WHITE PAPER

GREEN

LOGISTICS SOLUTIONS

A natural way of doing profitable business

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Topics related to Corporate Social Responsibility (CSR), above all the protection of the environment, have become omnipresent in the business world during the last few years. Consequently, environmental aspects have climbed up on management agendas and efforts in these areas have been intensified, belatedly including logistics. Due to the recent slump of the global economy, companies' focus on solving financial and economic issues are seeming to prevail over previously started efforts to protect the environment. As a matter of fact, most efforts of 'greening' the business can also be linked to an improved economic outcome.

The main sources for directly measurable financial benefits of green initiatives are reduced costs through lower energy consumption, rebates for the compliance with government regulations and subsidies obtained for the use of alternative energy. According to recent research by the Aberdeen Group[1], more than 50% of companies indicate 'reducing overall business cost' as one of the main drivers in pursuing 'green' initiatives.

This white paper analyzes opportunities for companies to optimize their logistics processes towards 'greener' and less energy-consuming solutions. It starts with an overview of how supply chain, network design and warehousing are interlinked and how optimizations have to be addressed with a comprehensive approach. Subsequently, the focus is set on the 'green' opportunities in and around warehouses, addressing highlights in the areas of civil engineering, mechatronics, automation and material flow processes.

Green Supply Chain

Within all aspects of a business, the supply chain probably represents the largest area for improvements regarding the impact of companies on the environment. Environmental initiatives within companies' supply chains are typically centered on optimizations around energy and waste. On the one hand these initiatives focus on energy savings, use of alternative energy and production of environment-friendly energy. On the other hand, they also largely focus on avoiding waste, recycling and re-using materials, and appropriate disposal.

The cost and environmental impact of the supply chain can be attributed to two basic areas: warehousing and transport. The latter is particularly important when looking at the carbon footprint. It accounts for roughly two thirds of the supply chain's overall energy consumption. In order to optimize environmental aspects and save money within the infrastructure and processes of a warehouse, it is important to understand how warehousing and transport are interlinked. For example, it can well be economically and ecologically viable to increase a warehouse's energy consumption, such as for additional automation, if at the same time the energy required for the transport can be reduced, e.g. due to better order accuracy, better cube utilization of trucks, improved pre-sorting and optimized distribution networks.

Green Network Design

Supply chains have become more global and shipping distances have grown supported by the availability of inexpensive transports and lower labor costs in emerging countries. Because of the distribution network's considerable impact on the company's environmental footprint, the optimal locations of new distribution centers and warehouses depend on the access to transport infrastructure, such as sea and inland ports, railways, road networks and airports. Choosing appropriate means of transport has an enormous impact on the emissions and the cost related to the fuel consumed. In order to put things into a relation: Long-haul transports produce 30 to 40 more CO_2 by plane than by ship, short-haul transports generate 5 to 6 times more CO_2 by truck than by train.

In order to model and design a network with a minimum impact on the environment, the traditionally used parameters, such as capacity, service level, availability and cost have to be extended by some sort of environmental constraint, e.g. 'social cost of carbon'. Such an additional constraint has a similar effect as an increase of the energy costs. The result is that more fuel-efficient primary transport will be extended in line with an increasing number of smaller distribution centers, and the routes of the secondary transport will be shortened.

A case study done by Infor[2] revealed that optimizing an average supply chain network purely for cost not only results in cost savings of around 7%, but it also reduces the emission of CO_2 by around 25%. Repeating the cost optimized network modeling with an additional environmental constraint, i.e. carbon offsetting of all CO_2 emissions, showed a number of very interesting results. Despite the additional cost of carbon offsetting, the overall cost could still be decreased by about 6% relative to the base scenario and most interestingly the CO_2 emissions would be reduced by 50%.

[1] Supply Chain Network Design: Architecting a Green Future, Aberdeen Group, 2008.

[2] Top Five Pressures for a Green Supply Chain, Infor, 2008.

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Green Warehousing

As mentioned before, the conceptual design of the warehouse or distribution center has to be done with a clear understanding of the interconnections between transport and warehouse. The overall energy consumption and efficiency of a warehouse depends on the different in-house processes, and the optimization in regards to manual or automated approaches has to be done with respect to the general set-up of the installation. Depending on the degree of automation, electricity, oil and gas used for material handling systems and air-conditioning account for about 70 to 80% of the overall energy required for the operation of a distribution center. The remaining 20 to 30% is indirect energy related to the daily commuting of the employees between their homes and work.

The intuitive assumption that automated warehouses overall tend to consume more energy than manual warehouses has to be verified on a case-by-case basis. There are different areas in which automated installations specifically help to reduce energy consumption and to save costs. First, the more compact shape of automated high bay warehouses reduces the amount of energy used for air-conditioning. Second, illuminating only the relatively small operator areas saves additional electrical energy. Third, less employee commuting, in particular in areas with low labor availability and therefore long commuting distances, further improves the environmental track record.

Green Civil Engineering

The engineering and design of warehouses and distribution centers and their facilities offers, independent of transport and warehouse processes, a wide spectrum of possible green initiatives. A main factor of efficiency is matching the building to its purpose – over-dimensioning should by all means be avoided.

Energy Efficiency

Reducing the cost of the operation of a building is a key interest which is linked to increasing the efficiency of cooling, heating and illumination. State-of-the-art insulation of the roof, the walls and the hot water piping has become a standard in the construction of new warehouses and distribution centers. Chekking and if necessary improving the insulation of older warehouses can be an attractive investment. Insulation has a positive effect on both cooling and heating efficiency. Not only does it eventually contribute to protecting the environment but it also contributes – after a short pay-back period – to the owner's net profit.

Intelligent and tailored air-conditioning and chiller systems can reduce energy consumption by up to 50%. Reconditioning inside air by recycling and mixing with fresh outside air, as well as heat recovery of the exhaust air, are energy-efficient approaches for cold seasons. Night aeration, i.e. letting the warm inside air escape through hatches in the roof and sucking in colder outside air through openings on the ground level, is an approach for warmer seasons.

Efficient lighting starts with the basic design of the building, i.e. cleverly arranged skylights and windows can be used to illuminate working areas with daylight in a cost-efficient and environment-neutral way. The use of energy-saving lamps provides an attractive return on investment in two areas: lower energy consumption and, due to the longer lifetime of these bulbs, longer maintenance cycles. Further optimization can be achieved, either by using mo-tion sensors to ensure that the illumination in less-frequented areas is only switched on when needed or by controlling the whole illumination through a bus system (e.g. KNX/EIB) to flexibly adapt the illumination pattern to potentially changing needs.

Green Alternative Forms of Energy

Warehouses and distribution centers are not only suited to use alternative energy, but they also provide good opportunities to use and produce renewable energy. Typical forms of use of alternative energies are wood-chip heating and block-heating power plants. Wood-chip heating is ecologically attractive because of its CO_2 neutral combustion process and the low emissions as well as the low environmental risks related to its preparation and transport when compared to conventional fossil fuels. The block-heating power plants attractiveness is linked to very high energy efficiency. The combined production of heat and electric power results in efficiencies of up to 90%. The higher initial investment for the use of both technologies is subsidized by government plans in most industrialized countries. In addition to these subsidies, there is a return on investment through lower operating costs.

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Energy piles are another source of alternative energy combining two functions in one. On the one hand, they serve as piles stabilizing the building's foundation in case of difficult sub-soil conditions. On the other, they serve as geothermal probes providing access to thermal storage capacity of the ground underneath the building. Due to its particular functional principle, these energy piles serve for the heating and the cooling of warehouse premises. During summer time, excess heat is extracted from the warehouse and stored in the ground. During winter time, the previously stored heat is then re-extracted from the ground and used for the heating.

The abundantly available roof space on top of warehouses is perfectly suited for photovoltaic panels, i.e. the buildings are high enough to prevent shadowing from trees and other objects. The electricity produced can either be used in-house or it can be supplied to the public power grid. Solar panels are still a relatively expensive investment. However, government subsidies and the decreasing prices for the technology are turning them into a frequently installed option. The solar panels attractiveness is enhanced by the fact that the energy production is not linked to any CO_2 emissions at all.

Warehousing and Corporate Social Responsibility

Other aspects of corporate social responsibility are often overlapping with the conventional 'green' initiatives in civil engineering. Extending existing operations is often a challenge for companies who have organically grown inside or close to residential areas. Building into the landscape, hiding parts of the building, and choosing colors to blend with the environment are possible approaches to minimize the impact on the environment of the new building. The acceptance within the population can further be increased by optimizing through-traffic, e.g. by aligning docking operations accordingly and rerouting access roads to minimize noise and other disturbing effects.

Brownfield construction is a sustainable alternative for the construction of new warehouses. Cleaning up and reusing abandoned industrial sites to set up a new warehouse has a positive impact on the overall ecological footprint of the building when compared to construction on pristine greenfields.

Wooden racking is an environment-friendly and financially attractive alternative to be used in high-bay warehouses. The wooden racking is precise and as stable as steel racking. Due to its higher degree of pre-fabrication, it can also be installed in a shorter time period. Using natural building materials inside the warehouse can also have a considerable impact on the employees' well-being and health. Companies like dm-drogerie markt[3] go even further: Having CSR high up on their agenda, they implement color concepts at distribution centers to create diversity, providing a high-quality work environment for staff in view of the automated and rather monotonous work processes.

Green Mechatronics and Automation

As for civil engineering, the key factor for the efficiency of the automated material handling equipment is design and dimension-ing. The components have to be dimensioned for the peak material flows within the warehouse or distribution center. Unnecessarily high peak performances can be avoided by better allocating and spreading system loads. Optimum energy efficiency is achieved when peak and average flows are as close as possible.

The energy efficiency of material handling equipment can be increased in three ways: mechanical, electrical and control optimizations.

Key elements of a mechanical optimization are reducing friction with high-quality bearings and gearboxes as well as reducing the weight of mobile parts with requirement-specific designs. Both these aspects not only impact the energy consumption but also the duration of the maintenance intervals and the lifetime of the components, which adds another 'green' aspect.

Electrical optimizations mainly consist of using efficient electrical motors. Electrical drives account for about 50% of the electric energy consumed inside a warehouse. Control optimizations in-clude speed adaptation depending on the system load as well as specific stand-by modes for unused system parts. Individual system parts of typical material handling equipment are in energy-neutral stand-by during 30 to 50% of the working time.

[3] Hier bin ich Mensch, hier pick ich gern. Logistik Heute, December, 2004.

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Energy recuperation is an attractive option for stacker cranes. Energy recuperation is particularly efficient for vertical movements where relative energy savings of up to 80% are possible. Horizontal movements have larger mechanical and electrical losses and recuperation is not as efficient. Recuperating vertical and horizontal kinetic energy reduces the overall energy consumption of stacker cranes by 30 to 50%. Retrofitting existing installations is an ecologically and economically attractive opportunity. Paybacks of less than a year can be achieved.

Green Material Flow Processes

Finally, material flow processes in warehouses and distribution centers offer further considerable potential for companies to reduce their impact on the environment, their energy consumption and their supply chain cost. Optimized processes not only impact the internal warehouse processes, but also the external transport processes.

In-house processes are optimized by keeping conveyor passages as short as possible, using gravitational force to move pallets and other containers effortlessly on roller conveyors, and avoiding circular flows. Dynamic slotting based on ERP information minimizes crane movements which not only saves energy and reduces the mechanical wear on the mobile components, but also speeds up the throughput of the system. Typical energy-optimizing slotting rules are: fast movers in the front, slow movers in the back, heavy goods on the lower levels, and light goods on the top levels of the racking.

Automation also creates other opportunities for environment-friendlier processes. Automated picking allows virtually paperless operations and specially designed picking systems allow semi-automated disposal of consumables and help ensure appropriate recycling of reusable materials, such as cardboard and shrinkwrap. Automated processes also have a big impact on order accuracy and product damage during the picking phase. Customer satisfaction is typically increased, while CO_2 emissions and supply chain costs due to unavailing transports and wastage are reduced.

Appropriate processes within the warehouse can also have an impact on the efficiency of the transports. According to a recent study in Germany, 20% of truck trips are empty.[4] Adding in inefficient space utilization of the other trips, most likely more than 30% of the available capacity of trucks driving on our roads is not used. Computer-aided load building optimizes the stakking of suitable pallets to optimally utilize the full height of the trucks' cargo compartment. An FMCG multinational in England was able to cut its transport emissions and costs by 20% after adopting this approach. Delivery routes can be further optimized by creat-ing mixed product pallets. In this case, clever stacking of the different types of cases and boxes with varying sizes again optimizes the cube utilization of the trucks' cargo area.

Outlook

Governments around the world are increasing their endeavors to comply with the Kyoto protocol, and regulations on the reduction of CO_2 and on carbon trading are being introduced. At the same time, the increasing number of indicators for climate change, such as flooding, droughts and hurricanes risk being overshadowed by the current financial crisis in the private sector. In the context of economic stimulus plans, governments of industrialized countries are therefore increasingly funding environment-friendly technologies and energy sources.

Although the costs for energy such as oil, gas and electricity are likely to stay constant in the short term, substantial increases in price are certain for the future. This increased cost in combination with the constantly growing environmental awareness will help further accelerate the transition to 'greener' and more sustainable warehousing processes in the future.

[4] Joint report on domestic traffic in German heavy goods vehicles in 2007 published by the Federal Motor Transport Authority and the Federal Office for Goods Transport, 2008.

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SUMMARY

Environmental aspects have gained in importance in the business world as companies have discovered that 'greening' their business often has a positive impact on their economic results – in particu-lar through reduced energy consumption, rebates for compliance with government regulations and subsidies for the use of alternative forms of energy.

A company's logistics processes offer sizable opportunities to reduce the impact of business on the environment. The energy consump-tion and the cost of a supply chain can basically be attributed to the areas of transport and warehousing. The relevant factors for optimizing a company's overall environmental impact and logistics cost are closely interlinked and include:

> Green network design optimizes transports in regard to CO_2 emissions and the related cost – the analysis of a typical supply chain revealed that optimizing the network for cost could bring about 7% in cost savings coupled with a 25% reduction of CO_2 emissions.

> Green civil engineering offers a wide range of possible initiatives in the fields of energy efficiency (e.g. insulation, climatization and lighting), use of alternative forms of energy (e.g. block-heating-power plants, solar panels and energy piles) and other green initiatives in the wider sense (e.g. brownfield construction or wooden racking).

> Green mechatronics and automation crucially depend on an appropriate dimensioning; optimum cost and impact on the environment are achieved by avoiding over-dimensioning. Using energy recuperation for the installed systems allows further 'greening' of mechatronics and automation.

> Green in-house material flow processes impact cost and emissions of warehousing as well as distribution. Due to computer-aided load building, an FMCG multinational in England was able to cut CO_2 emissions and transport costs by 20%.

ABOUT SWISSLOG

Swisslog is a global supplier of integrated logistics solutions with a comprehensive portfolio of services. These services range from building complex warehouses and distribution centers, through intra-company logistics solutions for hospitals, to software and consulting services, including energy and environmental optimizations.

Swisslog's logistics solutions optimize customers' production and distribution processes in order to increase flexibility, responsiveness and quality of service while minimizing environmental impact and logistics costs. Customers in more than 50 countries around the world rely on our decades of experience in planning and implementing integrated logistics solutions.

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