing inventory management software providers and more generally with ERM software providers. While our offering is unique through the interconnection of many entities that currently rely on their separate systems, it will be challenging to find use-cases in which we can implement the system without fully replacing existing solutions which always is a big hurdle. The process of change management needs to be carefully researched, prepared and addressed.

Barriers to entry - As main barriers to entry we see the hurdle to replace existing inventory management systems. The operational functionality, especially in hospitals, relies to a great extent on inventory management with direct consequences for patient health. Therefore, a careful approach must be taken when starting to replace existing inventory management systems.

New jobs opportunities, higher standard of living - If the evaluation of the business plan and result of the feasibility study grant positive results, BTRI will hire additional personnel to implement the proposal in the

⁶ Calculated at \$4.03bn/\$18.77bn based on IMF numbers.

market. We target to pay salaries above market average to attract the best job applicants and therefore expect to contribute on an overall higher standard of living for European citizens.

Environmental Impact - Currently, medicines valued at an estimated €19.5bn are thrown away each year in Europe alone. Making a simple approximation with €40 as average value per package and an average weight of 200g per package this amounts to about 100t of annual waste from medicines⁷. As these are usually incinerated, the effect on the carbon footprint is negative. In case other methods of waste disposal are being used it is possible that substances reach the water supply and help generate super-bacteria (multi-resistant) that represent serious challenges in the healthcare system already today. B²IMS can contribute to reduce these negative effects.

Business model

Alignment of proposal with overall strategy of applicant - BTRI is actively researching applications of blockchain technology that provide long term and quantifiable value-added in a truly user-friendly manner. We look to commercialize viable concepts and will likely require international partners to effectively implement business models. We therefore feel that anchoring B²IMS on a European level with multiple European partners will ensure fast and international market penetration and integration of local expertise and requirements.

Value Chain - Our value chain has limited suppliers (basically just hardware providers in case our customers want to outsource the operation of blockchain nodes to us). On the customer side we want to focus B²IMS on hospitals and health insurances in a first approach and possibly widen the group of customers to other industry related services like pharmacies and drugs wholesalers in a later stage. We feel that it will be helpful to involve a small group of customers in the final specification of the product (ie the blockchain, internal standards, APIs and its user interfaces) to ensure quick adoption in a segment that creates sustainable value for its users and therewith attracts others.

Model and Scalability - We look to implement a subscription based business model whereby the basic use of the blockchain / platform solution is free of charge and we benefit from a small fee for each transaction made by the participants in each logistical unit.

The model is highly scalable on multiple dimensions:

- A) Customer groups that can be logistically connected in an economically efficient manner will form logistical units that can interchange drugs and technical devices to where they are needed before the drugs expire. As the underlying software solution is to a high degree identical for every logistical unit, we can add a large number of logistical units without incurring additional fixed costs.
- B) The same mechanics of avoiding dead-stock problems in supply chain management can potentially be applied to other industries which in turn can be serviced with a very similar product.
- C) We will be able to connect smaller logistical units to clusters and thereby grow the market to interchange dead-stock items like medicines that are about to expire.

Initial commercialisation plan - Once a minimum viable product is developed (ideally together with customers' representatives) we target its implementation in a smaller environment first to smooth out potential bugs before deploying the product to a wider audience. We expect to already have close relations to a potential group of hospitals and insurers in place by the time WP 1 is nearing finalisation.

European dimension - As we work on WP 1 the deliverables will require us to reach out to and connect with European partners not only from the industry but also from industry organisations and other representative group to ensure compliance with existing standards and regulations. We envision to leverage

⁷ €19.5bn / €40 * 200g = 97.5t

these relations in the commercialization phase of the product to improve our reach and maximize both social, innovative and economic impact.

Improved international competitiveness - By applying the innovative technology which B²IMS will develop on a multinational level across the European Union, we will be able to maximize the cost saving impact to the overall healthcare system. This will enable us and participating organizations to highlight the heightened international competitiveness of the industry through our innovation and position Europe as a beacon for sustainably designed blockchain technology applications which provide substantial value-added.