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Energy Company Tracks Metal Drums via RFID, LoRa

- Chien Liu
- Software Engineer

CPC Corporation, Taiwan

 Chinese Petroleum Corporation was founded in1946 owned by the government of Taiwan. The firm provides petroleum-based energy throughout the country, including exploration, production, refining and so on.





Petroleum Catalyst Management

- The catalyst products are applied to speed up chemical reactions related to transforming the petroleum into a liquid fuel.
- The high-value (100K USD/drum in average) catalyst chemical is stored in metal drums (150 liters and up to 250 kg).
- Near 1000 drums of catalyst per warehouse are imported annually.



Issues With Manual Management

- The whole process was time-consuming, insecure and prone to human errors.
- Each drum is hard to locate at warehouse.
- The weight loss could only be discovered during stock out process.
- Based on the annual inventory, only 86% accuracy was achieved.



Radio Frequency Identification (RFID)

- RFID enables the system to scan tags at high speed in the distance.
- CPC first approached EPC Solutions in May 2021. The company, established in 2004, is among the world's leading integrated solution providers of customized RFID devices with 15 RFID journals published.



HLR-CW400 RFID readers



Real Time Monitor System





Automated Management System





Long Range Wide Area (LoRa)

- Onsite environmental condition:
 - The distance between office and warehouse is 600 meters.
 - Wi-Fi signal is weak around warehouse due to noise.
- E32 (within 200 m) and SX1278 (within 5 km) modules are applied.







LoRa Communication Range







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Automated Management of Petroleum Catalyst

 Installation began in November 2021,and was completed in April 2022. The system was taken fully live in August.





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RFID Tag Printing Process

- Passive LH-7030 Flexible on-metal UHF RFID tags are utilized.
- The tags are printed by Printronix T6000e, a industrial RFID printer offers fast print speeds.



Printronix T6000e

	Catalyst Type					Serial Number						
Position	1	2	3	4	5	6	7	8	9	10	11	12
Example	R	K	Ν	R	0	0	А	0	0	0	0	1
Example	R	K	Ν	R	0	0	F	9	9	9	9	9



RFID Tag Printing Process – User Interface





Stock In Operation

Forklift Routes For In-Stock Process





Stock In Operation – User Interface



Total Weight in Inventory System



Stock Out Operation

Forklift Routes For Out-of-Stock Process





Stock Out Operation – User Interface







Inventory Operation

- RFID handheld reader is provided for the operator to check the quantities of drums inside the warehouse immediately.
- There is a function designed for all scales to report their current weights. If there is discrepancy in weight, the system can identify the drums through Shielded Tag-Reading Portal.





HLH-7200C2(A11)



Web Server

• The data generated from all the operations are transmitted in real time via LoRa and updated to web server.

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L. 錯誤代碼說明表	R264L0A00006	FI9936000099	白金觸煤	UOP LLC R-264L PT/GAMMA AL2O3 PT-0.24				2022-10-04 10:30:12	2022-09-20 10:16:30
2.使用者帳號維護	R264L0A00007	FI9936000099	白金觸煤	UOP LLC R-264L PT/GAMMA AL2O3 PT-0.24				2022-10-04 10:30:12	2022-09-20 10:16:30
3.帳號登入明細	R264L0A00008	FI9936000099	白金觸煤	UOP LLC R-264L PT/GAMMA AL2O3 PT-0.24				2022-10-04 10:30:12	2022-09-20 10:16:31
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5.群組欄限維護	R264L0A00010	FI9936000099	白金觸煤	UOP LLC R-264L PT/GAMMA AL2O3 PT-0.24					2022-09-20 10:16:31
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RFID Gate Control System

Forklift Routes For RFID Gate Control System





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RFID Gate Control System – Webpage





Improvement in New Management System

- The stock in operation time was reduced by around 50%.
- The real-time monitor system is built and thus any unauthorized movement and weight gain or loss in drum will be recorded.
- The detailed information of each drum is updated in database automatically and immediately with 100% accuracy.



Next Stage

 CPC intends to install four ultra-wideband (UWB) anchors on the roof of the warehouse and UWB tags on each of its forklifts. The company will then be able to track the location of every operator and better manage dispatch assignments to ensure an efficient, safe process for warehouse workers.





THANK YOU



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