

# Digitizing Mining & Mineral Industry for Sustainable Future: Distinguishing Regulatory Expectations with Business Operations

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**Abstract:** Sri Lankan mining and mineral industry is the driving industry of local construction projects. The effective management of all engineering processes at the mining and mineral industry will ensure the industry's sustainability. As per studies conducted based on the cement consumption of the country, the total local sand consumption and the sand supply through the Geological Survey and Mines Bureau has a gap of more than 50% from 2014 to 2018. The disparity between the supply and the consumption has only been matched by supply from illegal sand mining. To promote sustainability, we tried out an online digitized solution known as Mining & Mineral Production (mmPro) Monitoring Solution, which effectively controls and monitors the licenses by recording transactions done using issued licenses. Meanwhile, according to a case study done between 2017 - 2020, another solution called the Welithota application has been introduced with the aims of promoting efficient transaction management at mining sites. These two applications currently function independently without intercommunication. It is clear that these two solutions have eliminated the technophobia in the miners' and government officers' minds and the technological challenges in mining sites. Therefore, this study proposes a framework for the co-existence of the two applications, without interchanging the sensitive data, thereby ensuring better cooperation.

**Keywords:** Engineering Management, Synergizing, Mining & Mineral Industry, Mmpro, Welithota.

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## I. INTRODUCTION

From ancient times of 40000 BC [1], mining was a process done by human beings to extract valuable minerals and other geological raw materials from the mother earth having considerable deposits. The world of mines provides us with a variety of minerals across the globe including base metals such as Aluminium, Tin, Chromium; Clay; construction aggregates such as Gravel, Sand; Diamonds; Fossil fuels and many more. There are numerous mining methods applying around the world based on minerals, deposit size, geographical location, a potential risk to the miners, the depth of the deposit and many other factors [2]. Though the mining industry in Sri Lanka is smaller compared to the world, we have a unique position in the world due to the quality and the purity of certain minerals we have. One example is Eppawala phosphate deposits [3]. As an industry, mining & quarrying contribute 9% of the industry sector with 2.8% increment in the year 2019 compared to the 5.2% negative growth in 2018 [4]. This situation has worsened due to the economic crisis and the Covid pandemic. For this reason, the mining sector has become more daunting and the

number of licensees who operate lawfully has declined tremendously.

The regulatory body for the mining industry in Sri Lanka Geological Survey & Mines Bureau (GSMB) was formed under Mines And Minerals Act No 33 of 1992. All the regulatory processes are done manually with physical form filling with a person to person contacts. Therefore, the process is very cumbersome and wasting GSMB officer's and mining license owner's time, effort, energy and money who are running industries in a very rural area as the nature of the industry. The prices of the construction materials especially sand and gravel were increased due to this and the cabinet of ministers decided to scrap the transport license on 4th December 2019 which invited many other problems including increment of illegal activities and creating socio-economic problems [5].

Meanwhile, we can find digitization initiatives to facilitate the mining site operations, sales, lifecycle of transport licenses, labour salaries, advances, equipment hiring costs, internal transportations, backhoe operations in the case studies of the Welithota application [6].

Additionally, there are initiatives from the government and regulatory institute to move from manual process to digitization using solutions similar to Mining & Mineral Production (mmPro) solution trial out solution by GSMB [7]. In this paper, we discuss the essence of the coexistence of the two products collaboratively with mutual exclusion to serve their own solution domains, assuring the digitization of business operations and regulatory requirements of different stakeholders' point of view.

## II. PROBLEM

### ➤ Concerns on GSMB License Process

As per the Mines & Minerals Act No. 33 of 1992, GSMB issues five types of licenses including exploration, mining, trading, export and transport licenses. As per the current process of applicants need to come to the GSMB office physically to get each of these licenses. Each time they apply for a new license or renew existing licenses, should have to provide the same set of documents including application form, copy of the deed, copy of the plan and what are the documents ask from GSMB, if the applicant is not the landowner, an affidavit from the landowner or lease agreement, economic viability report, concerned letters from any other party, copy of mining license for TPL, TPL card, a letter from mining license holder giving consent to provide minerals [8] as applicable. There are instances when the license owners have to return to office just for a photocopy of a document.

Additionally, the mining license owners do not live in the same area of the mining site. Mining sites are situated far away from GSMB regional offices. Therefore travelling more than 100 km is needed in some cases to come to GSMB office as it is essential the mining license owner needs to be present in person to get the license. This wastes lots of time, money,

effort and energy of the mining license owner and it added to the end product cost of the mineral and sand use for construction. In certain cases, a mining license owner keeps a dedicated person to manage GSMB licenses who sometimes stay overnight closer to the GSMB office to get the same day transport licenses for the following day.

As per the transport license process, the used transport licenses (TPL) had to return GSMB. So, mining license owners, lorry drivers had to pay special attention not to lose the license even after completing transportation.

### ➤ Effect of TPL Cancellation

The cabinet of ministers decided to cancel the transport license with effect from 4th Dec 2019 considering the effect of sand price to the construction industry [10]. While this decision helped in bringing down the prices of the corresponding minerals, it created a different set of socio-economic problems due to the increase of illegal sand mining [11]. The ministers of cabinet decided to get the Sri Lanka Army to investigate illegal sand mining [12] since the Sri Lanka Police who were doing illegal sand transport control could not continue the same due to cancellation of transport license. Since GSMB doesn't have an effective database of potential illegal mining sites and mechanism to communicate such updates realtime or near-real-time to other government organizations, the involvement of the Army was not effective enough and the loss for the GSMB for the first six months of the operation was 1.2 billion as per the GSMB chairman's statement by June 2020 [9]. Additionally, the cabinet decision was legally challenged by environmentalists insisting on the requirement to issue transport licenses by GSMB [5]. As per the order by the court of appeal to the acting inspector general of police on 17th July 2020 via case number CA/WRIT/12/2020 requested to implement the licences for the transportation of sand, soil and clay as before [21].

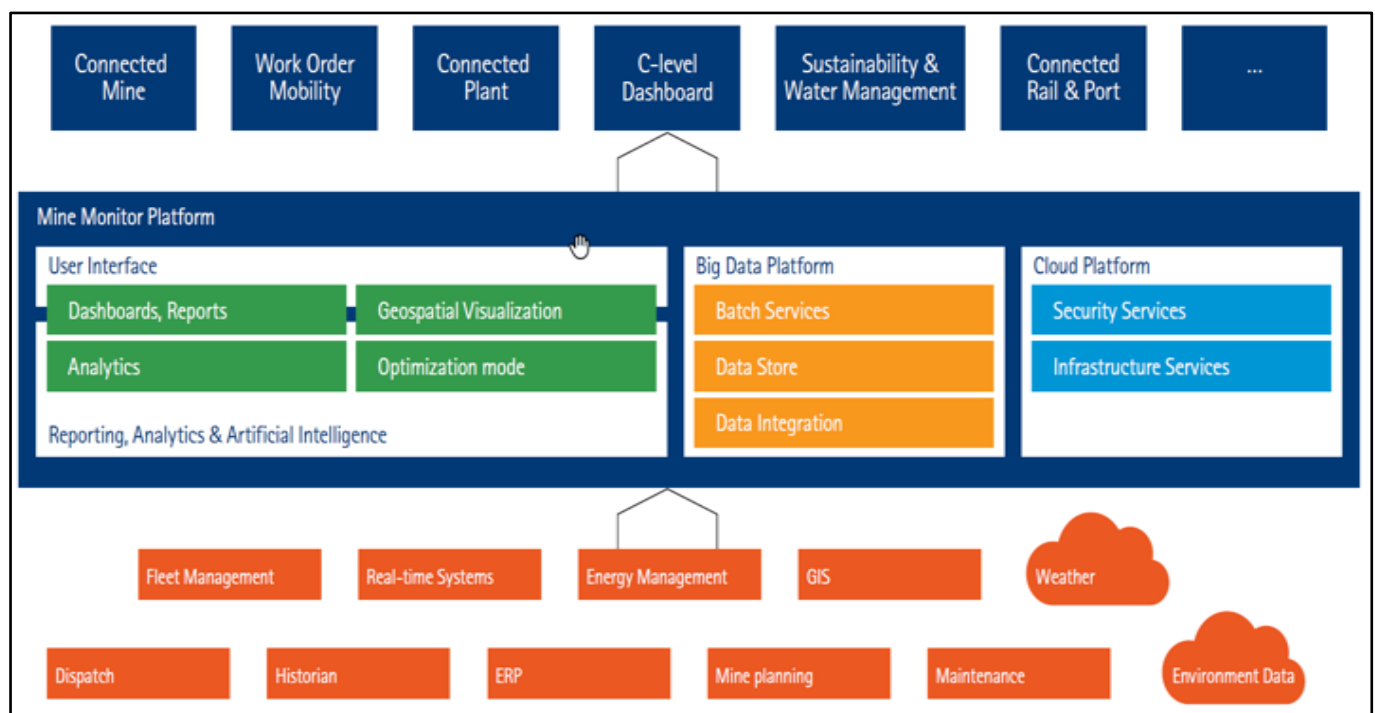


Fig 1 Comprehensive Solution Architecture for Digitize Mining Operation

### ➤ Mining License Owners Expectation

Meanwhile, the mining license owners face the problem on their angle. To minimize the effect of inefficient GSMB license processes they try to implement software-based and mobile-based solutions to track TPL lifecycle on their own [6]. This solution cost is high due to the effort of pitching, implementing and supporting at the individual level. Not only GSMB related activities, but also expenses tracking, internal

sand transport tracking, salary and advance payments, backhoe operations, site expenses, bank deposits, sand sales, payment collection and other similar activities which should not expose to GSMB or any other third party also need to be captured on these solutions and should keep secret and private to the mining license owners with appropriate access levels.

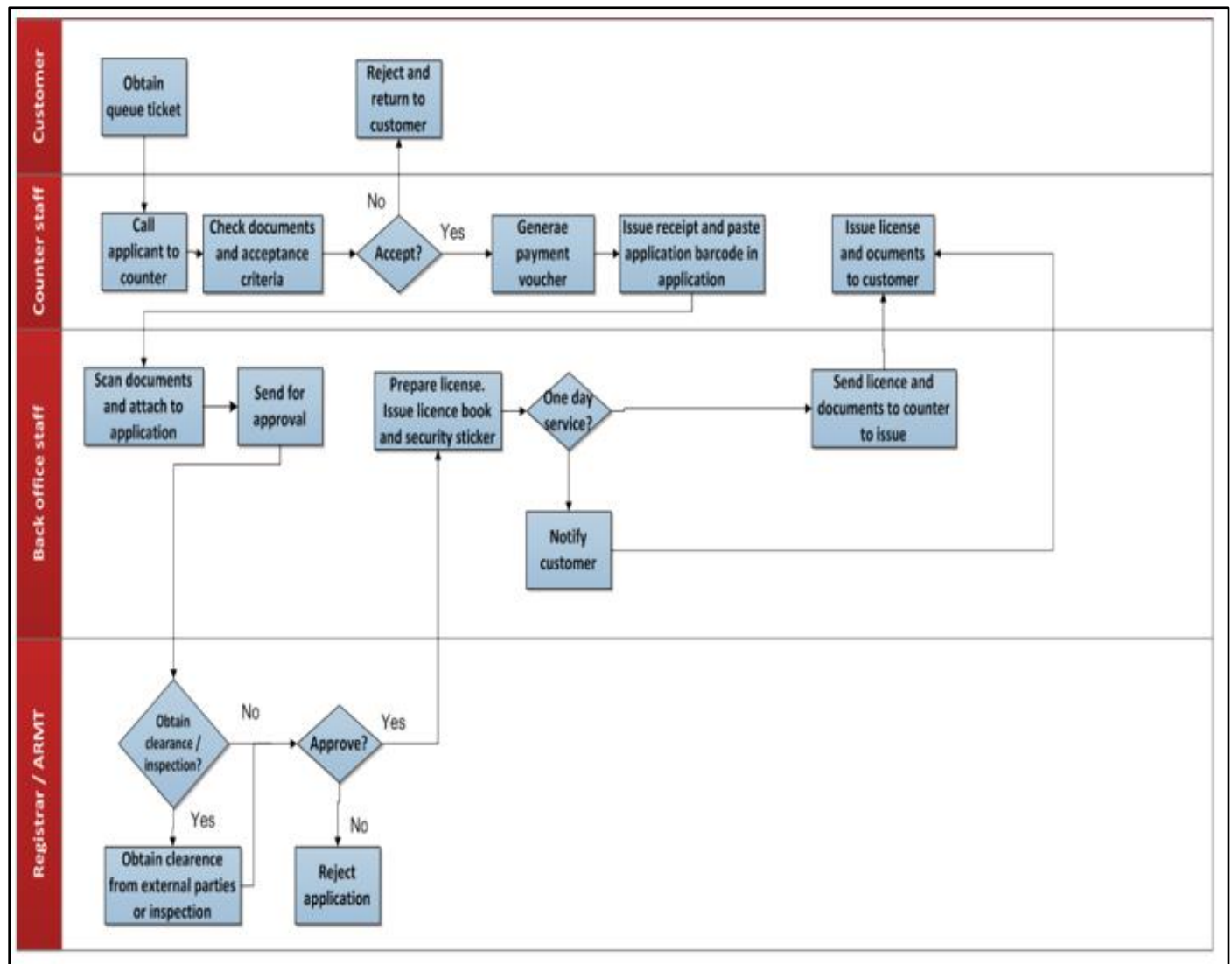


Fig 2 GSMB License Processing System

### ➤ Post COVID New Normal Impact

All the mining operations in Sri Lanka were closed unexpectedly on 13th March 2020 with the Corona outbreak. GSMB as the regulatory body for the industry extended facilitation to the affected stakeholders by providing needed assistance like extending the license validation and delaying the royalty payment deadlines [13, 14]. However, GSMB could not immediately implement the digital solution they have tried successfully in Kalutara, Kurunagala and Manampitiya in Polonnaruwa as an effective solution to maintain the social distancing following the health guideline. Therefore, due to reinitiation of old transport license process implementation with minor modifications to simplify the process [15, 16], the mining license owners had to gather

back in GSMB head office and regional offices putting both GSMB staff and citizens visiting there at a health risk. With this decision, the sand price was increased again and to control the situation GSMB Chairman enforces a ceiling price for a sand cube [17]. However due to the voice of mining license holders about the practicality of fixing a ceiling price effective to all mining sites in the country without considering the geographical difficulties, depth of the mining site, quality of the sand, rain & other environmental effect causes availability of sand deposit and other practical factors involved, the decision had been revoked within one week.

As we have independent solutions to each problem domain of regulatory requirements of GSMB and business

requirements of mining sites, this paper proposes a hybrid solution from two worlds of expectation. The Mining & Mineral Production (mmPro) solution [7] as a case study from regulatory side the Welithota application [6] used as a case study to coexist while serving each domain without conflict of each other.

### III. SOLUTION

#### ➤ Global Digitization in the Mining Industry

As per Accenture article [18], in the challenging market of the mining industry, the digital transformation has become a business imperative to improve processes alignment to value using leveraging technologies as illustrated in Figure 1. A combination of market volatility, environmental effect, increased cost base, social, community impact, protection of wildlife and heritage grounds and changing local & global demand is driving a seismic shift in the mining industry. In response, the government, ministry and GSMB as the regulatory body with mining license owners from the industry

should shift their strategies and adopt new business and operating models faster than ever before. To seize the opportunity, the industry is embracing digital tools and capabilities, including mobile technologies, cloud-enabled mobility, online payment integration, big data-powered analytics, SMS based status verification/updates and the Internet of Things (IoT).

#### ➤ Digitization in Sri Lankan Context

In Sri Lankan context digitization for mineral industry should be done in practically implementable steps. As per the system requirement specification document prepared by PricewaterhouseCoopers for GSMB, the comprehensive requirements were identified in 2013 [19]. Out of all the GSMB processes planned to automate, the licensing process is illustrated in Figure 2. GSMB signed a memorandum of understanding on 11th July 2018 with Sri Lanka Telecom and Mobitel to curb corruption and irregularities in sand transportation using a Global Positioning System (GPS) [20].

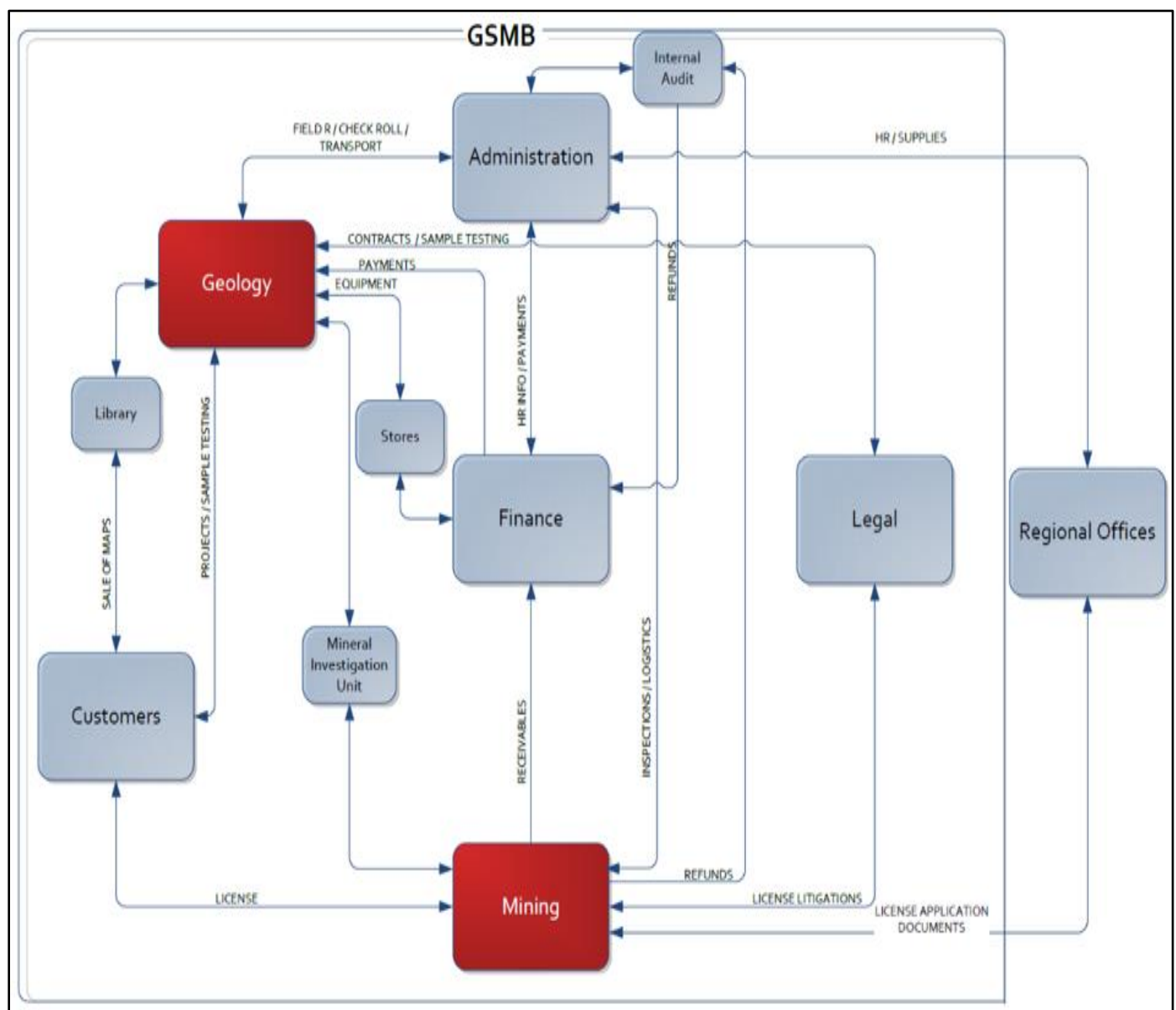


Fig 3 Core & Supportive Functional Units of GSMB



However, till 2025, when we publish this paper, the automation project has not been implemented. Therefore, it is important to understand the GSMB operational interaction units as illustrated in Figure 3 and identify the independent

solution components to be implemented with priority, based on which will be most effective and adaptable to the GSMB staff and all relevant stakeholders.

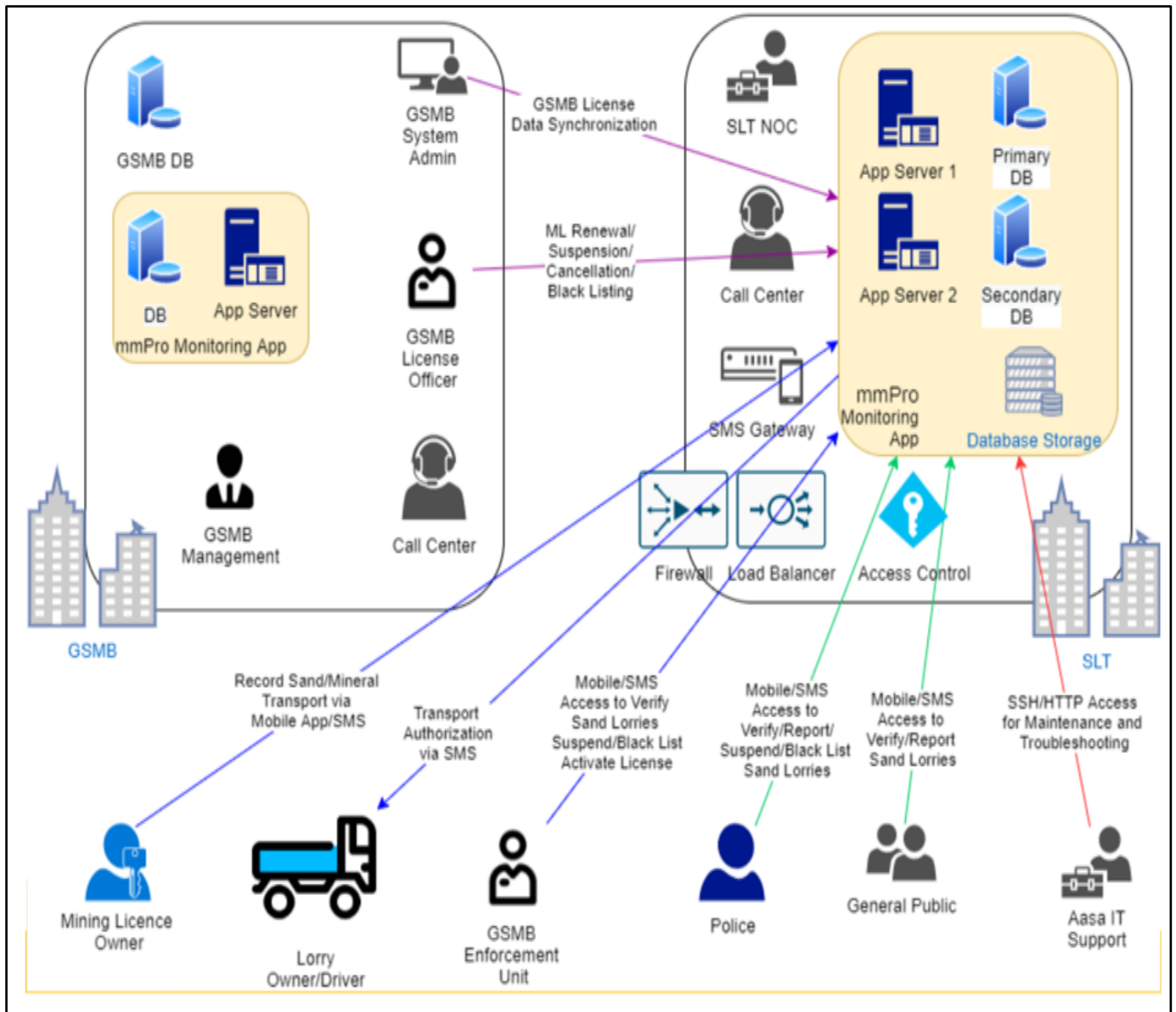


Fig 4 Mmpro Solution Architecture

#### ➤ *Mmpro as Digitization for GSMB*

When the transport license was cancelled, the Ministry of Environment and Wildlife Resources appointed a committee to provide a sustainable and effective solution for this problem. On GSMB invitation for an urgent digitized solution to address the requirement of monitoring and collecting royalty while taking actions against illegal sand mining, Sri Lanka Telecom (SLT)

Proposed Mining & Mineral Production (mmPro) Monitoring Solution. Since the decision of transport license cancellation was arguable at the time of mmPro evaluation, the solution was designed to be practically implemented either with TPL or without it as illustrated in Figure 4.

In mmPro, the authorized GSMB license officers are allowed to add, modify, renew, suspend, blacklist, extend, do adjustments to the mining licenses using the web and mobile applications. At the time of renewal or investigating complaints, they can search the license and owner's details and history by NIC, license number, location, mobile number.

The licenses including their renewal, updates, suspension and extensions are immediately effective for the site operation. The mining license owners can use mmPro with instance effects on-site to dispatch loads. Load dispatch can be done via SMS, mobile or web application. The mobile and web interface shows the real-time view of total permitted capacity, the total loads dispatched, the balance remains validity period and pending royalty to be paid.

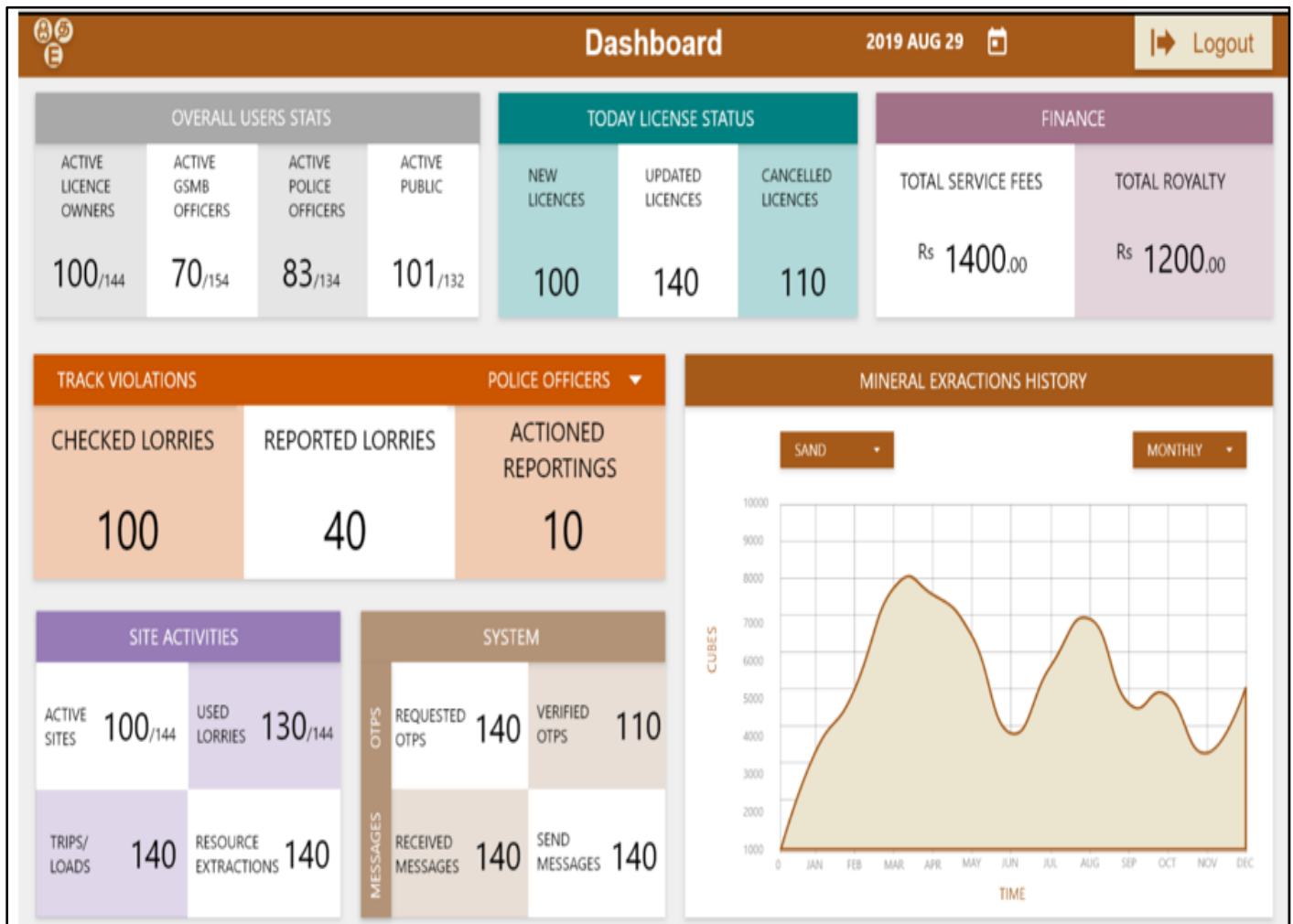


Fig 5 Mmpro Management Dashboard

Once a load is dispatched, the corresponding lorry driver receives an SMS with permission to transport the load. Optionally, they can have a printed copy of the receipt using a mobile printer which is not essential. Police officers, GSMB enforcement officers and other authorized officers can send an SMS to a given number to check the load validity including license number, time of dispatch, intended destination, contact numbers of the mining license owner, mobile number of the driver transporting the load. mmPro has gone a step ahead letting the general public also to verify any mineral or sand load on the move by providing the lorry number using mobile, web or SMS interface. The GSMB never had real-time visibility of the mineral dispatch from their site in their history. mmPro provided a bird-eye view of mining licenses, their utilizations, dispatch history, and destinations transported to higher management as illustrated in Figure 5.

#### ➤ Welithota, the ERP for Mining Site

Welithota application, developed for single-site management in Yaan Oya in 2017, had been extended to

manage multiple sites by 2018 and received the Juror's Distinction Award at e-Swabhimani in 2019. mmPro, received an award at the World Summit Awards (WSA) 2020 for its innovative approach towards tracking and overseeing mining and mineral output. The system enhances compliance with regulations and transparency via real-time tracking of mining activity, easing data gathering, and coordination across stakeholders. Its contribution to sustainable management of resources and governance in the extractive sector is an example of how digital technology is efficiently utilized for public sector innovation. The uniqueness of this solution is that the entire solution was run with full functionality on mobile phones without any external data or cloud connectivity. This assures the application is usable for any remote site with no mobile connectivity. The entire range of sand operations including sales, salaries, advance payment, site expenses, payments for backhoes, check deposits, cash deposits, daily summary, TPL tracking were covered in this application. The solution overview of Welithota Application is given in Figure 6.

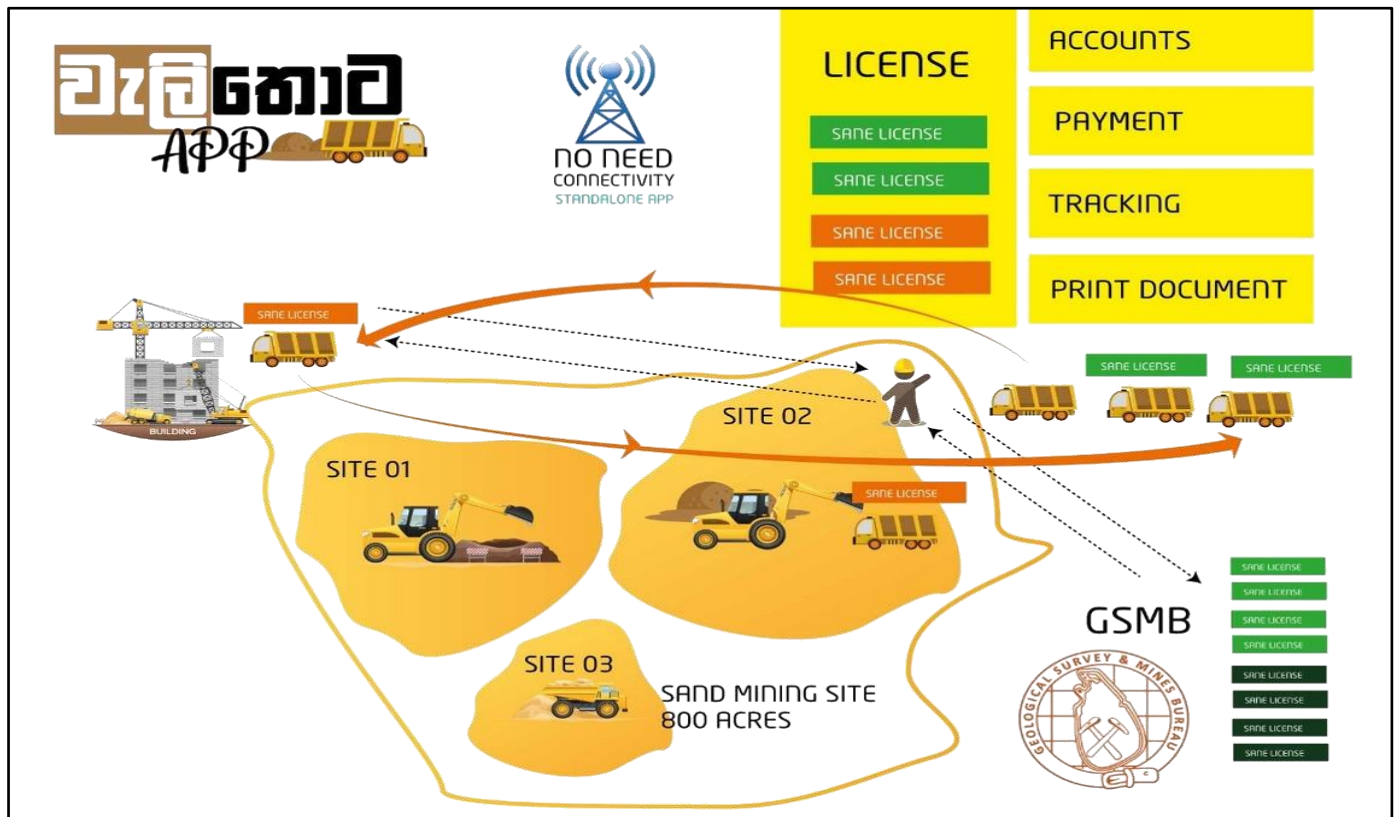


Fig 6 Welithota App Overview

The colour-coded Welithota application interfaces were one of the key attractions of mining site operational staff to use the solution effectively as illustrated in Figure 7.

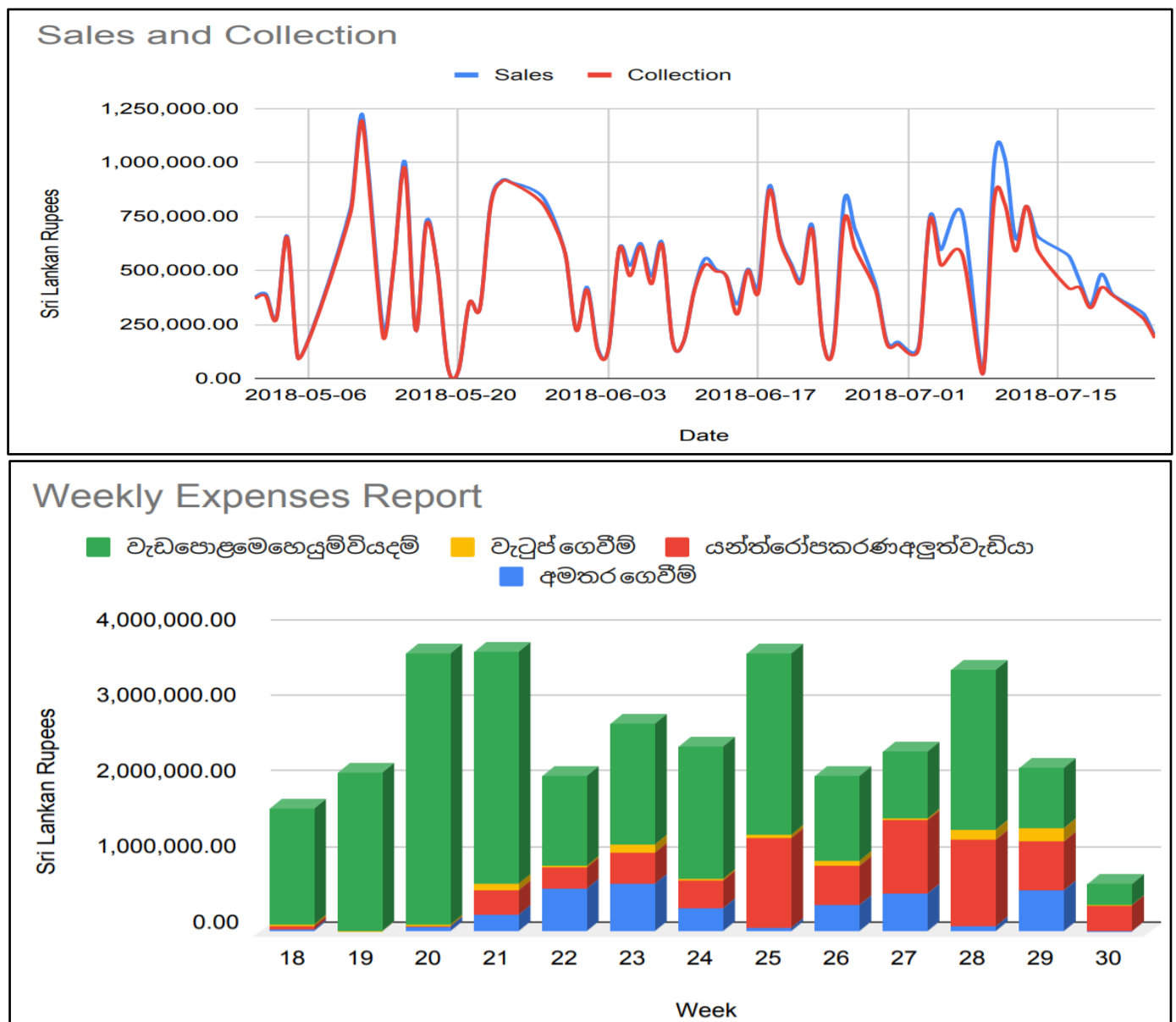


Fig 7 Colored Native Language Interfaces

Figure 8 below demonstrates how a young site manager uses the Welithota mobile application with a portable printer to record the sand sale on real-time.



Fig 8 Portable Bluetooth Bill Printer





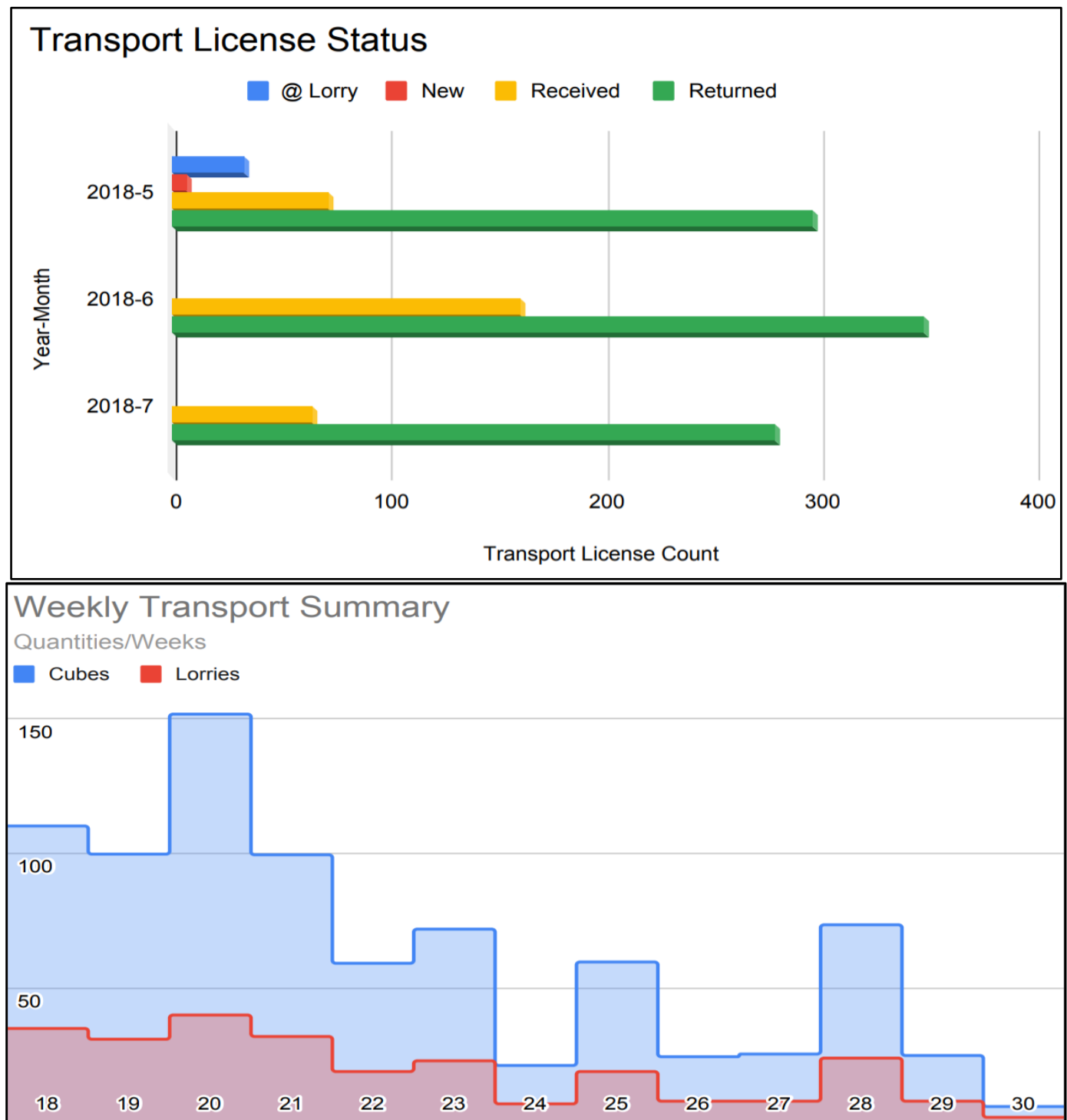


Fig 9 Reports of Welithota Operational Data

#### IV. RESULTS & DISCUSSION

##### ➤ Business Success of Welithota App

The very first customer of Welithota application from Yaan Oya happily implemented the solution on-site in 2017 and worked closely with the development team to improve the functionalities as per on the ground requirements. By 2018 the same customer extended the solution to his all sites in Hambantota, Ambalantota, Embilipitiya, and Ratnapura as it made his life as a mining license holder operate from a remote location. However, an interesting business model was

proposed by those potential customers to price the solution as a service fee per load instead of outselling the software. Additionally, they proposed why not push this solution through GSMB to all mining license holders as a compulsory solution, which will extend the benefit of TPL transparency to the regulatory body too.

With a proper track of site operations, Welithota application lets site owners get the statistics and history of operation records of sales, expenses and transport license utilization to optimize over the time as illustrated in Figure 9.



Fig 10 Mmpro Deployment Site Visits

#### ➤ Regulatory Achievements with Mmpro

Similarly, the experience of mmPro was positive not only from small license holders tried in Kalutara and Kurunagala but also license holders who are in the mining industry working in collaboration with GSMB Technical Service (Pvt) Ltd, which operated the largest river sand mining site in Sri Lanka. Meanwhile, GSMB is interested in providing more facilities and enhancing the quality of life of

the stakeholders and attracting the younger generation to the industry through digitization and supportive technologies as the government's responsibility to the industry.

Figure 10 shows a few photographs taken on the on-site introduction program from Kalutara to introduce the mmPro digital solution to selected mining license holders

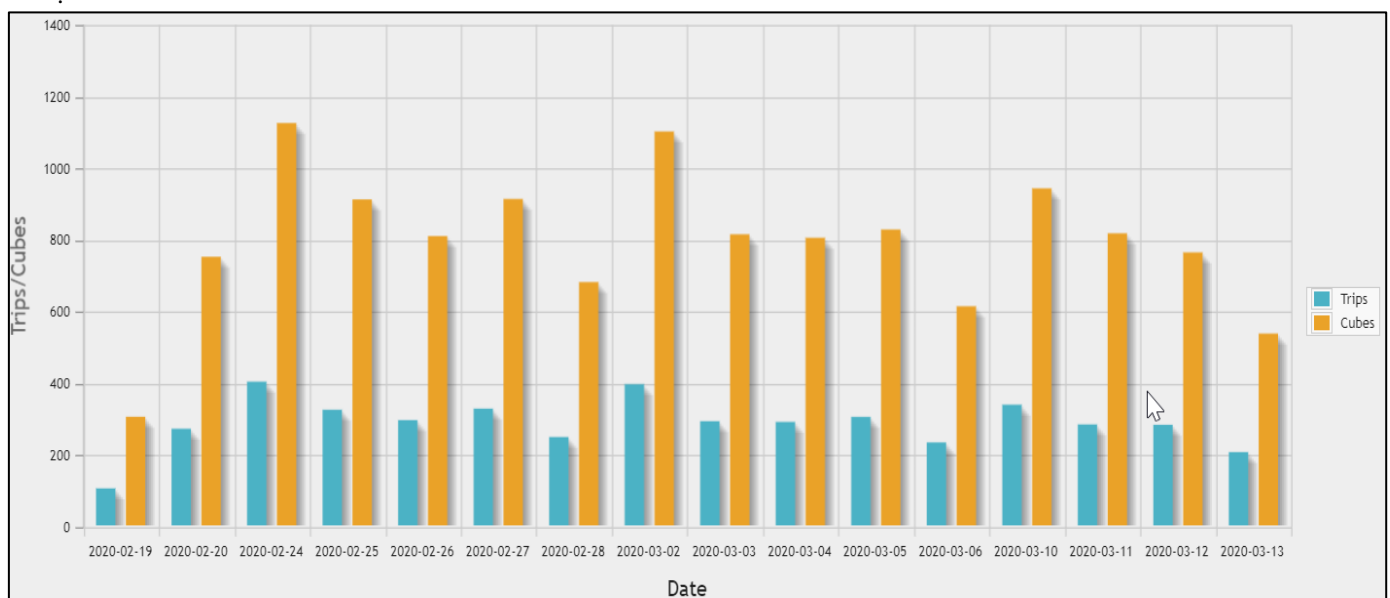


Fig 11 Manampitiya Trips/Loads Dispatched

During the pilot conducted in Manampitiya from 19th February 2020 till 13th March 2020 system's daily track records number of trips and the total loads dispatched are graphically represented in the graph shown in Figure 11. This records covered real time track of total 12,755.5 cubes corresponding to collection of Rs. 4,408,300.80 of royalty collection.

#### ➤ Best out of Two Worlds

Sand minors are doing business. Welithota is an application that makes their life easy and effective. Meanwhile, they have their own business secrets which should not be shared with anyone including competitors, facilitators, GSMB and government officers. GSMB and all service providers have to maintain the business ethics honouring license holders rights to have their secrets of

competitive edge. At the same time mining license holders, transporters are bound to share the sand extraction and transport details with GSMB as the regulatory body. Assurance of transparency and proper track of mineral extraction put hold on the illegal extraction and transportation

which will increase the income not only for GSMB but also for permitted mining license owners. Figure 12 illustrates the high-level conceptual model for coexistence of Welithota as a site operation management solution while mmPro serves the purpose of regulatory enforcement.

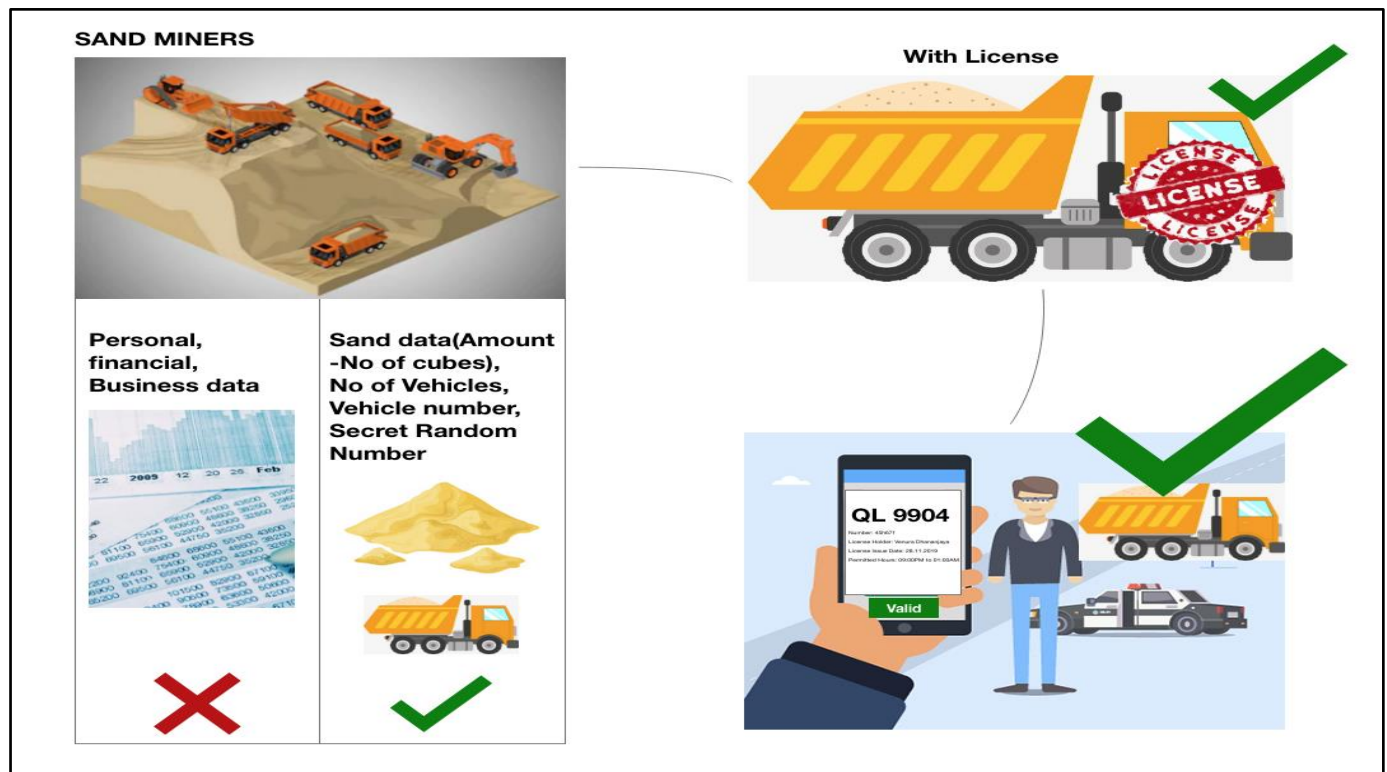


Fig 12 Welithota Coexistence with Mmpro

In the new coexisting architecture, business data could be maintained at the mobile application level if needed with a separate cloud back-end for mining license owners to access from anywhere. Only the needed regulatory information will be exposed to GSMB which will be handled collectively through its own cloud data backend. This way the online and on-site solution support can be provided by a single solution team and infrastructure, which will be cost-effective at the industry level.

## V. CONCLUSIONS

As discussed in the paper mining and mineral industry is a fairly virgin market in Sri Lanka to introduce digitized solutions to increase the effectiveness of the regulatory and on-site business operations. Welithota and mmPro have addressed the two domains of requirements independently. As a conclusion we see the clear advantages of coexistence of these two solutions with mutually exclusivity to assure the security of business secrets and statistics.

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