CONFERENCE PAPER 1

2nd International Conference on Asphalt 4.0

Integrated digitial value chain as a contribution to sustainable road construction

#ICA4point0

Thomas Leopoldseder
CEO Q Point Group
thomas.leopoldseder@q-point.com

Integrated digitial value chain as a contribution to sustainable road construction

ABSTRACT

Digitization solutions help to design and manage the process optimally, from the procurement of raw materials to transport and production to installation, and with the lowest possible use of resources. They are also able to distribute information and automatically measure quality criteria in order to inform employees on the construction site which activities are necessary to obtain a high-quality and therefore long-lasting asphalt pavement.

Every hour that is saved to lay the asphalt pavement, every truck that does not have to drive due to optimized use, every batch that is less necessary at the mixing plant and every day that an asphalt pavement lasts longer reduces the burden on the environment, has a positive effect on the sustainability of road construction and saves costs for all companies involved.

In practice, however, a digital value chain only works if all those involved in the process work together and achieve corresponding advantages for their sub-process. The integrated digital value chain ensures that not only a continuous data flow is established, but also that all relevant information for the optimal execution of a sub-process is available, changes can be reacted to quickly and errors are largely excluded.

This paper shows, how a digital value chain between the construction site and the mixing plant can be used for an efficient asphalt paving process and optimal and resource-saving production.

1. INTRODUCTION

While "Just-In-Time manufacturing" has been in use in many other industries for a long time, the asphalt road construction sector is still largely far from it. However, the underlying concepts could ultimately be applied in road construction as well, in order to achieve a process-optimal, resource-efficient, and thus sustainable value chain. Digital solutions play a significant role in this regard.

The basis for "Just-In-Time manufacturing" is knowledge about demand. In the automotive industry, demand arises from car purchases in different countries. Due to standardized ordering processes and minimal possibilities for order changes, demand can be predicted very accurately, and production can be optimized accordingly.

The situation is different in asphalt road construction. Demand depends not only on geometric and structural requirements and the scheduling of construction execution but also on external factors such as weather, availability of machinery and personnel. Therefore, in addition to medium-term plannability, maximum flexibility in the ordering process is also crucial.

Nevertheless, a "Just-In-Time manufacturing" approach would have significant advantages in the asphalt industry as well. A prerequisite for this, however, is that all relevant information is made available to the stakeholders in a timely manner, in order to be able to optimally accommodate even last-minute changes. The integrated digital value chain assists in achieving this goal.

1.1 Digital value chain

The ideal digital value chain provides uninterrupted, consistent digital information for the subsequent process steps, can help to minimize the use of resource, minimizes costs, and supports sustainable asphalt paving processes.

2. THE ASPHALT PAVING VALUE CHAIN

If we analyze the various phases of the value chain of asphalt paving operations, we can identify in which of them digitization has, or can have, a very relevant role, as well as assign which organizations are the main data generators in each of the phases. A schematic of these stages of the value chain is shown in Figure 1.

Figure 1: Digital value chain.

The starting point for an efficient overall process is the planning of the construction and the prior notice of demand supported by digital tools. For instance, mobile apps and web solutions provide the opportunity to send non-binding requests to the mixing plant in a timely manner, thereby indicating preliminary demand to the plant.

Figure 2: Digital order management at the construction site by Q Site App.

These demand notifications are sent digitally to the mixing plant. Depending on the construction progress, the demand can be updated from the construction site at any time. Thus, if all customers of the mixing plant are sending their requests with a digital solution, the mixing plant always has a current overview of demand from all construction sites without manual interaction (phone calls, mails, faxes, personal orders, …). Since the communication between the construction site and the mixing plant also takes place by using digital tools, all processes, changes, and comments are centrally documented and accessible and comprehensible for all parties involved.

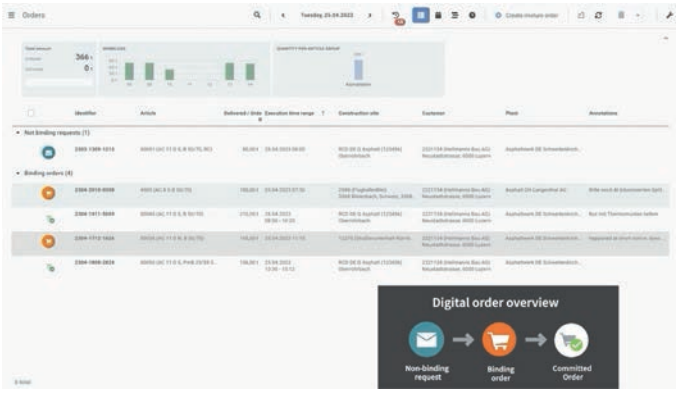

Figure 3: Digital order management at the mixing plant with Q Plant.

With this information, the mixing plant is therefore in a position to estimate its production requirements in the best conceivable way and to adjust its supply chain accordingly. This enables accurate raw material management, optimal transport and production sequences and therefore contributes to a sustainable production process. Once the effective paving time has been fixed by the construction manager or the foreman and the actual demand has been determined, the non-binding order can simply be changed into a binding order. The online communication between the mixing plant and the construction sites allows all participants to react at short notice.

Modern mixing plant control systems also contribute to the most energy-efficient and low-emission production by offering a wide range of options for production control and optimisation (e.g., usage of recycled asphalt) for an energy saving and sustainable production.

Figure 4: Digital management of an asphalt mixing plant with as1 control system.

The possibility to analyse data is one of the key benefits of digital solutions. The following figure shows the recipe changes of an asphalt mixer on one day. It is noticeable that the same recipe was produced by the mixing plant multiple times a day with short interruptions. This production process is highly inefficient and results in high energy costs. By consolidating common recipes into a production batch, not only setup time can be saved, but energy costs can also be dramatically reduced.

Figure 5: Production dashboard in Q Plant.

However, for an optimal planning, it is necessary to know the future demands as accurately as possible to avoid a situation as it is shown in figure 5.

A decisive quality factor in paving is continuous paving. In order to ensure this, the most accurate information possible about the delivery time and a demand-oriented and continuous delivery performance are crucial. This is where mobile applications can help to integrate the delivery process into the digital value chain and to share important information between all participants (e.g., estimated time of arrival at the construction site). Especially for Warm-Mix-Asphalt the delivery sequence is an important factor of high-quality pavement.

Figure 6: Digital transport information, positions of the trucks, mobile information about delivery with Q Transport and Q Site.

By receiving the estimated time of arrival, which is currently updated in case of traffic jams the paving team can plan their paving work and paving speed accordingly. This leads in most cases to a continuous paving process thus to a high-quality asphalt pavement with minimal warranty risk.

Information about the asphalt temperature during paving but also during the compaction process also help the paving team to create a long-lasting asphalt pavement.

Figure 7: Digital compaction control at ARGE Midnightforce – Renovation of runway 10/28 at Zurich airport by Walo Bertschinger (CH) and Implenia (CH).

Modern digital automated measurement and visualisation systems enable positionally accurate

and continuous monitoring and documentation of temperature, passes and compaction, automatically and independently of the machine manufacturer. With a machine manufacturer independent system it is very easy to implement such a system into a mixed fleet of a construction company with the advantage to get a complete documentation of the paving and compaction process but not only of some machines.

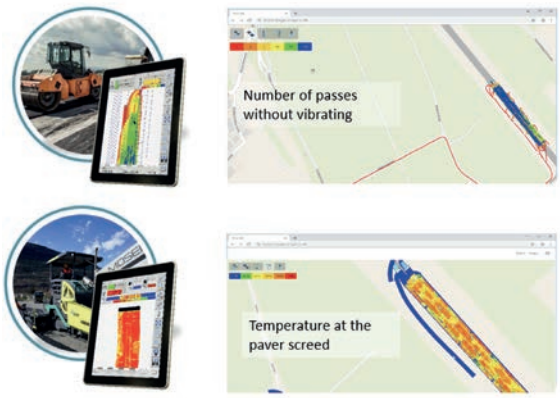

Figure 8: GPS based measurement and visualisation and reports of the paving and compaction process.

By defining the optimum number of passes for the rollers or the best temperature range for compacting and by visualizing that for the roller driver an efficient compaction process can be achieved.

	Optimal passes													
Passes in practice	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
6														
7	14%													
8	25%	13%												
9	33%	22%	11%											
10	40%	30%	20%	10%										
11	45%	36%	27%	18%	9%									
12	50%	42%	33%	25%	17%	8%								
13	54%	46%	38%	31%	23%	15%	8%							
14	57%	50%	43%	36%	29%	21%	14%	7%						
15	60%	53%	47%	40%	33%	27%	20%	13%	7%					
16	63%	56%	50%	44%	38%	31%	25%	19%	13%	6%				
17	65%	59%	53%	47%	41%	35%	29%	24%	18%	12%	6%			
18	67%	61%	56%	50%	44%	39%	33%	28%	22%	17%	11%	6%		
19	68%	63%	58%	53%	47%	42%	37%	32%	26%	21%	16%	11%	5%	
20	70%	65%	60%	55%	50%	45%	40%	35%	30%	25%	20%	15%	10%	5%

Figure 9: Savings by compacting with the optimal number of passes.

Already an average reduction of the number of passes from 7 to 6 leads to a reduction of operating times and thus the use of operating resources by 14%, with a reduction from 8 to 6 passes it is already 25%.

Simultaneously with the documentation and monitoring, it is also ensured that the installation is carried out in the ideal temperature range and with the optimal number of passes. This increases the quality of the installation and extends its lifespan.

Only digital solutions can provide this information to the paver and roller operators in order to minimise the use of resources.

With the continuous digital documentation along the entire value chain, much information is collected that can be used for any repairs, in case of demolition and recycling in order to conduct these tasks in the most environmentally friendly way possible.

3. CONCLUSIONS

Consistently digital solutions throughout the entire value chain between the mixing plant and the construction site support in many areas, simplify the workflow, relieve administrative tasks, distribute information for an efficient workflow, lead to cost savings, and support sustainable road construction.

However, the implementation requires coordinated collaboration and integrated digital solutions, as well as open platforms for data exchange. With this, both mixing plants and transportation companies, as well as road construction companies, can achieve significant advantages in their respective processes.

4. BIBLIOGRAPHIC REFERENCES

- All pictures, Q Point GmbH, Austria