MachineDesign

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# How Technology Advancements are **Transforming the Mobility Market**

Adoption of highly efficient, integrated gearmotor technology, along with battery and other design innovations, continues to redefine the performance and expand the reach of mobile power platforms into new medical, industrial, and all-terrain applications.

The market for mobile power platforms continues to expand, with a wide range of devices and applications ranging from automated guided vehicles and mobile robotics to human aid and transport systems. The modern mobility expansion owes much of its success to the development of devices to aid humans in need, and with significant advances in technology these devices have expanded and been adapted for many different applications.

Developed in the 1950s, the first powered mobility chairs were heavy and cumbersome, and battery life was short. The wheels were commonly driven by belts or sometimes even bicycle-type chains and sprockets. With no direct drive and non-integrated motors and gearboxes, their overall performance was lacking. Cost was also an issue. Even up until the 1980s, powered chairs cost as much as cars.

Markets such as aviation and industrial automation introduced integrated gearmotor technology—which combines motors and gearboxes into one unit,

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thereby reducing weight and size—into the mobility market, it began to evolve rapidly.

With the ability to drive the back wheels of the chair directly, new, right-angled gearmotors like the ElectroCraft MP-Series eliminated the inefficiency and frequent maintenance plaguing belts and chains. At the same time, advances in drive technology

improved control and responsiveness for the user, while batteries became lighter and more efficient.

The modern electric mobility era was ushered in, defined by lighter chair weight, better torque, and a 60% improvement in battery life.

Now, providers of medical mobility solutions are developing custom applications for bariatric solutions, rehab chairs, and high-performance sport chairs, such as those used by the Wheelchair Football Association (WFA). Other custom applications include industrial mobile devices like autonomous vehicles, all-terrain vehicles, and surgical assist medical robots that have more stringent requirements, including quieter operation, extended battery life, and the ability to operate in harsh environments.

## A Better Motor Design

Up until recently, modern mobility designs for medical, commercial, and industrial markets almost exclusively used permanent magnet DC motors (PMDCs). These are characterized by their high starting torque, fast response time, and compact design.

PMDCs cover a wide performance spectrum. In mobility applications, peak torques range from 57.7 to 134.2 N-m, depending on motor configuration and

gearing. Nominal no-load motor speed at 24V can be as high as 252 rpm, although peak torque and power occur at lower speeds between 80 and 130 rpm.

BLDC motors, which have several advantages over PMDC motors in mobile power applications, are rising in popularity. BLDC motors are extremely quiet and efficient, and require little maintenance because they have no brushes (which wear). The absence of brushes also lowers inertia, making BLDCs very responsive with high efficiency output, a long battery life, and quieter operation.

By integrating the motor with the gearbox, more motor options can be utilized for more application flexibility.

## Better Gearbox Design

Gearboxes are available in many different configurations. Some gearmotors use a single-stage gearbox with plastic gears. Fewer stages means lower power losses, allowing for more power to be transmitted from the motor to the drive wheels. Plastic gears are also quieter and lighter, giving mobile solutions powered by these gearmotors an edge for standard application requirements.

More demanding mobility designs use two-stage gearboxes that feature custom metal gears for robust operation for use in extreme operating environments. Gearmotors like these are used in sports chairs and all-terrain machines.

Two-stage PMDC gearmotors are also used in industrial mobile devices that require toughness and better low-range power. BLDC motors may be integrated with a wide range of planetary and spur gearboxes to meet the specific needs of a wide range of applications.

## Extended Capabilities

The details of motor and gearbox construction and integration are important because they determine the platform's capabilities. The original medical mobility solutions had a weight-carrying capacity of around 300 lb. for continuous operation, whereas modern heavy-duty designs can accommodate more than 600 lb.—ideal for bariatric applications or patient handling systems.

A wide range of adaptive choices in integrated motor and gearbox designs affords a wider array of platform designs. For example, an ElectroCraft MPS32, which features a 2-pole PMDC motor integrated with a single-stage, plastic worm gearbox for quiet, reliable operation, is an excellent motor for general purpose wheelchairs. A more aggressive application, such as a sport wheelchair, may require a four pole MP36 with a 2-stage gearbox and a wide range of available gear ratios, allowing for higher speed and quicker response or greater starting torque.

Industrial applications call for an increased weight-carrying capacity. An autonomous mobile robot for example, might be moving several hundred pounds of raw materials from a warehouse to a work station. Similarly, the mobile power platforms in surgical robots must support the weight of the mechanism to permit delicate and precise operations.

The range and capabilities of modern mobility applications continues to expand along with the evolution and advancement of motor and gearbox integration.

## Expanded Environmental Capabilities

The original medical mobility solutions were designed for the environments commonly encountered in everyday life. They are designed to operate in a limited range of ambient temperatures, whereas

modern mobility solutions may accommodate a temperature range of between −20°F to 120°F. They are also designed to tolerate incidental water ingress, dust, and debris intrusion.

Standard solutions are designed to operate on terrains described in the Americans with Disabilities Act (ADA), which include ramp angles and smooth terrain. In contrast, today's wide range of mobility solutions allow for greater terrain variations, including the ability to mount curbs when ramps are not available.

The wide adaptive range of motor and gearbox solutions also allows platform designers to work with manufacturers to develop custom systems to meet a range of application requirements. For example, they can choose motor and gearbox solutions that tolerate cryogenic and elevated temperatures; select BLDCs for spark-free operation in areas with explosion hazards; or specify water and dust ingress protection up to IP65 with sealed field shafts.

## Conclusion

When the era of mobility began, non-integrated motor and gear solutions were the norm, but they were cumbersome, with limited application potential and a short battery life. Modern solutions, based on a wide range of integrated motor/gearbox combinations, provide mobility solutions with powerfully responsive, efficient, and reliable operation. The integrated mobility platform continues to evolve with custom mobility motor manufacturers developing the next generation of mobile power platforms that can tackle the mobility and industrial motion applications of today and tomorrow.