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CASE STUDY

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Enhancement of Milk Quality by Deployment of Stellapps Cold Chain Monitoring System in Mysore Milk Union (MYMUL)

Authored By

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Introduction

Mysore Milk Union Limited (MYMUL)

Mysore Dairy with the capacity of 10 TLPD was started in the year 1965 under the control of the Department of Animal Husbandry and Veterinary Services of Karnataka State, which was transferred to Karnataka Dairy Development Corporation in the year 1974. The capacity was expanded to 60 TLPD in 1980 under the scheme operation flood and transferred to the Karnataka Milk Federation in 1984. As per the Government policy the Dairy and its Chilling Centers were handed over to Mysore Milk Union on 01.06.1987. The capacity was expanded to 100 TLPD under the Operation Flood II and further expanded to 180 TLPD under Perspective Plan I Program.

Mysore District Milk Union (MYMUL) is committed to procure and supply safe Milk & Milk Products to the satisfaction of consumer by:

- Complying with statutory and regulatory requirements
- Constant communication with all parties involved in the food chain
- Adopting GHP, GMP & HACCP
- Adopting scientific processing methods
- Training of employees Union/Dairy Co-operative societies.
- ISO 22000 Documented and Under Implementation.

This commitment is supported by measurable objectives and brings about continual improvement.

Stellapps Technologies Private Limited (Stellapps)

Stellapps is an end-to-end dairy technology solutions company – the first of its kind in India. It is an IITMadras incubated company founded by a group of IITians and technologists with a strong industry background and rich experience including IIT-Madras, IIT-Kharagpur and IIM-Ahmedabad alumni, with over 18 years of Industry experience across Wipro, Nortel, Ericsson, Alcatel-Lucent, AT&T, Vodafone, Telstra, Bharti-Airtel, Aircel, Avaya, Cisco et al. It produces and procures comprehensive farm optimization and monitoring support, which helps dairy farmers

and cooperatives maximize profits while minimizing effort. It is funded by Omnivore Capital – a fund anchored by Godrej Agrovet Limited and investment patrons include a large group of IIT alumni.

It's innovative applications and state-of-the-art mechanization tools leverage Internet of Things (IoT), Big Data, Cloud, Mobility, and Data Analytics to improve Agri supply chain parameters, including milk production, milk procurement, cold chain, animal insurance and farmer payments. Our SmartMoo™ IoT router and in-premise IoT Controller acquire data via sensors that are embedded in Milking Systems, Animal Wearables, Milk Chilling Equipment & Milk Procurement Peripherals, and transmit the same to the Stellapps SmartMoo™ Big Data Cloud Service Delivery Platform (SDP) where the SmartMoo™ suite of applications analyze an-d crunch the received data before disseminating the Analytics & Data Science outcome to various stakeholders over low-end and smart mobile devices. The patent pending hardware and software is designed to scale horizontally across other industry verticals.

Cold Chain

100% milk was procured by MYMUL from remote village farmers. Societies (collection centre) were established for this purpose. Milk were poured by the farmers at the Societies. Upon receipt of milk, it is expected to be chilled immediately to 4 °C. Else milk quality will be degraded on account of microbial multiplication. For this reason, chilling centres were put in place by MYMUL at feasible locations. Milk were chilled to 4 °C at the chilling centres till it was lifted by the Dairy tankers. MYMUL started with one chilling centre way back in 1984. Now the numbers have increased to 78. All the 78 Bulk Milk Coolers above are located remotely at a distance of 50-70 Km. The 78 BMC's are divided into 21 routes. 21 different milk tankers go and lift the milk from these 78 BMC's and bring it to dairy for further processing. Each centre has a BMC technician to look after the collection and proper chilling.

MYMUL with 10 TLPD (Thousand Litres Per Day) capacity has been expanded in phases and now it has 3 LLPD (Lakhs Litres per Day) capacity. It has chilling centres at Hunsur-60 TLPD

and Kollegala-40 TLPD. Total chilling capacity 100 TLPD. There are 78 Bulk Milk Coolers, 386 Automatic Milk Collection in the union. The union procures on an Average 4.44 lakh kg/day of milk and sells 2.42 lakh litres/per day. The Union also produces Butter, Ghee, SMP, Cream, Burfi, Peda, Paneer, Nandini Bite & Mysorepak.

MBRT (Methylene Blue Dye Reduction)

Methylene Blue Dye reduction test is used in Dairy industry to judge the quality of milk. Better MBRT fetches better price as it can be used to make other premium products. In MBRT test 1 ml of Methylene blue dye solution is added to 10 ml of milk sample. The colour of the solution turns blue. The blue solution is kept under a water bath at 37°C.This time is noted. Then frequently the solution is observed. The time at which the solution turns colour less is noted. The time interval for turning colourless from blue is the value of MBRT in min. The milk is rated as per below table:

MBRT Value in min	Rating
300 min and above	Very Good
180 – 240 min	Good
60- 120 min	Fair
30 min or Less	Poor

Tender for BMC Remote Monitoring System

MYMUL wanted to have an insight into the operation of the BMC. This was required for procuring better quality of milk. The only way was to get reports from the BMC Technicians. The reports required lot of human efforts and was prone to errors. More over the technicians were mostly villagers and were not much to count on. Hence

there was a need for automation to avoid the errors. MYMUL came across through NDDB & other sources regarding Stellapps BMC Remote Monitoring System. Stellapps BMC monitoring System was recommended by NDDB to all the Milk Unions. MYMYUL wanted to check the performance of the Stellapps BMC Monitoring System. Hence Stellapps were requested by MYMUL for

providing trials at its chilling centres. Accordingly, BMC monitoring system were installed by Stellapps at MYMUL Chilling centres. The system were found to be satisfactory and meeting the needs of MYMUL. For procuring the same a tender was floated by MYMUL where Stellapps was invited . The order was won by Stellapps upon participation.

Case Study on Performance & ROI of BMC Remote Monitoring System

Stellapps was requested for a Case Study by The Managing Director of MYMUL. The Case Study was intended to study the Return of Investment(ROI) of Stellapps BMC Monitoring System. Stellapps was expected to present the comparison of the data before & after the installation of BMC Remote Monitoring System. Stellapps & MYMUL mutually agreed for the below 4 stage plans for the Case Study

Stage 1 - Milk Quality Assessment before Installation of BMC Remote Monitoring System

It was decided that Stellapps will study the milk chilling process as it is. For the same a team was deployed by Stellapps to all the chilling centres of MYMUL. The Lifting temperature and Volume of milk of each BMC (Bulk Milk Cooler) from each chilling centre was observed and noted. On arrival at the MYMUL Dairy again the arrival temperature was noted down. MBRT test was performed on the samples received and its values were also noted. Below is the graphical representation (Refer figure 1 below) of MBRT on a daily basis for one of the routes till before the installation of BMC Remote Monitoring System. As can be seen from the graph the line in blue represent the MBRT value in min on a daily basis from start date of study till the date of

installation. It can be seen that the lowest value of MBRT is 150 min and highest is 175 min. The average value is around 170 min.

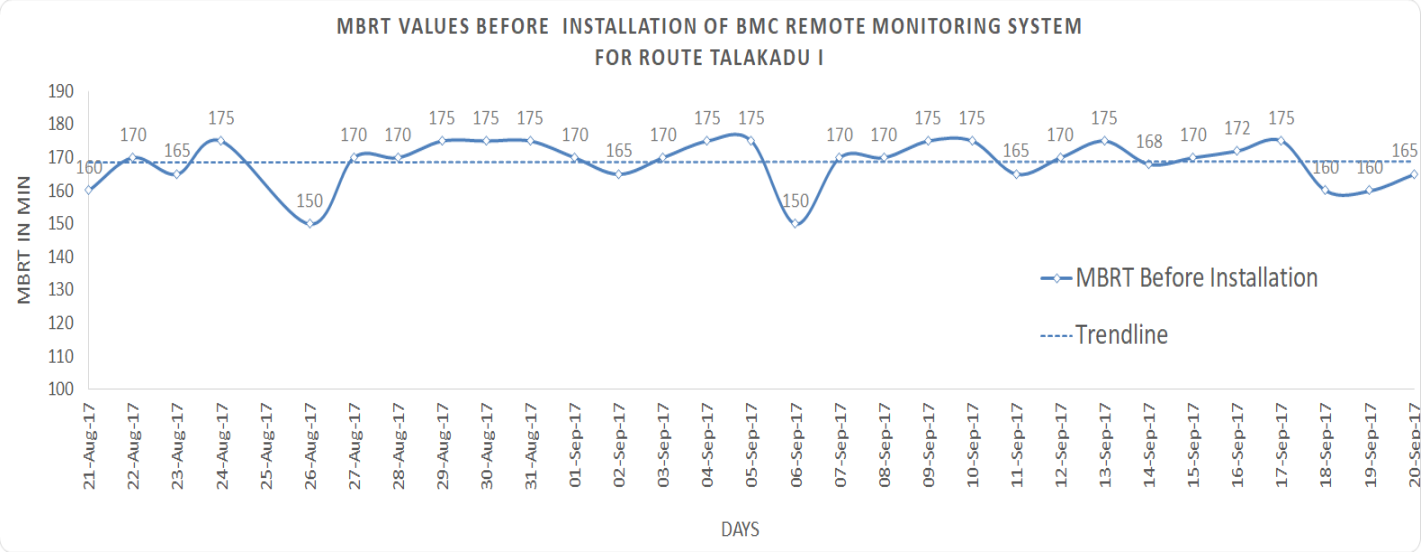


Figure 1:Graph of MBRT over time before installation of BMC Remote Monitoring System.

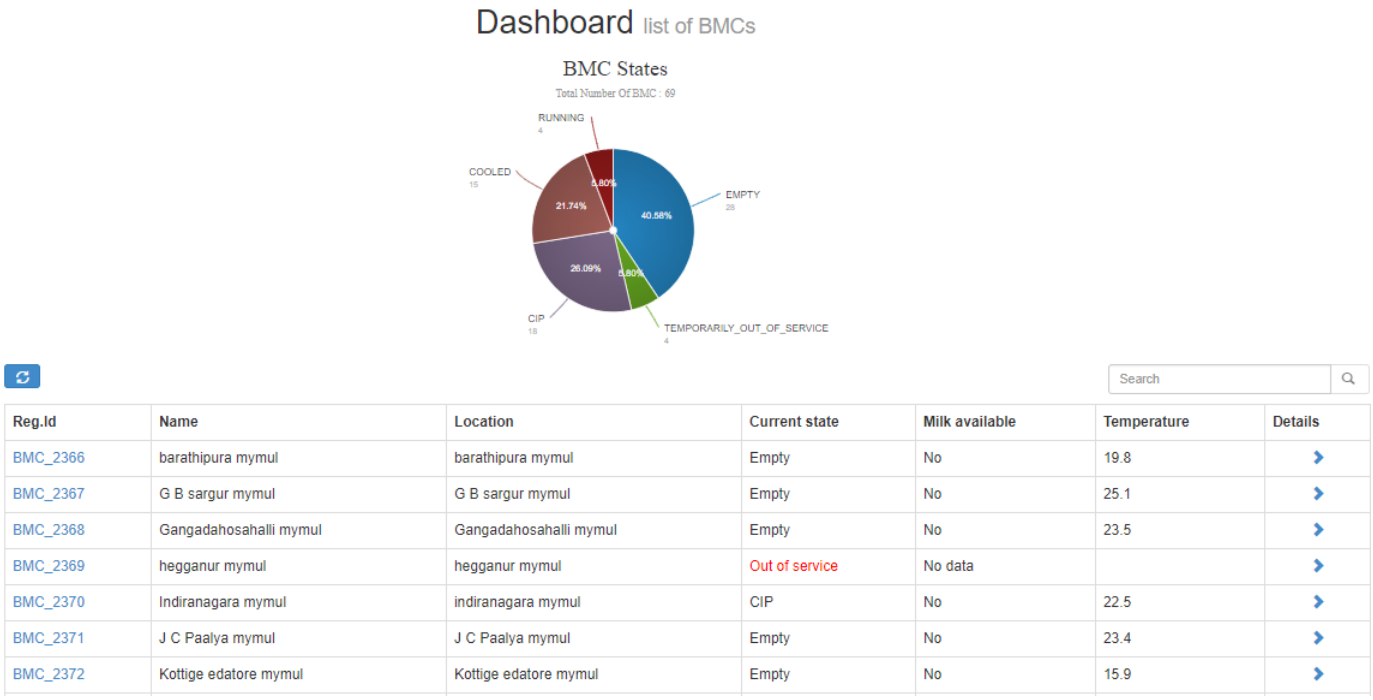
Stage 2 – Installation of BMC Remote Monitoring System

For approximately a month the MBRT data was captured for all the routes. Then the BMC Remoted Monitoring System were installed by Stellapps one by one at respective sites. The feedback data was made available from remote sites. Mr.Vashishta was appointed as support consultant to MYMUL by Stellapps for the BMC Remote Monitoring System.

Stage 3 – Monitoring of BMC & Corrective Actions

After BMC Monitoring system was online (Refer Figure 2 & Figure 3 below), different type of alerts were generated and sent (Refer Figure 4 below) . The alerts were categorized into two:

- Info Alerts like the Power On/Off, DG On/Off, Agitator On/Off, CIP (Clean in place), Chilling start/stop.
- Critical Alerts like the DG-Grid-both on, Turn on Chilling, Over-Cooling, CIP Undetected, Lifting at High temperature.



Reg.Id	Name	Location	Current state	Milk available	Temperature	Details
BMC_2366	barathipura mymul	barathipura mymul	Empty	No	19.8	
BMC_2367	G B sargur mymul	G B sargur mymul	Empty	No	25.1	
BMC_2368	Gangadahosahalli mymul	Gangadahosahalli mymul	Empty	No	23.5	
BMC_2369	hegganur mymul	hegganur mymul	Out of service	No data		
BMC_2370	Indiranagara mymul	indiranagara mymul	CIP	No	22.5	
BMC_2371	J C Paalya mymul	J C Paalya mymul	Empty	No	23.4	
BMC_2372	Kottige edatore mymul	Kottige edatore mymul	Empty	No	15.9	

Figure 2: Dashboard List of BMCs

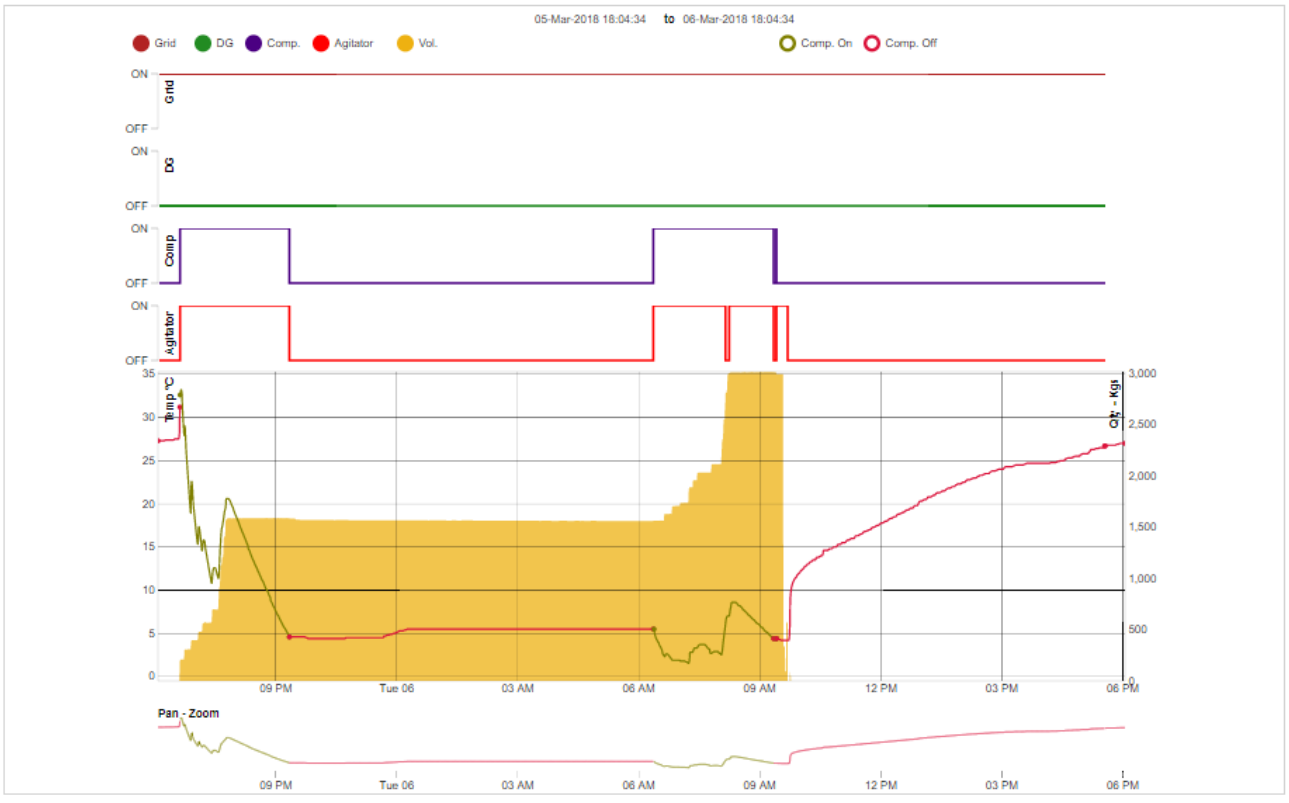


Figure 3: Chilling Graph

BMC	Alert Name	Location	Time		Priority	Alert
			Generated	Occured		
BMC_2436	Lifting-At-High-Temp	MAADAPURA MYMUL	2018-01-23 10:56:22	2018-01-23 10:09:58	Critical	MAADAPURA MYMUL, Milk Lifted at higher temperature BMC ID: BMC_2436 Temp: 14.3C Time: 23-Jan-18 10:09 AM Volume: 2850.0 kgs Status: Under Chilled
BMC_2436	Lifting-At-High-Temp	MAADAPURA MYMUL	2018-01-16 11:09:21	2018-01-16 10:21:16	Critical	MAADAPURA MYMUL, Milk Lifted at higher temperature BMC ID: BMC_2436 Temp: 10.6C Time: 16-Jan-18 10:21 AM Volume: 2902.0 kgs Status: Under Chilled
BMC_2439	Overcooling	MUGURU MYMUL	2018-01-30 08:16:39	2018-01-30 08:14:27	Critical	MUGURU MYMUL, Please stop chilling BMC ID: BMC_2439 Temp: 1.8C Time: 30-Jan-18 8:14 AM Status: Over Chilled
BMC_2436	Lifting-At-High-Temp	MAADAPURA MYMUL	2018-01-29 10:57:22	2018-01-29 10:09:12	Critical	MAADAPURA MYMUL, Milk Lifted at higher temperature BMC ID: BMC_2436 Temp: 8.3C Time: 29-Jan-18 10:09 AM Volume: 2715.0 kgs Status: Under Chilled
BMC_2436	Lifting-At-High-Temp	MAADAPURA MYMUL	2018-01-28 10:32:51	2018-01-28 09:48:29	Critical	MAADAPURA MYMUL, Milk Lifted at higher temperature BMC ID: BMC_2436 Temp: 9.5C Time: 28-Jan-18 9:48 AM Volume: 2738.0 kgs Status: Under Chilled
BMC_2439	Overcooling	MUGURU MYMUL	2018-01-28 06:57:30	2018-01-28 06:21:44	Critical	MUGURU MYMUL, Please stop chilling BMC ID: BMC_2439 Temp: 1.3C Time: 28-Jan-18 6:21 AM Status: Over Chilled
BMC_2439	Cip-Undetected	MUGURU MYMUL	2018-01-27 12:57:04	2018-01-27 12:59:15	Critical	MUGURU MYMUL, CIP not detected BMC ID: BMC_2439 Current Temp: 2.0C Current Time: 27-Jan-18 12:59 PM Lifted Time: 27-Jan-18 11:25 AM Current state: Empty
BMC_2439	Overcooling	MUGURU MYMUL	2018-01-27 11:27:03	2018-01-27 10:50:15	Critical	MUGURU MYMUL, Please stop chilling BMC ID: BMC_2439 Temp: 1.7C Time: 27-Jan-18 10:50 AM Status: Over Chilled
BMC_2439	Overcooling	MUGURU MYMUL	2018-01-26 08:25:51	2018-01-26 08:23:36	Critical	MUGURU MYMUL, Please stop chilling BMC ID: BMC_2439 Temp: 1.9C Time: 26-Jan-18 8:23 PM Status: Over Chilled
BMC_2439	Overcooling	MUGURU MYMUL	2018-01-25 08:10:21	2018-01-25 08:10:45	Critical	MUGURU MYMUL, Please stop chilling BMC ID: BMC_2439 Temp: 1.8C Time: 25-Jan-18 8:10 PM Status: Over Chilled
BMC_2439	Dg-Off	MUGURU MYMUL	2018-01-23 07:09:11	2018-01-23 07:08:30	Info	MUGURU MYMUL, DG is OFF BMC ID: BMC_2439 Temp: 23.7C Time: 23-Jan-18 7:08 PM Compressor: ON
BMC_2439	Agzfb-Off	MUGURU MYMUL	2018-01-23 07:09:11	2018-01-23 07:08:28	Info	MUGURU MYMUL, Agitator OFF BMC ID: BMC_2439 Temp: 23.7C Time: 23-Jan-18 7:08 PM Volume: 948.0 kgs Status: Agitator OFF
BMC_2439	Agzfb-On	MUGURU MYMUL	2018-01-23 07:02:36	2018-01-23 07:05:07	Info	MUGURU MYMUL, Agitator ON BMC ID: BMC_2439 Temp: 23.7C Time: 23-Jan-18 7:05 PM Volume: 895.0 kgs Status: Agitator ON
BMC_2439	Dg-On	MUGURU MYMUL	2018-01-23 07:02:35	2018-01-23 07:04:57	Info	MUGURU MYMUL, DG is ON BMC ID: BMC_2439 Temp:23.7C Time: 23-Jan-18 7:04 PM Compressor: ON

Figure 4: Alerts generated by Stellapps BMC Remote Monitoring System

The online available data & alerts were closely monitored by MYMUL in the following manner:

- **Shri. Santhosh**, **Deputy Manager-MYMUL**, technical responsible for the BMC's prepared reports related to the Diesel Generator (DG) fuel Consumption. Running hours of the DG was calculated using hour meter for the complete month. Using the consumption rate the fuel consumed for the month was calculated. This Data was read vis-à-vis the data from the BMC Remote Monitoring System(Refer Figure 5 below) to ensure effective usage of DG. It was seen to it that DG was not used when power was available and thereby saving on the fuel cost.

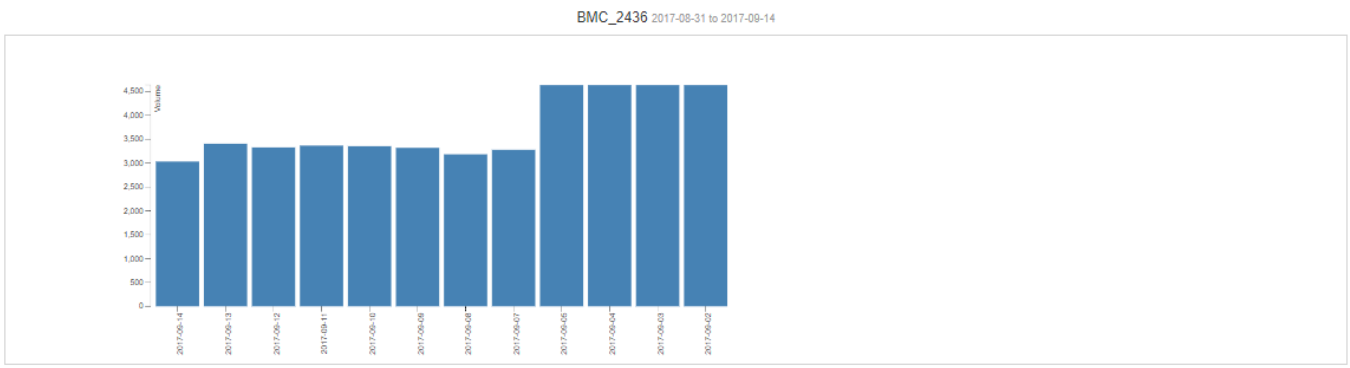
BMC BMC_2436 – MAADAPURA MYMUL

Date	Used For Chilling				Not Used For Chilling			
	DG		Grid		DG		Grid	
	Duration	Energy (Ltrs)	Duration	Energy (Units)	Duration	Energy (Ltrs)	Duration	Energy (Units)
14-09-2017	2 hrs 23 minutes	8.60	2 hrs 30 minutes	10.27	0 hrs 11 minutes	0.64	15 hrs 22 minutes	7.68
13-09-2017	0 hrs 0 minutes	0.00	5 hrs 4 minutes	20.69	0 hrs 0 minutes	0.00	17 hrs 49 minutes	8.91
12-09-2017	0 hrs 0 minutes	0.00	5 hrs 7 minutes	20.89	0 hrs 14 minutes	0.76	16 hrs 48 minutes	8.40
11-09-2017	2 hrs 31 minutes	9.10	2 hrs 13 minutes	9.07	0 hrs 33 minutes	1.82	13 hrs 55 minutes	6.97
10-09-2017	2 hrs 11 minutes	7.90	2 hrs 43 minutes	11.11	0 hrs 22 minutes	1.23	9 hrs 27 minutes	4.73
09-09-2017	2 hrs 29 minutes	8.98	2 hrs 18 minutes	9.45	0 hrs 0 minutes	0.02	12 hrs 19 minutes	6.16
08-09-2017	1 hrs 32 minutes	5.58	3 hrs 12 minutes	13.12	0 hrs 39 minutes	2.16	13 hrs 15 minutes	6.63

Figure 5: DG/Grid Power Consumption Data

- **Shri. Govindaraju, Deputy Mananger-MYMUL** responsible for the volume of milk procured prepared reports on the volume procured from all the routes. Volume lifted at site as per the challan was compared with the volume data available from the BMC Remote Monitoring system(Refer figure 2 below). This data was cross verified with the actual volume measured at MYMUL Dairy plant to check for inconsistencies.
- **Shri. Panniraju , Deputy Manager -MYMUL** responsible for testing the quality of milk prepared reports on the MBRT ,Lifting Temperature ,Fat & SNF values of milk from all the routes. Lifting temperature data in the challan was compared with the data from the BMC Remote Monitoring System(Refer figure 6 below). and was corelated with the milk temperature on arrival at MYMUL Dairy plant. Corrective measures were taken to ensure milk temperature on arrival was between 4°C & 6°C.

Milk Lifting Data BMC_2436



Date	Time		Duration	Temperature		Volume
	Start	End	(Minutes)	Start	End	
2017-09-14	10:44:32	11:03:32	19.00	6.6	6.6	3033
2017-09-13	10:21:20	10:44:48	23.47	6.7	6.7	3405
2017-09-12	03:07:55	03:28:56	21.02	8.2	6.9	3328
2017-09-11	10:05:20	10:26:50	21.50	7.2	7.2	3367
2017-09-10	10:10:31	10:37:23	26.87	6.4	6.3	3354
2017-09-09	10:23:31	10:42:34	19.05	7.1	7.1	3320

- **Shri.Mallikararjun , P&I-Manager-MYMUL** was kept updated about the savings at the weekly & monthly meetings to whom Shri. Santosh reported.
- **Shri Narsimhamurthy , Plant Manager** was kept updated on the milk quality and volume procured at the weekly & monthly meetings to whom **Shri. Panniraju & Shri Govindaraju** reported.

In the Monthly meetings **Shri. Shivalingegowda, Managing Director - MYMUL** was briefed on the overall procurement, milk quality and operational efficiency.

Stage 4 : Studying the MBRT Data again

After the installations, once again Stellapps continued to capture Lifting temperature, arrival temperature and MBRT data. Below is the graphical representation (Refer Figure 7 below) of MBRT vs time for the same route considered above. As can be seen from the graph the line in red represent the MBRT value in min on a daily basis from the date of installation for a period of

1 month. It can be seen that the lowest value of MBRT is 180 min and highest is 265 min. The average value is around 220 min.

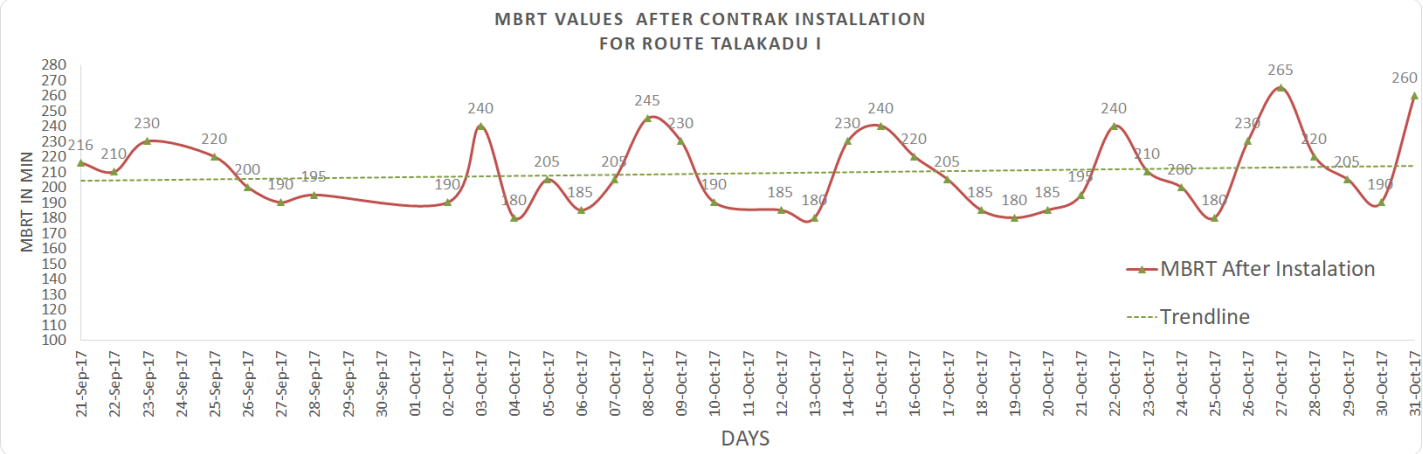


Figure 6: Graph of MBRT over time after installation of BMC Remote Monitoring System.

Other Improvements – Quantity, Diesel Cost, Capacity Utilization

Although this case study has focused only on Quality enhancement, other significant improvements were also seen along with Quality improvement.

- Quantity mismatch from BMC in terms of tanker volume and procured volume were reduced significantly. On an average about 30 more litres of milk was delivered to the processing plants per BMC. This was due to the reduced pilferage or in-accurate Dip Stick for milk quantity measurements.
- Diesel consumption for chilling was now reported more accurately. Actual number of hours of chilling based on DG was reported accurately and hence Diesel consumption was tracked at central location. This can be used for dynamic diesel cost payment.
- BMC capacity utilization has been improving as the volume is monitored centrally, and route managers are directing milk to emptier BMCs, and also manage tanker routes optimally.

Conclusion

Stellapps on request of MYMUL prepared the case study. MBRT data before and after the BMC monitoring System installation was captured. The result was MYMUL saw a good improvement in MBRT values as can be seen in below graph (Refer figure 8). As can be seen from the graph, the blue and red line indicates the MBRT in minutes daily before & after the installation of BMC Monitoring system respectively. It can be seen from the trendline that the MBRT value is on an increasing trend. From an average value of 170 min of MBRT it has rose to an average value of 220 which is an increase of 50 min. The improvement cab be attributed to the below facts:

- Availability of monitoring parameters for proper chilling from remote place to a central location, made possible by Stellapps BMC Remote Monitoring system.
- Data analytics to identify the shortcomings for the proper chilling made, possible by Stellapps Remote BMC Monitoring system
- Corrective measure & actions taken on time. The complete credit goes to the MYMUL team who used Stellapps Remote BMC Monitoring System to its full potential.

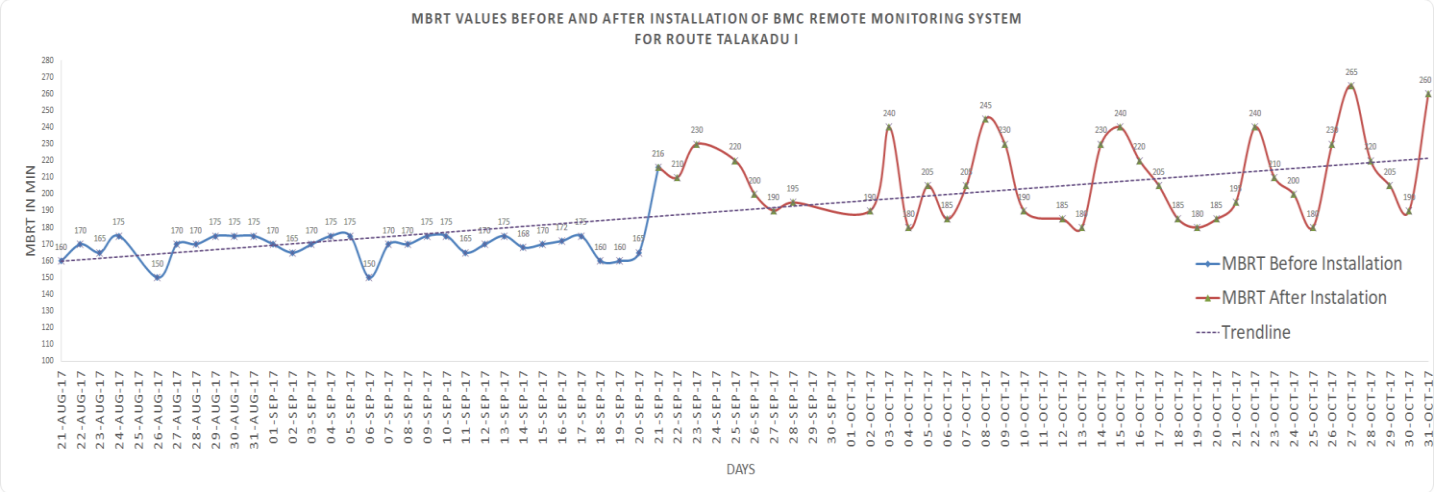


Figure 7: Graph of MBRT over time before and after installation of BMC Remote Monitoring System.

This indicates improvement in milk quality. This means that less number of rejections of potential revenue and more revenue realisations. Increased MBRT of milk through BMC Remote

monitoring solution has helped dairy companies to enter premium milk products (UHT milk etc.) which also adds to the revenue realisations. Operations cost were reduced because of fuel/power savings by better monitoring. With remote monitoring, also number of technicians required were reduced. Thus, increase in realisation per litre of milk and reduced cost of operations helped MYMUL to ensure RoI within six months.

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Author's Profile

Mr. K Shivalingegowda, Managing Director, Mysore District Co-operative Milk Union Ltd

Has 32 years of experience in Dairy Industry in Senior Management level. He has a degree in master's in business administration. He has been associated with many co-operative union in his career. Some of the Unions, Dairies & Federation include Bangalore Urban, Rural & Ramanagara District Co-Operative Milk Producers Societies Union Ltd. (**BAMUL),** Kolar-Chikkaballapura District Co-operative Milk Producers Union Ltd **(KOMUL), Mother Dairy -a** wholly owned subsidiary of the National Dairy Development Board (NDDB) and Karnataka Milk Federation **(KMF).** He is currently the Managing Director of Mysore District Co-operative Milk Union Ltd **(MYMUL).**

Mr. Ravishankar G. Shiroor – Co-Founder, Stellapps Technologies Private Limited

Has more than 20 years of experience in the global Telecommunications industry. He is an M.Tech in Telecommunications from IIT Madras. In the last few years he has been an entrepreneur focused on developing & deploying M2M, Smart Systems and Internet of Things based end-to-end solutions specific to industry segments specific emerging economies like India. His company, Stellapps Technologies, is making significant inroads in to applying these technologies in to Dairy and Agriculture sectors.

Mr. Prasanna Ramachandran – Business Analyst, Stellapps Technologies Private Limited

Has around 11.5 years of experience spread across diversified Industries including Dairy Industry. He has bachelor's degree in Electrical & Electronics Engineering. His experience has been mostly in senior management roles. He has been recognized and is known for his analytical acumen. He is currently associated with Stellapps technologies.