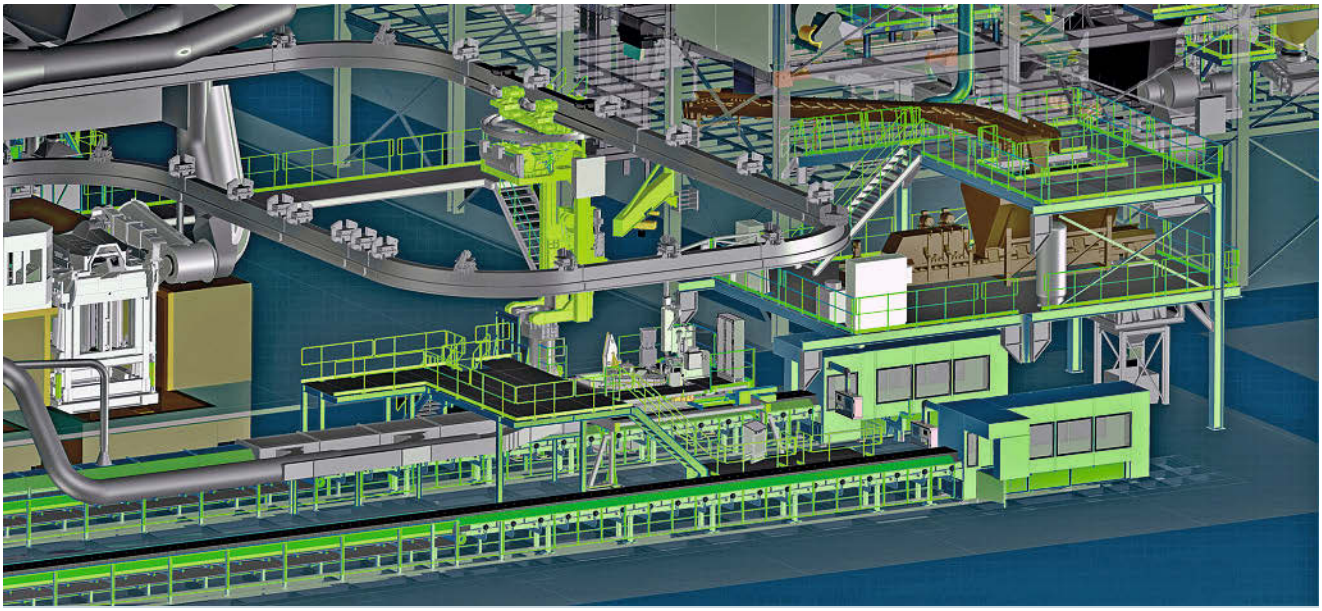

Photo: Gemco

Foundry logistics, process integration, interface design.

Factory planning

Logistics as basis for an optimally functioning foundry

In reality, the efficiency of a foundry is not solely determined by installations and production processes. A suitable layout and good logistics are prerequisites. Gemco, as a foundry planning and consulting engineering company, is involved in the planning of new foundries or the modernization of existing foundries. The analysis of the various „bottlenecks“ as well as the material flows to the installations are just as important for improvements as the installations and the process itself.

Huub van der Weiden, Eindhoven

A foundry is a complex system of people and installations that exchange energy and material. The performance of a foundry is influenced by the specification of the production programme, the equipment, transport capacity, their interruptions and energy requirements. The concept of casting systems, metallurgical properties, process control of mold and cores as well as ensuring consistent quality and punctual deliveries are emphasized in foundries. The installations are maintained and the machine builders focus on the continuous improvement of their machines, frequently with the involvement of the foundry customers. That is why, when considering a new investment, foundries and machine builders often spend a lot of time on improving the systems from the experience of both.

Just as important for improvements, as the installations and the process itself, is an analysis of the various „bottlenecks“ or the material flows to the installations. The core of Gemco‘s work lies in the planning of new foundries or the modernisation of existing production installations allowing for an optimal selection as well as the effective interaction of systems and departments.

We are involved in the projects from conceptualisation up to implementation. It is essential to include logistics inside and outside the foundry already in the concept phase.

Buffer systems for more efficiency

Good logistics in new foundries or changes to the logistics in an existing layout can already optimise the overall performance; in existing plants, often without affecting the capacity of the individual system.

Gemco analyses all logistical processes, the value stream and the essential transportation of all semi-finished products.

We make sure that the logistics of good parts, NOK parts and parts in quarantine do not mix. With the installation of matched buffer capacities, the utilisation of installations can be optimised and sub-processes can be better exploited.

GEMCO CAST METAL TECHNOLOGY

Bottleneck analysis

Department / process step	Required output & capacities of departments in order to achieve projected 2x production capacity with scope for sustained growth Current output ↓ +35%↓ +100%↓	Remarks
Charging area		*Non-magnetic scrap handling needs optimization including relocation of storage for more efficient charging of furnaces*
Melting department		*3rd furnace (considered in lay-out) will allow further expansion/sustained growth*
Liquid metal transport		*Current pouring by overhead crane has sufficient capacity*
Core shop		*Existing mixer will be dedicated to core production*
Sand mixing		*New mixer will be dedicated to the production of copes and drags*
Moulding department		*Optimized workflow and mechanized transport and mould handling will double moulding capacity and reduce labor/mould*
Pouring, cope lifting, in-mould cooling		*Mechanization of the mould transport strongly reduces labor/mould*
Shake-out and knock-off		*Mechanized operation eliminates manual operations and increases safety*
Sand reclamation		*New sand system: current Olivine-Silica to be converted into Chromite Silica system*
Heat treatment & quenching		*Mechanization of (un)loading improves the utilization of quenching and heat treatment and increases the system capacity*
Finishing department		*Extension of the finishing area increases capacity, mechanization foreseen for the future*

Capacity of current facilities
Capacity after implementation of second phase (expansion)

Figure 1: **A capacity and bottleneck analysis was the first step towards doubling capacity at Nortrak in the USA.**

Dynamic buffer systems, having products in different manufacturing states in (usually automatic,high) shelves, reduce the overall buffer volume in the foundry. In addition to lower capital requirements (buffers are ultimately m² of building space), this also leads to fewer human errors in logistics and often to fewer forklift truck movements, which promotes safety. Beyond that, logistical calculations are important to achieve good material flow with buffers at strategic points to optimally manage the bottlenecks so that their maximum capacity is utilised. Bottlenecks will always occur somewhere and then move elsewhere depending on which ones are resolved. However, it is beneficial to identify potential hold-ups and the most common bottlenecks in advance.

The use of different scenarios for different products is important as bottlenecks can be „hidden" because they can be based on, for example, „wrong assumptions".

In this way, the various causes of bottlenecks in different installations and stages in the overall process(-sequence) can be systematically identified. Derived from these findings, it becomes readily apparent which capacities are required for which installations and where buffers are desirable. Based on such an analysis, it is possible to make the right choice as to which bottlenecks need to be eliminated and which not. Gemco plans buffer systems keeping bottlenecks in the value stream in mind and always with the option of bypassing the buffer system in the event of a malfunction. During the detailed planning, attention is paid to the accessibility for maintenance, repair and operation in order to optimise the available uptime.

The logistics of ancillary and support processes must also be considered. It is important to optimise them, as these costs are not borne by the customer. This includes recycling material, but also waste streams (slag, dust, scrap, used sand, etc.). Gemco is of the opinion that their logistical routes should not cross each other. A robust concept is required for data traffic, cooling water, extraction and supply of fresh air, compressed air and electricity (media supply). Good logistical planning therefore makes an important contribution to the efficiency (OEE) of the foundry, reduces human error and curtails costs. This also applies to the accessibility of the installations for maintenance and repair work, especially at the casting, molding and blasting installations.

Keeping internal and external logistics in mind

In addition to the internal processes within the plant, care must also be taken in advance regarding the design of the external area and the surroundings of the plant. The area and space available outside the foundry are different for each project.

Truck and forklift traffic with different frequencies must constantly be kept in mind, as these are often subject to restrictions and even require permits. Points to consider include the following:

> Do measurements have to be carried out before a truck enters or leaves the works premises, such as for weighing or radioactivity measurements?
> How are the trucks loaded and unloaded?
> Which turning circles are required for the trucks?
> Are there regulations regarding circulation and/or heavy traffic on and to the site for 2nd and 3rd shifts?
> Are warehouses or storage areas required outside the foundry and where?

For this purpose, all occurring and required movements must be taken into consideration.

> How and where will lighting be installed on the premises?

Al together, a safe and well-functioning logistical flow is also required outside the foundry.

Logistic solutions from practice

Intermediate storage already included in the concept

In the (greenfield) foundry project of a Scandinavian truck manufacturer, in which Gemco is involved in both the concept phase and the implementation of the project, it was already clear in the concept phase that an intermediate storage facility would be advantageous at different points to ensure the effectiveness of the installations as well as maximum flexibility in the production planning. Like many customers today, this customer also wanted to avoid forklift transportation for production purposes. The first intermediate storage facility was planned between the core and molding facilities, and it was clear from the outset that a high storage would be the best solution, explicitly considering investment costs (capex) and functionality. The weekly production of cores is collected in the high-bay storage and thus balances the daily core requirements in the molding facility.

The task of the second intermediate storage is not only to balance the production of the molding facility with partial demand in the area of production/reworking, but also to store parts that have not yet been released for further processing. In the case of the high-bay storage at this point, the question "are the parts blasted or are they parts with adhering sand" also played a role. The third and largest high-bay storage is located at the end of the production chain. It serves not only as a warehouse for truck forwarding, but also as a space for curing/drying the primer.

All intermediate storage facilities are fully automated and connected to the installation control system of the foundry's systems-control system. In addition, all installations are equipped with fire-extinguishing systems based on the highest standards and optimally integrated into the structural concept. Drawing up the specifications for the storage and buffer systems made out only a small part of the planning work; the greatest challenge was the planning of interfaces and communication with suppliers, the building design and site management during assembly, which was done to the satisfaction of the customer.

NORTRAK, USA

This example shows how through improved logistics, the production capacity could be doubled within an almost unchanged floor area by means of adjustments to the layout, the optimisation of existing systems and the improvement of the workflow. A bottleneck analysis was carried out for the entire foundry to determine where and which additional equipment/ installations would be required to achieve the desired doubling of capacity (**Figure 1)**.

The analysis clearly showed in which areas additional machines were required. For example, the smelting department required a third furnace for further expansion. Further, the molding capacity could be doubled by automating the transport from batch to continuous transport and by changing the casting process from a batch to a continuous (and flexible) casting process. The analysis also showed how certain existing installations can be better utilised by changing the operating sequence (logistics)

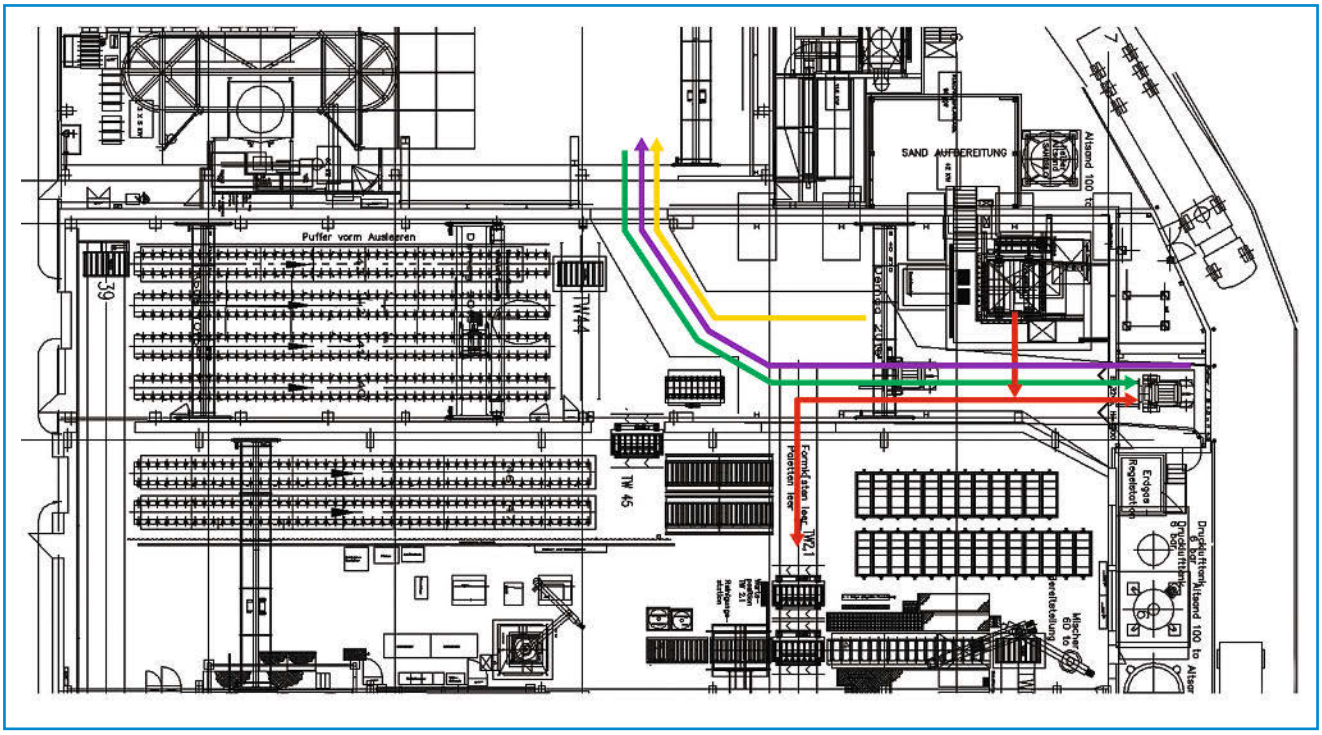

Figure 2: Linde Material Handling: Layout/ workflow before modernization.

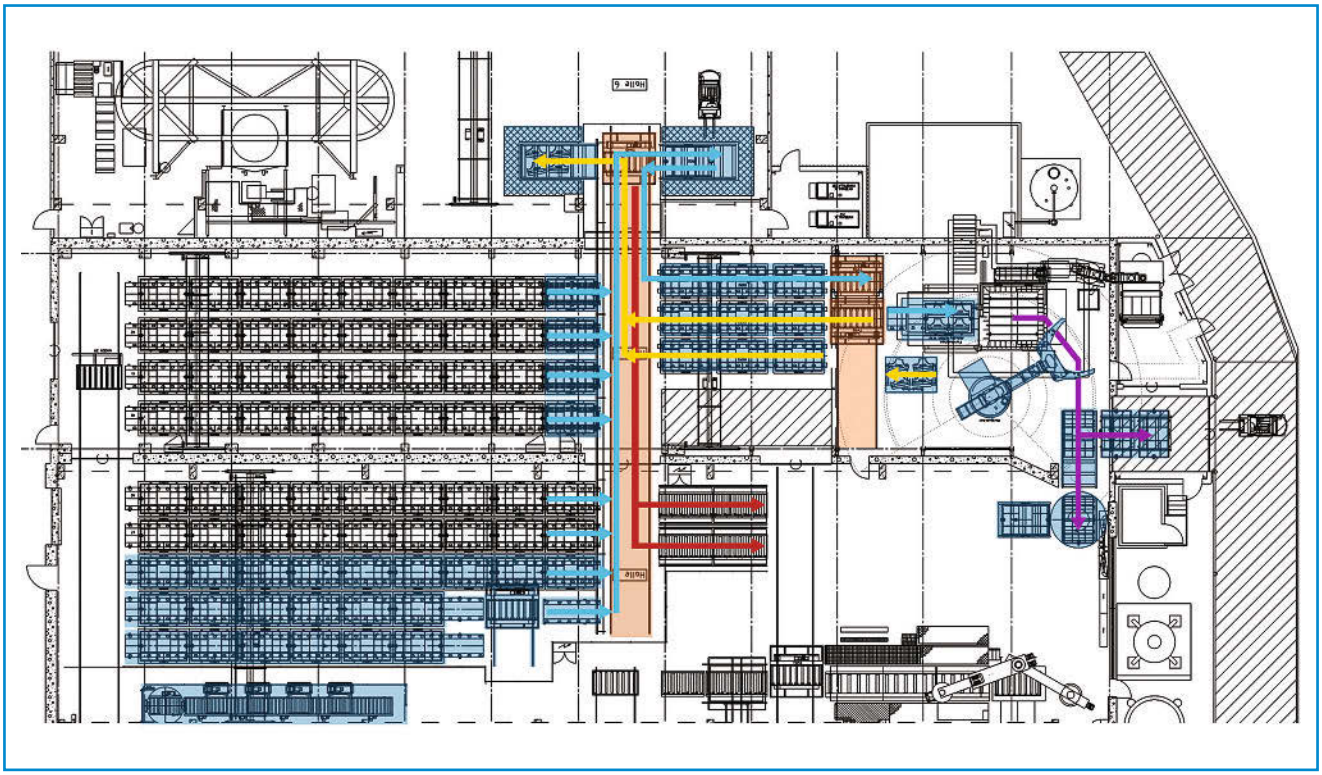

Figure 3: Linde Material Handling: Layout/ workflow after the modernization.

and creating buffers before and after these installations.

Linde Material Handling, Weilbach

Gemco was awarded the contract to support Linde Material Handling in a number of areas, namely to improve working conditions and handling at the shake out area, to reduce sand entrainment inside and outside the foundry and to extend the cooling time in the mold. Linde originally regarded these areas as separate issues with stand-alone solutions from different sources and consequently envisaged separate projects for Gemco.

However, Gemco chose a different approach and developed a holistic concept to solve all tasks (working conditions, emptying processes and sand loss) around casting and mold handling. An analysis revealed that logistical changes would be required to effectively address the key issues. The processes in this part of the foundry included the handling of the heavy and specially dimensioned castings and of the corres-

pondingly large mold boxes at the shake out area.

The molding boxes, consisting of upper and lower boxes, are taken apart here, emptied and transported away. These required procedures necessitated crane and forklift movements within a relatively narrow range (Figure 2). These processes also affected the air quality in the adjacent halls. In addition, a solution had to be found for the problem of sand entrainment in the handling areas inside the building and in the cooling areas outside.

Gemco proposed an integrated concept that envisaged an automated logistics system for the overall delivery and removal of the molding boxes and castings in the production hall as well as a specially developed manipulator to separate them. The new logistics concept also considered various non-standard equipment and installations that had to be foundry-suitable and easy to maintain to make the processes in the respective work areas as efficient as possible. The integrated concept allowed for improved operating conditions and the air quality, as well as more efficient handling and transport of molding boxes and castings in the shake out area. A specially developed lifting and tipping table along the shake out facilitates sand recovery and reduces the entrainment of sand within the handling areas and in the outer area. With this concept, the worker, who safely controls the system from the soundproofed and air-conditioned cabin of the manipulator, and who has an overview of all processes from there, is the only employee present in the hall.

The concept also provided for an expansion of the cooling areas as well as significant changes to the casting logistics. In addition, it even offered the possibility for future installations for forced cooling with a direct connection to the shot blasting machine which would eliminate the need for cooling in the outer area (Figure 3). A budget and implementation plan was also drawn up for the concept which was presented.

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