INFORMATICS JOURNALS

Online ISSN : 3049-3455

Mineral Metal Energy Oil Gas and Aggregate

Contents available at: *www.informaticsjournals.com/index.php/2MEOGA*

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Digitising By Road Dispatch Operations by QR Code Verification in Mines

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Abstract

In an iron ore mine in South India, the mine team recently tried to solve the problem of trip sheet verification using QR code scanning. In a byroad truck dispatch, every trip dispatched carries a printed copy of the DMG sheet. The concern here is printing the same trip sheet as generated against the number as registered on the DMG site; avoiding double generation of the same trip on two sheets (which happens due to a slight delay between the generation of the sheet and its reflection on the website); ensuring the generation of only those permits which have got a clearance for the given day. The solution to this could be preventive or corrective. Due to the nature of the DMG website, a foolproof preventive measure has yet to be found. But a QR code-based corrective measure has been developed. The team is extracting the following information from the QR code:

a. Sheet number against which the trip is generated

b. Permit number

c. Vehicle number.

This data is then automatically matched with:

a. Physical trip sheet number, as in the barcode

b. Master data containing allowed permits with their validity date

c. A formula to avoid double trips of the same vehicle at a given interval.

Moreover, a separate sheet linked to the above two keeps track of sheets used and barcode numbers missed, if any. The next steps could be the use of a Raspberry Pi and OLED for implementation at all exit gates and a dashboard for central monitoring. And the ultimate solution would be a preventive measure.

Keywords: *Digitisation in Mining, Digitalisation in Mining, Automation in Mining, Dispatch in Mining, Innovation in Mining, Byroad Dispatch, DMG Tripsheet, QR Code based Verification*

1.0 Introduction

In the dynamic environment of mining logistics, even small lapses in verification can lead to regulatory or operational setbacks. At the iron ore mine in South India, a recurring challenge in truck dispatch was ensuring that each vehicle left the premises with a valid and accurate trip sheet—one that matched the data registered on the official DMG (Department of Mines & Geology) portal. With a daily outflow of about 1000 trucks from a single mine, and multiple such mines operating across the country with printed DMG Sheets, the problem of document validation has emerged as both an operational bottleneck and a technical loophole in dispatch operations. The issues are:

1. 4*1000 data points to be checked hinders operation and requires manpower.
2. Non-verification often leads to mismatched trips exiting premises, requiring reconciliation during audits and account closing, again causing unnecessary load on the administrative machinery of mines.
3. It causes unnecessary load for unaware truck drivers.

For the current printed DMG Tripsheet-based system, to reduce human error and enhance compliance, a QR code-based trip sheet verification system has been introduced—designed, tested, and implemented entirely in-house using basic digital tools like Google Sheets and a 2D QR code scanner.

2.0 The Challenge

Byroad dispatch mandates that every truck be equipped with a printed copy of the DMG Tripsheet, which is generated within the mine's premises and undergoes verification at checkpoints on public roads.

The trip sheet comprises the following information:

a. Permit Number: A unique identifier assigned by DMG to each auctioned batch or quantity.
b. Tripsheet Number: DMG provides a set of DMG Books containing 100 tripsheets. Each truck is required to carry a physical copy of the trip sheet during its journey. The trip sheet printed on a DMG sheet must match the physical trip sheet number against which it is deducted.
c. Vehicle Number and Tonnage
d. Timestamp
e. Destination

Before this system, the dispatch process relied on manual verification of printed trip sheets. This created the possibility of:

a. Mismatched trip numbers
b. Double printing of the same vehicle against two tripsheets due to a lag in the server.
c. Human error during verification at the exit gate
d. Generation against the permit number, which has not been allowed by the commercial department.

Even with vigilant gate checks, ensuring 100% accuracy at the point of dispatch was labour-intensive and was not infallible. The Tripsheet number is of alpha-numeric form, say, AA3B123456789. Even the most vigilant check focuses on the last 4 digits. There have been instances of a mismatch in the 5th or 6th digit from the right. Similarly, the Permit number is checked on each trip, but instances of different permit numbers have been there. Keeping track of DMG Tripsheets is painstakingly difficult. For instance, a party is issued two books, which are printed on two separate systems in two weighbridges. Keeping note of each leaf manually is a hectic process and often misses some leaves, which then poses an administrative challenge at the time of audit or year-end closing.

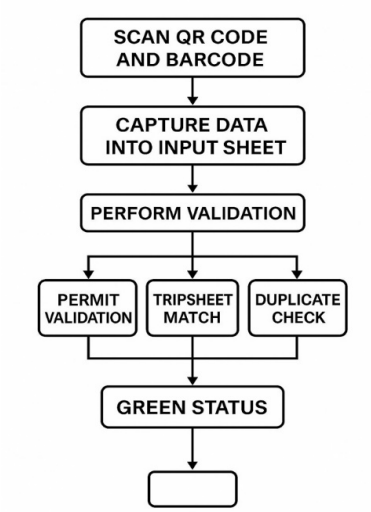


Figure 1. Process flow chart

Manual check had brought the errors down to about 0.07% but it was a hectic process. It requires three personnel specially designated for manually checking every leaf for 4 data points and maintaining a physical count of each book. The new system envisages a near 0% error and freeing up manpower for other technical roles.

3.0 The Solution

Developed a low-cost, user-friendly system where a QR code and Barcode on a printed DMG Tripsheet are used to verify the above details without manual intervention. This QR code is scanned, where the system automatically checks it against pre-fed data in Google Sheets.

3.1 Implementation Details

Each printed DMG tripsheet carries two machine-readable elements: A QR code encoding the Permit Number, DMG Tripsheet Number, Vehicle Number, Tonnage, etc.

- A **Barcode** representing the Tripsheet Number in alpha-numeric format.

  At the checkpoint:
- A staff member uses a 2D QR & barcode scanner, connected to a laptop running a Google Sheet-based validation system.
- When scanned, the QR code and barcode data are captured into an input sheet (Figure 3), where automated logic processes the entries.

The system performs three layers of validation: (Refer to Figure 1)

1. Permit Validation
   The system extracts the Permit Number from the QR code and cross-checks it with a manually maintained Master Sheet (Figure 2). This sheet lists permitted parties, associated permit numbers, and gate pass validity. If a match is found and the permit is still valid, the corresponding party name is returned. If not, the trip is flagged as "Expired" or "Not Found".
2. Tripsheet Match
   The barcode's decoded Tripsheet Number is compared with the Tripsheet Number embedded in the QR code. Any mismatch triggers an alert for possible duplication or printing error.
3. Duplicate Check
   To prevent accidental re-use or double printing, the system searches the last 100 scanned trips for the same vehicle number. A match raises a "Duplicate Trip" warning, prompting re-verification (Refer to rows 27 and 29 in Figure 3). Once all validations pass, the system shows a green status, allowing the vehicle to proceed.

Batch Reconciliation (Figure 4). For backend tracking, the system automatically clusters trip sheet numbers into DMG Books.

- Each book contains 100 serially issued sheets, and the system groups them by extracting the prefix and applying a calculation to derive the Book Number.
- For example, if a Tripsheet Number is AA3 B123456789, it is grouped under book AA3B1234568 using the logic:AA3B123456 + Int((789 ÷ 100) + 1).

This allows the team to identify missing or unused tripsheets from any book—providing a second layer of control.

	A	B	C
1	Name	Barcode	ValidUntil
2	F	25267	22/07/2025
3	K	25267	24/07/2025
4	K	25267	28/07/2025
5	M	25267	28/07/2025
6	J	25267	10/08/2025
7	K	25267	13/07/2025
8	J	25267	13/07/2025
9	A	25267	24/07/2025
10	J	25267	04/08/2025
11	E m	25267	24/07/2025
12	k	25267	24/07/2025
13	J	25267	24/07/2025
14	J	25267	24/07/2025
15	J	25267	24/07/2025
16	J	25267	04/08/2025
17	J	25267	04/08/2025
18	T	25267	08/10/2025
19	S	25267	08/04/2025
20	S	25267	04/08/2025
21	S	25267	04/08/2025
22	J V	25267	04/08/2025
23	J	25267	18/08/2025
24	S	25267	08/04/2025
25	K	25267	13/07/2025
26	V	25267	08/04/2025
27	JINDAL SAW	25267	28/07/2025

Figure 2. Master data sheet.

	A	B	C
1	252	KA05AK3841	OK
2	MM		
3	252	KA35C 2468	OK
4	MM		
5	252	KA34B 7411	OK
6	MM		
7	252	KA35D 7280	OK
8	MM		
9	252	KA35C 2267	OK
10	MM		
11	252	KA35AA1086	OK
12	MM		
13	252	KA35AA0481	OK
14	MM		
15	252	KA35C 2804	OK
16	MM		
17	252	KA35D 4815	OK
18	MM		
19	252	KA37B 8734	OK
20	MM		
21	252	TN68T 4484	OK
22	MM		
23	252	KA35AA1088	OK
24	MM		
25	252	KA25AB2432	OK
26	MM		
27	252	KA35B 5554	OK
28	MM		
29	252	KA35B 5554	Error: Vehicle Double entry
30	MM		
31	252	KA35D 5755	OK
32	MM		
33	252	KA35D 8491	OK
34	MM		
35	252	KA35C 2434	OK
36	MM		
37	252	KA48 7132	OK
38	MM		

Figure 3. Sheet used for QR scanning.

	A	B	C	D	E	F	G
1							
2		Book1			Book2		
3	Party	Starting	Ending	Missing Numbers	Starting	Ending	Missing Numbers
4	W	616	676	No missing numbers	0	0	No Missing Number
5		201	300	210, 211, 212, 213, 214	677	700	No Missing Number
6		801	838	804	0	0	
7		799	799	No missing numbers	0	0	
8		901	999	No missing numbers	0	0	
9		434	450	No missing numbers	0	0	
10		551	555	No missing numbers	0	0	
11		0	0	No missing numbers	0	0	
12		0	0	No missing numbers	0	0	
13		0	0	No missing numbers	No Next Block		
14		0	0	No missing numbers	No Next Block		
15		0	0	No missing numbers	No Next Block		
16		0	0	No missing numbers	No Next Block		
17		0	0	No missing numbers	No Next Block		
18							
19							
20							

Figure 4. DMG book and sheet number record.

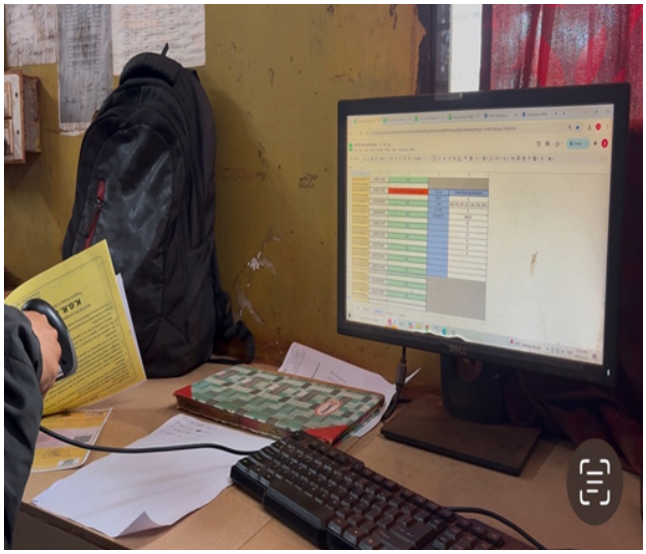


Figure 5. Field-level implementation of the system.

Visibility: Owing to cloud-based data storage, the entire process is readily available to the entire dispatch team on their devices. All data entry, validation, and live responses are handled through Google Sheets logic, making the process both scalable and transparent.

4.0 Impact and Benefits

Since implementation:

- Accuracy has improved significantly, with almost no inaccurate trips leaving the mine.
- **Verification time has reduced**, leading to faster dispatch without compromising on checks.
- **No new software or infrastructure** was needed, keeping costs minimal.
- **Smooth Learning Curve**- The scanning process is very simple- staff with minimal formal education have been trained to scan copies. The sheet (Figure 3) has been colour-coded. Green signals OK, while Red indicates "Error", allowing minimal intervention of core officials in the checking process. The missing sheet number data party-wise is shown alongside for the ease of the operator (Figure 5).

5.0 Conclusions and Way Forward

This small but effective digital initiative reflects how context-driven problem solving and basic tools can lead to impactful outcomes—even in sectors like mining, where large-scale automation may not be immediately viable. This can act as a stepping stone in both digitisation as well as digitalisation. The team is now working on its backward linkages which includes- Digital entry in system at point of entry, Tracking exact loading point, checking tare weight within RTO permissible limits and forward linkages as Real time dashboard giving weighbridge wise/ party wise and Hourly wise dispatch data for section heads using Python data analysis tools linked with scanned data in Figure 3 for loaded trucks and W/B wise data from ERP systems for empty trucks. Plans include integrating this system with real-time dashboards and possibly shifting to Raspberry Pi-based scanning and OLED displays at the gate for further automation.