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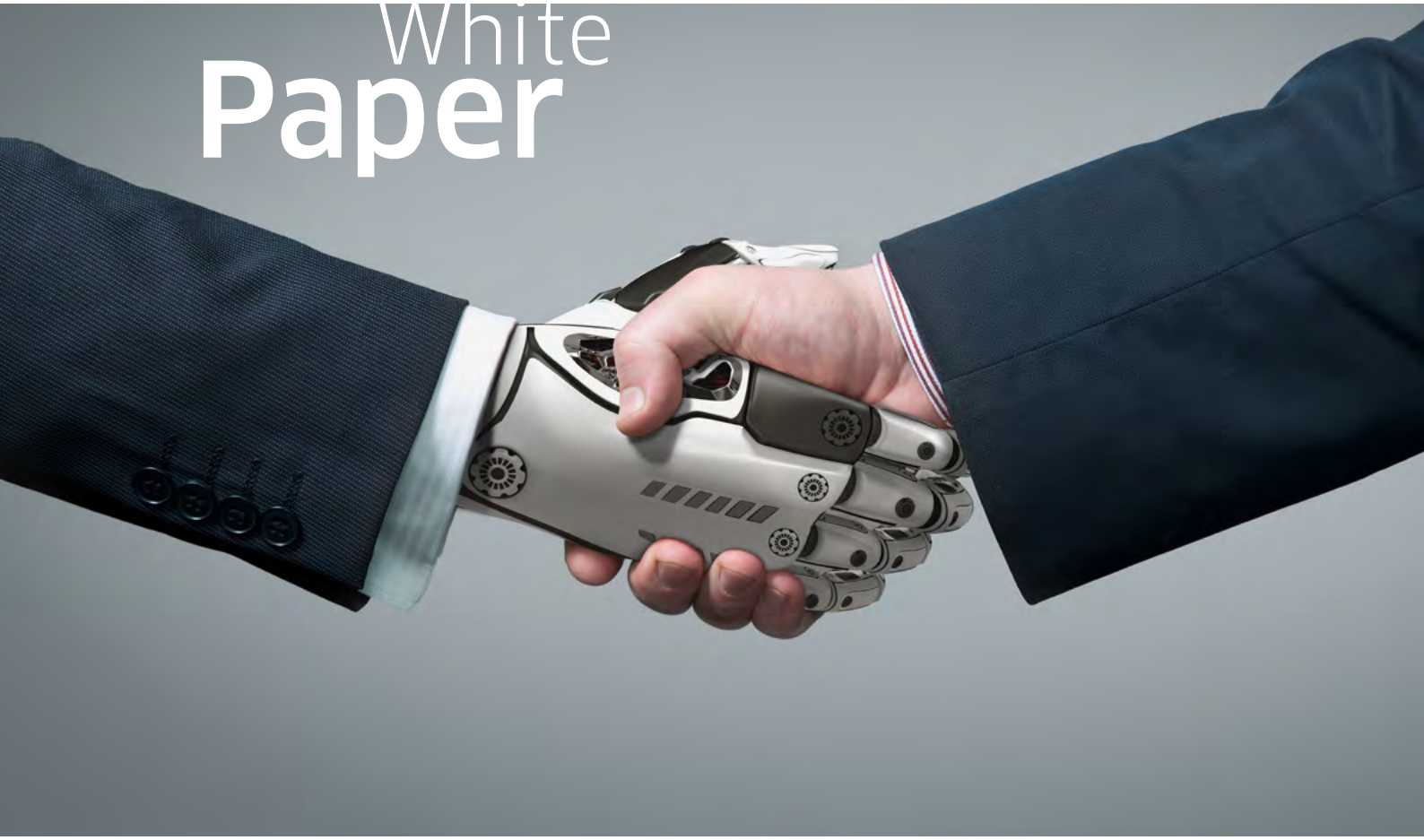
White
Paper



Robots in picking logistics

A statement from the perspective of Dr. Frank Hohenstein and Ole Wagner, Miebach Consulting

Miebach Consulting White Paper, March 2017

“More and more
often customers raise
questions about the use
of flexible robots.”

Introduction

This whitepaper gives an insight into current limitations and possibilities of robots in logistics, as well as answers and additional suggestions on the current state of robot-based automation, the feasibility of applications and their opportunities.

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Mr. Picrob sits on his order picker, picks up an empty pallet and begins his picking process. Along the pallets provided on the lower access points, past pallet rack integrated carton flow and shelf rack locations, he heads to his first picking target. He takes the requested number of cartons, places them on a pallet and moves to the next location. Once arrived, he has to open a carton, picks the required units and puts them away. He continues. Seemingly effortless he picks both the last carton from the location's backside at the ground and from the highest location at a height of 2.5 m. At the next location, he releases a stuckcontainer in a flow storage lane and removes two units. He confirms the zero-crossing, takes an empty container and puts it into a flow rack lane reserved for empty containers. Today, as always, Mr. Picrob does not have a break and works two shifts.

It's a fairy tale or future vision? It's desire or utopia? In any case there is a demand for a picking robot (Mr. Picrob) to do these tasks independently. If you follow the state of research, published studies and overall development in field of automation in last 15 years, you can easily imagine that this is about to become reality.

Every year Miebach Consulting develops more than 200 concepts on intralogistics solutions for customers in a very broad range of industries. Moreover, Miebach Consulting implements a further 100 projects until the final approval of frequently highly complex logistics systems. More and more often customers ask for flexible robot systems due to a complicated age-demography of their employees, a lack in available workforce at local markets and general requirements on ergonomic working conditions. This goes way beyond currently established automation solutions such as depalletizing and palletizing robots, fully automatic picking and packing or flexible driverless transport systems for goods-to-man-systems. Based on Miebachs experience, specific practical requirements and concepts for flexible robots will be discussed below. At the same time it will be explained how robotics are going to develop in logistics and what difficulties need to be overcome.

Expectations on cost-saving effects by robotics in shipping operations are particularly high in the future. Experts foresee a general cost saving potential of 20 up to 40 percent.[1]

1 Source: Study „Of Robots and Men – in logistics: Towards a confident vision of logistics in 2025". Roland Berger. 2016.

Abilities and Limitations of Robotics in picking Logistics

Whenever goods have to be separated from a defined static state (for example a pallet) at a certain place or have to be transferred to a defined consolidated condition (for example a pallet or roll container) via a feeding process, the task can nowadays be solved in manifold different ways of automation. However, today certain conditions are presumed. For example, for articles that are outside a defined size and/or weight range, or those which are too insecure in handling or transport, or differ too much in their characteristics, current automation won't work.

The application of robots as a special means of automation is especially interesting in logistics if employees are to be released from difficult, stressful and monotonous tasks. Robots can also be of interest if cost advantages also allow 24/7 – operations to offer an improved service level to customers.

In industry welding robots have been successful because they can carry out repetitive tasks at high speed even in difficult-to-reach positions. But they are (still) static, they cope only with little variability on defined tasks and usually no unexpected variation occurs.

In logistics in general robot tasks are more complex, which resulted in even higher restrictions on robot applications in warehouses in the past. However, there are many indicators for a higher flexibility of future robotics – Acernoglu and Autor[2] point out likewise: in increasingly complex areas, manual activities are carried out by very flexible, cognitively strong robots in connection with novel sensor systems, methods of artificial intelligence and correspondingly required computer performance.

This development can be illustrated in a two-dimensional matrix (see Figure 1): repetition frequency and cognition (i.e. analysis, adaptive and decision-making).

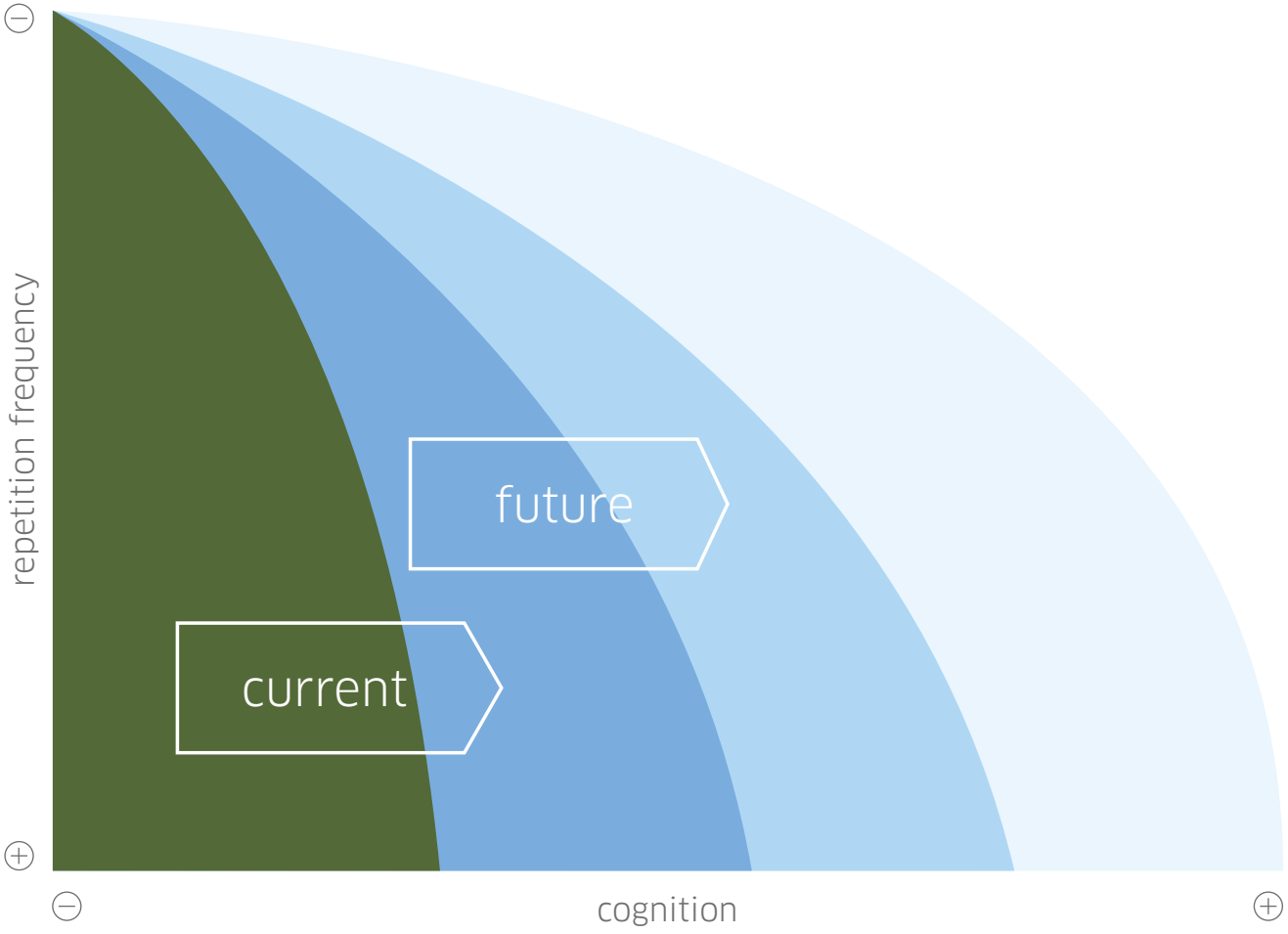
24/7

The use of robots in logistics is particularly interesting when, among other things, a 24/7-operation can be realized with cost advantages.

2 D. Acemoglu, D. H. Autor: Skills, Tasks and Technologies – Implications for Employment and Earnings in Handbook of Labor Economics Volume 4, Orley Ashenfelter and David E. Card (eds.), Amsterdam: Elsevier, 2011

Development of robot-based automation in picking

Fig. 1



- Supporting functions of picking (goods-to-man, sorting, packing)
- Picking of similar articles
- Picking of diverse articles
- Activities that can not be covered by robots

Commissioning activities

Commissioning shows a high degree of repetition and is a central function in logistics; moreover, it also requires multiple cognitive abilities on the part of the worker. Everything starts with the question of how containers and in particular articles can be precisely grasped, as their position cannot always be precisely defined in advance and their dimensions are often very diverse. Moreover, commissioning does not only consists of item picking itself, but it comes along with numerous other activities (see figure 2).

Successful and increasingly common automated depalletizing-, storage-, picking- and packaging solutions generally cover activities marked with a green dot. Remaining activities are therefore a challenge for future robotic development. It is, however, to be assumed that the variance of these activities in some applications still exceeds feasible cognition capabilities of robotics.

The state of development and general feasibility of current robotics is also well illustrated by the DHL study “Robotics in Logistics” published in March 2016. In particular single-piece picking robots (stationary and mobile piece picking robots; see figure on page 7) show that currently achieved applications are largely equivalent to fully automated stationary units.

Nevertheless limitations, e.g. due to various dimensions of articles, will remain sometimes. Although small units can be picked, at the same time the maximum dimensions of the colli are limited (or vice versa).

Activities of a picker when picking

Fig. 2

* Collo = pack, beverage pack, carton, large single piece

Stationary and mobile single piece picking robots in comparison

(Source: Knapp, IAM robotics)

When is an application of robots profitable?

Up to now picking robotics pay off in case they show a high amount of daily operation hours (>1 shift), daily order peaks are moderate, the remaining share of non-automated articles is small and in general labour and space costs are so high that they will compensate investment costs for sure.

Robots are presently mainly used in retail and FMCG business – in FMCG mostly in e-commerce. These industries are eager to increase robot applications, because in general throughput level and / or scale effects guarantee efficient robot operations and more often labour costs are high in comparison to other industries. Companies within these business segments are likely to take part in studies and research projects on robotics or even directly invest in companies working on promising robotic concepts. As currently purchase prices slowly decrease, some robot applications are already very interesting. Applications on particular article assortments, e.g. many very heavy parts, are more likely than those for standard articles showing diverse requirements as already described in this report.

"For the foreseeable future, the path to flexible robots which can execute human- like tasks can only operate throughout process changes and division of labour."

Opportunities for picking robots

For the foreseeable future, the path to flexible robots that are able to execute humanlike tasks can only be implemented by changing processes and current concepts on division of labour. For example many activities can also be carried out within the replenishment process or in a second picking either in a robot-robot- or in a robot-human collaboration.

At the same time there are other opportunities for robotics. The range of gripping operations, which today in a manual picking system without lifting or climbing aid is limited to a height from 0.2 m up to approx. 1.8 m, could be extended without substantial deductions on performance by robots. Likewise there are opportunities for an increased use of robots in the field of operational logistics in case of a lack in availability of skilled workforce. With 2.85 million employees in logistics, according to an analysis by the Fraunhofer Instiut IIS, the number of employees rose by 17 % during the last 10 years. This development has been significantly driven by e-commerce and results often in a scarcity of skilled workforce[3].

Today many companies – not just when launching/using automation systems – find that their master data quality has potential for improvement. At present not only dimensions and weights, but also shape, balance points, solid state, sensitivity, surface characteristics, material type and further characteristics are required for the discussed automated applications. They have to be recorded for each article.

This recording usually needs to be repeated for the same articles for each batch and / or delivery as characteristics can change little over time. A higher degree of cognition in automated systems would decrease the level of accuracy on master data. In a nutshell, the challenge for future development is to come up with more efficient systems for those variations.

17 %

growth in workforce in the last 10 years due to growing e-commerce business. Finally there is an increased chance for robotics.

3 Roboter – Der Angstgegner; in Wirtschaftswoche, 09.09.2016, Handelsblatt Verlag

Summary and Outlook

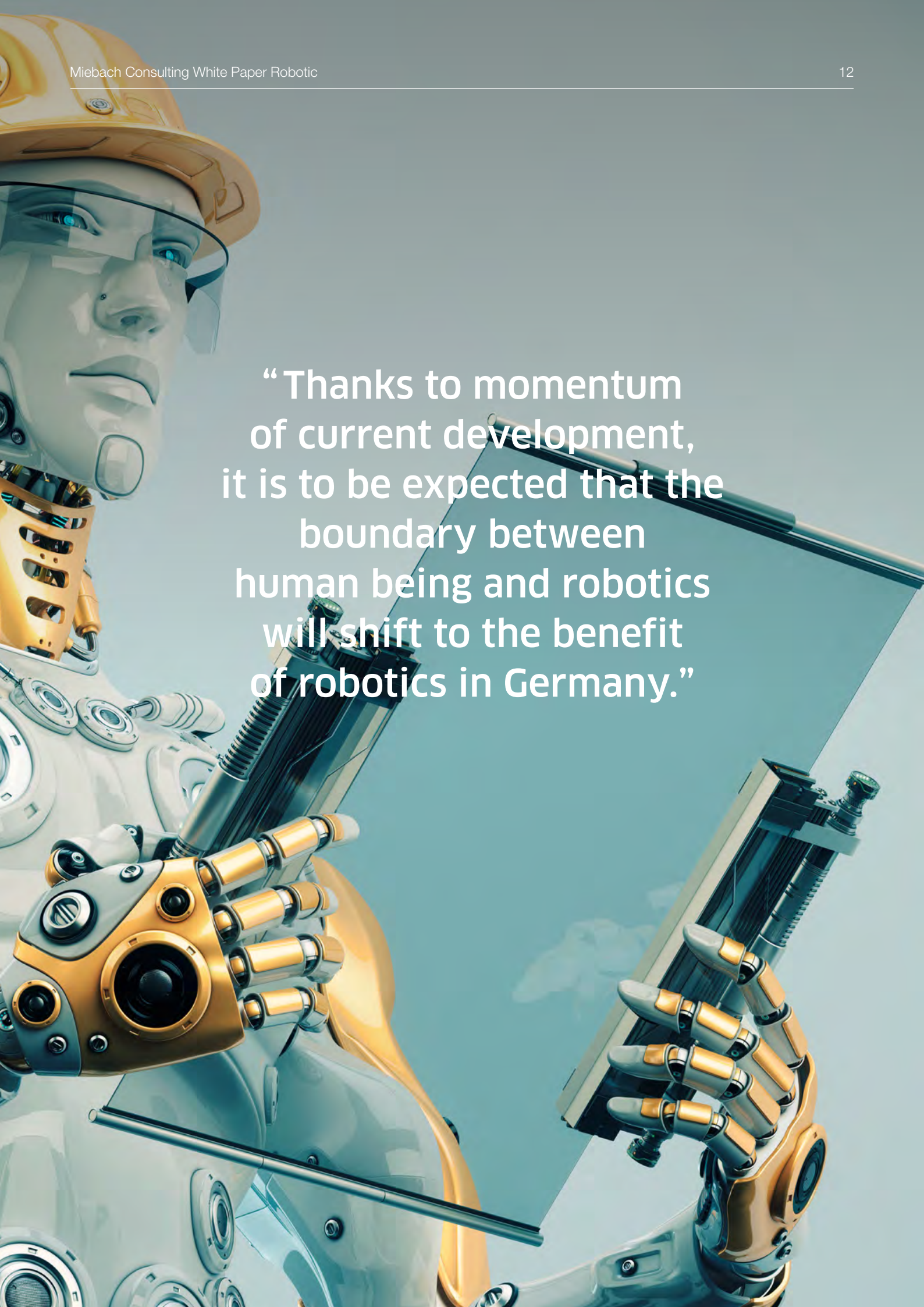
Robotic applications are not driven solely on the grounds of wage and operating cost in logistics today. Costs of technology have been reduced and therefore an approximation of labour and operating costs while considering general productivity is ongoing. But there are even other drivers for their application. In addition to aspects of ergonomics, workforce availability and space efficiency a potential driver are expectations on future competitive advantages. It's a typical pattern of early adopters to collect profound experience in operational processes at an early stage already – a common means is to establish a strong relationship with robotic suppliers as their technology partner.

Especially e-commerce applications are among the key drivers for robotic applications; since they are in general favorable towards robotics in comparison to other sales channels (e.g. wholesale). E-commerce is particularly space-consuming and workforce-intense[4] while showing only small scale effects based on each orderline.

Nowadays existing logistics processes in picking have to be rethought to a large extent in case a significant share of activities shall be automated by robotics. Recent achievements in cognition of robots continue to experience limitations in operational use, which can be absorbed by human and robot collaboration today. In such cases human efficiency is increased by focusing on human activities and their strengths - analysis, interpretation and flexible response.

Thanks to the momentum of current development it is to be expected that the boundary between human being and robotics will be further shifted significantly in favour of robotics. But in general in the nearer future very complex and other specific fields of logistics applications will remain a domain of human beings. The challenge is to identify these limitations in the rapid development of technology and to be able to reliably assess the state of development in terms of its practical feasibility.

4 The Global E-Commerce Revolution; Studie, Prologis GmbH, 09.2016



"Thanks to momentum of current development, it is to be expected that the boundary between human being and robotics will shift to the benefit of robotics in Germany."

Miebach Consulting:
The Supply Chain Engineers

Miebach Group

The Miebach Group was founded in 1973 by Dr.-Ing. Joachim Miebach in Frankfurt to offer international supply chain consulting and engineering services to large and medium-sized companies in logistics and production.

The experience gained in over forty years and countless projects have led to the methodical approach of “Supply Chain Engineering”, which creates network structures, processes and intralogistics along the supply chain. Strategy and technology are equally and holistically considered, since only the integration of both elements can represent an optimal result.

As a consulting company we offer our services in 24 offices around the world. With a total of 350 employees Miebach is one of the leading international consultancies for logistics and supply chain design. Our presence in the key regions of Europe, Asia, South and North America can support our global customers with local background knowledge.

Expert know – how

For over four decades we have been developing innovative logistics solutions with the competences required for efficient and functional supply chains.

The strength of Miebach Consulting is the integration of these core competencies in order to offer comprehensive solutions that exceed the expectations of the customer. We design strategies, develop economically viable concepts and specify IT solutions as well as technical installations down to the last detail. We assume responsibility and implement the developed solutions. We also support our customers from commissioning to “fine-tuning” in live operation. We believe that the extra service helps us to realize the visions of our customers as good as possible. Our perennial R&D initiatives often lead to directional innovations.

Sector specialization

Miebach consulting offers consulting services across a wide range of industries. We consider the industry specialization as a must in order to precisely understand the specific requirements and processes of our customers. We also consider the exchange of expertise between the different industries as the ideal way to develop innovative and best-in-class solutions for our customers.

2017

- 24 offices worldwide
- 350 employees

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