

# Mariasteen

## Case summary

Part of the Gidts group, Mariasteen is a Belgian social enterprise that specialises in mechanical and electronic assembly work. Of the 860 employees, the majority (about 80%) have some form of occupational disability. With a view to delivering a higher volume of orders and more complex assembly work, in 2016 the company deployed an AR-based system (light guidance system, LGS) to guide employees through the assembly process step by step, taking into consideration their individual capabilities. The use of the technology has resulted in employees learning new skills, feeling more empowered and satisfied with their job. To capitalise on the experience with LGS in sheltered workplace environments, a spin off was created in 2019 in a public-private partnership with a network of job coaches and other sheltered workshops in the region, to repeat and scale-up the positive impact of LGS into other sheltered production environments.

## About

**Case study name:** Digitisation in the workplace ([/case-study-names/digitisation-in-the-workplace](#))

## Establishment profile

Mariasteen is a non-profit organisation, with 60% of its income arising from business turnover and 40% from social welfare schemes. It is part of the privately held Gidts Group which employs 1,647 individuals and oversees 26 service locations for (partially) disabled persons in Flanders (Belgium). Gidts Group is focused on providing care, education and sheltered workplaces for employees with physical and/or cognitive disabilities. Established in 1963, Mariasteen is one of the production divisions, focused on metalwork and woodwork assembly, employing 856 people (of whom 38% are female and 62% male) across eight departments. About 80% of the workforce in Mariasteen have some partial disability. These employees are referred to as target employees in Mariasteen, as all processes are organised around their needs and capabilities, and 21% are supporting employees who assist target employees in performing their daily tasks. Although all age groups are represented at Mariasteen, a large share (299 employees) is over 50.

The majority of the workforce works part time and on a fixed contract (78.6%). To successfully place employees, Mariasteen takes a tailored approach resulting in 150 different rosters. The capabilities of the target employees differ; some are physically disabled, some mentally, and some both. Additionally, persons that have been unemployed for a longer period can be placed in this establishment or in other workplaces via Mariasteen's network. Since 2017 Mariasteen has increasingly placed traumatised refugees who often don't speak Flemish.

In terms of activities, although Mariasteen is primarily focused on offering sheltered employment, it functions as a Business-to-Business supply unit for metal and assembly work for large corporations such as railway transport manufacturer Alstom, ICT supplier Delaware and medical devices and equipment producer Heyer Medical. Originally, the assembly projects were low tech, but to cope with market demand for increasingly medium and high-tech products, and in part due to the introduction of the AR technology, the assembly projects have become more complex. This is due to a higher number of electronic components and electronic fittings, for instance in train components such as carriage fittings or hospital room fittings.

At Mariasteen, two trade unions (ACV and ABVV) represent approximately 19% of personnel. The core of their negotiations has been oriented towards increasing flexibility (for example through rostering and supporting more employees to reduce their working time, increasing the number of part time workers), reduced work hours for elderly, safety by reducing potential hazards (for example related to heating metals, which is needed to bend and assemble components), financial rewards, environmental sustainability (for example waste reduction) and facilitated commuting.

In addition to the two trade unions, there is a specific committee for prevention and protection (with six employees and five employer representatives) which focuses on safety measures to reduce injuries within the sheltered workplaces of Mariasteen. Via these structures employees are directly involved in the decision-making process in various stages.

[/studies%2Fdigitisation-in-the-workplace%2Fmariasteen](#)

## Technologies adopted and embeddedness in the workplace

(mailto:?)

The AR-based system (light guidance system, LGS) combines computing, projection and sensor technologies. Visual instructions are projected using LGS mounted on a workstation and programmed to guide employees through any assembly process, in line with client requirements. Sensors are attached to the LGS and workstations to monitor the quality of the assembly work by measuring the shape and weight of products. The programming is done by an R&D team to ensure the guidance is tailored to the employee's capabilities. Workstations fitted with LGS show dynamic visual instructions on screen, supported by audio and light signals, indicating what should be picked and placed in which order. Quality assurance is integrated in the process steps, which means quality can be tracked and guaranteed (ISO certifications). If quality parameters are not met, the assembly worker will not be able to proceed to the next assembly process step until the issue at hand is solved. With each projected instruction target, employees can ask for more detailed descriptions by hovering over a projected '?' icon. Once the process step has been completed and checked for quality by the attached sensors, the target employee can hover their hand over the '=>' icon to move to the next step.

The LGS also keeps track of the time taken to complete each step, the number of errors made and the adjustments required before proceeding to the next step. This information is used to assess the complexity of the tasks that each employee can handle and to adjust the workload to best fit employees' own capabilities. The components of this AR based guidance system can be tailored to any process and any product. The system was necessary to support target employees in learning to perform more complex tasks, for instance tasks in which following the exact sequence of precise steps is key.

To structure and standardise work processes, Mariasteen uses 16 criteria for complexity, of which ten are cognitive criteria and six are physical. The physical complexities were supported through the introduction of collaborative robots in 2012, the cognitive complexities were eased with the introduction of the LGS in 2016.

- Cognitive complexity
  - Multiple routes to solution: degree of problem-solving skills
  - Many components: extent to which sequence can be memorised
  - Long throughput times: extent to which the user is able to adapt and cope
  - Hidden operations: requires memory and concentration
  - Necessity for specialisation: applicable to more complex processes
  - Sequence important: this requires deduction and memory
  - Subjective inspection: requires critical thinking
  - Finetuning: requires critical thinking and concentration
  - Need for detailed work instructions: due to complexity

- Lack of feedback: being able to control and proceed independently
- Physical complexity
  - Difficult positioning components: for example due to material flexibility or required accuracy
  - Difficult access: often applicable when fitting electric components
  - Bad ergonomics: unnatural position required in assembly process step
  - Fine motor skills: manual dexterity is required
  - Unstable raw materials: difficulty in handling components due to form or composition
  - Soft and flexible materials: may require manual dexterity in both hands when handling them as it can be more difficult to precisely position these materials

In terms of Technology Readiness Levels (TRL), LGS within Mariasteen progressed from the university-based demonstrator (TRL 6), to being acquired in-house and the technology being adapted from a commercial product for implementation (TRL 7-9). It is now at the stage of being further refined, adding new features and the experience being sold to other organisations (TRL 9).

## Drivers to technology adoption

The main driver behind the adoption of the AR technology in Mariasteen was the need to provide adequate support to employees for working on more complex assembly projects, which the company had to take on to remain competitive in the market. In 2010-2011, Mariasteen saw orders decline substantially as industrial clients increasingly outsourced simple repetitive assembly work to China and Eastern Europe. In the region, Mariasteen observed that work opportunities for low skilled labour declined, whilst demand for more complex mechanical and electronic production work increased. Given its primary function as a sheltered workshop, and to continue without going bankrupt, Mariasteen and its staff had to learn to deliver on complex tasks related to mechanical and electronic assembly. In order to cope with increasingly complex assembly projects with the existing workforce more support was needed to guide target employees through assembly process steps.

## Initial expectations and strategy to technology adoption

Mariasteen's expectation was that the technology would help target employees handle more complex assembly steps. The approach taken to the introduction of the technology was aligned to the values and vision of Mariasteen, which is to offer sustainable, safe and rewarding work to persons with disabilities. To make sure the technology would be sustainable and safe, no specific implementation deadline was set.

In 2010, the R&D team in Mariasteen started scouting for implemented solutions in companies facing similar challenges. In 2014, through a study in collaboration with the Catholic University (KU) of Leuven, the light guidance principle was tested at eight workstations in the establishment. The American Light Guidance System company was then asked to organise a demonstration of their product. Once it was proven that the LGS was suitable, time was reserved to organise the introduction properly. The goal was to make sure LGS was introduced sensitively, thoroughly and taking into consideration the specific needs of employees.

In 2016, Mariasteen purchased the first eight Light Guidance Systems. The supplier delivered the infrastructure (without regular maintenance) and a one-off training programme for the R&D team to learn how to programme the visual process instructions in the system. Multiple aspects however still needed to be tailored. The LGS had to be adapted to the workstations, for instance by creating a higher structure to build the projectors to cover the complete workstation. The R&D team had also to learn how to programme different instructions, including different levels of complexity in each instruction and embed quality checks based on input from monitors throughout the instruction process. It was crucial to the success of this project that enough time for trial and error was allowed. While it took six months, this was not determined beforehand as the R&D team received freedom to continue until all issues were solved.

To organise the implementation, a working group was organised with the ergotherapists of the R&D team in the lead. The team worked closely for approximately six months in a lab setting to get acquainted with the system and conceptualise various audio, video, and text instructions. The lab, an integral part of the R&D unit, consisted of two workstations fitted with LGS. During this period various target employees were asked to participate in test settings, clarifying this was still work in progress. The leading quality criterion for the working group was that if the target employees could not understand parts of the instruction, this needed to be improved. In short, a human centred approach, tailored to the needs of these specific employees. Over the years, Mariasteen acquired more Light Guidance Systems.

## Impact of the technologies in the workplace

### Business model

The urgency to re-orient the business model arose once it was clear that large scale simple assembly project orders were decreasing. Within the sheltered workshops the majority of projects featured a short sequence of simple tasks repeated for a long period. For instance, bicycle assembly traditionally consisted of a small number of parts, but once bicycles became electric and customisable, these projects became too complex and costly to be executed within Mariasteen. B2B clients demanded greater complexity and increasingly electronic components, and with LGS, Mariasteen could deliver these complex projects with high quality results.

Prior to the introduction of LGS, guidance was on paper, supported by multiple supervisors (support employees) ranging from one supervisor for two target employees to one supervisor for 25 employees, based on the extent of the disabilities of the target employees. With LGS, in the long run it can be expected that increasingly less supervision will be needed as quality checks are embedded in the system. Contrary to expectations, the demand for support in complex processes has grown (and not reduced) since the introduction of LGS in 2016. This is apparent from the increase in working hours of support employees and the hiring of new staff for R&D and supervisory positions.

The introduction of the AR technology resulted in turnover growth, from 15 million euro in 2011 to almost 20 million euro in 2019. The turnover growth has stimulated recruitment (30 employees since 2015, of whom 21 are target employees). There is a low turnover in both the target employees and the support employees, resulting in many employees working at Mariasteen for more than 30 years. With a low employee turnover of ca. 2%, substantial resources are invested into in-house training and development, tailored to both target and support employees.

To implement the LGS, the R&D team has developed extensive knowledge regarding LGS hardware calibration and developing easy to follow visual instruction (software). To better capitalise on the value of this developed knowledge and to introduce LGS in more sheltered workplaces, Mariasteen founded the spin off 'Licht Werk' together with workplace architect Emino, a Belgian network of 175 job coaches for unemployed persons, active in 20 locations in Belgium.

### Work organisation

#### Internal organisation and decision-making

The impact on the internal organisation has been limited to aspects related to the production quality of more complex projects, whilst stimulating shorter production cycles. Since the merger of sales and R&D teams, no other changes have been implemented in the structure of the internal organisation. By merging the sales and R&D teams the decision-making process regarding the feasibility of potential new orders from clients has become much shorter. If it is concluded that these potential projects can be delivered, the team will proceed directly with translating the project into components that can be implemented via LGS. As experience with previous projects is monitored by the same team, it has become easier for them to make realistic and more specific estimates for potential projects. This has resulted in shorter decision-making processes and increased the profit margin per project.

### Task definition and content

Target employees still work in the same factory albeit at enhanced workstations with greater autonomy regarding the detecting and solving of issues related to production and assembly tasks. LGS has made it possible to guide two persons to perform complementary tasks, collaborating as a team with a joint product output. For R&D team members, the task has remained the same in terms of formulating work instructions but enriched as programming work instructions in LGS required new skills and more creativity. Given the many possibilities of guidance via LGS, more effort went into finding solutions to provide intuitive audio and/or visual guidance. This has made the job content more diverse. This has increased job satisfaction and, as mentioned often during the interviews, self-esteem.

For R&D team members, the task has remained the same as well in terms of formulating work instructions, but quite enriched as programming work instructions in LGS required new skills and more creativity. Given the many possibilities of guidance via LGS much more effort went into finding solutions to provide intuitive audio and/or visual guidance. This has made the job content more diverse which was appreciated by the team members.

A change within the organisation is expected in coming years as additional IT talent is necessary to automatically link data retrieved from the LGS to dashboards and resource planning in order to increase efficiency in terms of business management. In addition, the option to add biometric sensors to LGS is being explored to adapt guidance based on real-time measured stress levels.

#### Workflows, quality controls and standards

The R&D team still works on developing work instructions for every new assignment. However, due to LGS, more time is spent in detailed testing and programming the guidance at the beginning of the implementation process. When working with paper-based instruction, the finetuning and testing of the understanding of these instructions would occur later. The sensors attached to LGS make it possible to monitor and track quality in greater detail. This also requires extensive testing, for example, to allow measurement of the exact and correct position of parts, or to detect missing parts based on measured weight. Additionally, programming the most efficient sequence requires extensive testing before it can be used as a work instruction in LGS, up until guidance on the order in which to pick and mount which screws.

Quality checks were previously completed by supervisors, but via LGS the quality monitoring is more precise, as sensors detect quality issues during each process step. This has enabled the setting of high accuracy and traceability quality standards required for more complex projects.

#### Employee monitoring and control

Employee monitoring is one of the key elements of a sheltered workspace. Although target employees are monitored via LGS, they do not perceive it as such. In their words, with LGS they can perform tasks autonomously, as much less personal supervision is needed. The monitoring via LGS keeps track of which employee is performing the task, in order to adapt guidance to their individual needs and learning curve. Only the R&D team can see the coded progress of each individual per task, in order to improve the planning and required adjusted instructions for future projects. Supervisors oversee the workstations on screen but do not track individual performance. This is in line with the structure prior to the introduction of LGS, therefore no privacy concerns were raised during implementation.

As guidance is task oriented, target employees gain more autonomy with respect to trouble shooting. Prior to LGS, if quality standards were not met, the supervisor would normally take over to analyse the issue and suggest solutions. Via LGS, if a quality standard is not met it guides the target employee to potential solutions: for example, if sensors measure the weight as too low, the lights will highlight the positions of the screws in order to check if all screws are in place. If the shape does not correspond, the assembly sequence of the last steps will be projected. Target employees therefore have more autonomy in detecting issues and more control over their actions in solving the issues. Being able to detect smaller issues more quickly and being in control when solving issues has also reduced physical and/or cognitive stress, as target employees feel less overwhelmed when issues arise.

The R&D team is currently considering adding stress sensors to the guidance system in order to adapt instructions to enable stress reduction. One concern is that the rich biometric data produced would be traceable to individuals. Current data is also traceable to individuals, but the reasoning of the management is that biometric data is far more personal than what is currently being collected.

#### Job quality

##### Physical environment

The environment changed significantly in 2010 when the metal and assembly units were physically moved from the previous premises into a new high-tech factory, featuring new mobile workstations which can be reassembled based on the project at hand, new production systems (for example energy efficient ovens), automated collection and re-use of waste material and collaborative robots. The introduction of the LGS did not induce further changes in the environment, besides the projected images and texts on various surfaces. The production systems, workstations, assembly lines and waste streams are logically organised similar to any other modern factory, according to management. Even though Mariasteen is a sheltered workshop, it still is a factory workshop with factory fixtures.

The LGS, however, requires a highly structured working space, as sensors can only detect if the assembled shape and weight corresponds with the quality parameters if all components are in a fixed place. The guidance, for instance illuminating which screw needs to be where, only works if the box with the required screws is in the exact same place as where it was when the R&D team programmed the work instruction. If materials on the workstation are not perfectly placed, projections would be 'off key', and sensors would not be able to detect the required materials.

##### Social environment

By using LGS the work of the R&D team has become increasingly digital. The fact that the R&D team collaborated intensively during the test period in the lab has led the involved employees to become more socially engaged. Two members of the R&D team recalled it as a pleasant period with lots of trial and error whilst helping each other to develop improvements. LGS enabled the introduction of projects that could be done in multiple teams of two, which resulted in more target employee interactions and more fall-back options in case someone fell ill. Nearly all employees at Mariasteen have a natural predisposition to provide support in line with its mission and values. For support employees this is part of the job, target employees are inclined to help and support their colleagues as they are used to being supported themselves.

##### Working time quality and work intensity

The goal of LGS technology was to increase sales as demand for production had decreased to a critical point, meaning that losses were made in 2010. Even with increased production and more complex products, work has become less stressful for the target employees, as LGS support makes them feel more secure in the work they are performing. Of course, not all target employees are equally flexible in terms of adapting to new ways of working. For some it took more time to become accustomed to work with LGS. During the adaptation period, target employees perceived the work intensity to be higher compared to the situation prior to LGS. They were temporarily supported with additional supervision and lowered production targets.

For the R&D team, work intensity has shifted although the overall workload has remained the same. Programming instructions in LGS involves higher work intensity at the beginning of the process but results in less time being needed for finetuning once the work instructions are implemented. Previously, the workload was distributed in the opposite manner. The implementation of the AR technology did not alter working times, as employees already worked in rosters tailored to their needs, and no additional roster changes were needed with the introduction of LGS.

##### Skills and discretion

The implementation of the LGS supported the development of new skills for target employees, supervisors, and the R&D team. LGS aimed to support target employees in learning the new skills required to produce more complex products. For all employees, the learning of new skills has mostly occurred via on-the-job training. For some target employees, at the outset, the use of LGS symbolised weakness based on their perception that 'strong persons don't need help', whereas LGS offers help. Rather quickly all were happy to use the system as it proved to be a steppingstone to achieve new results as they delivered complex high-quality products.

Within the R&D team, the multiple options available via the LGS triggered them to be more creative and develop digital skills for making the instructions more intuitive and attractive. There was no guideline for this, but the improved intuitive instructions were developed at their discretion. Additionally, building in quality checks induced the R&D team to develop other approaches and parameters to monitor quality via the LGS. One interviewee reported that working with LGS made their approach more structured and analytical, to design work instructions involving as few steps as possible while also testing all possible sequences to properly programme each step, in line with the quality requirements set by the client.

The R&D team estimates that the speed of developing tailored work instructions with LGS approximately the same as developing the paper-based versions, although the approach is quite different. At every assembly step the output of target employees is monitored via sensors (weight and cameras measuring shape and position), which provides a significant quantity of detailed observational data regarding quality (for example shape and weight) and speed (time needed to

execute each step correctly). As this data remains available over time it is possible to monitor progress in terms of learning curves, where quality and speed both increase over time whilst the number of required instructions decrease. This helps to understand each employee's learning process and is useful input on how to plan similar tasks in the future. The majority of employees learned to work with shorter instructions resulting in shorter throughput times.

#### Prospects and earnings

No additional rewards have been linked to improved performance via LGS, neither for support nor target employees. Target employees constantly delivering quality products, in line with the quality and quantity parameters in place, were promoted to more complex tasks and where possible to supervising roles.

#### Employee involvement

With the introduction of LGS, the employee representatives were involved in the first explorative stage to look at suitable options. Based on their concerns regarding adaptation to working with LGS, it was decided to invest in a thorough testing period, which would only end once it was proven that LGS could work successfully.

During the testing period, target employees were asked to participate in small tests in the lab to test guidance principles, which also meant they acquired basic experience in working with the technology. Supported by LGS, they were able to perform tasks such as producing and assembling electric components, which boosted self-esteem and gave a sense of fulfilment as they now were able to autonomously produce technically complex products they never imagined they would be able to do.

During this testing period employee representatives were also involved in the decision-making process regarding the rollout of LGS to the first eight workstations. To train the target employees at these workstations, additional supervision was organised in the first weeks by the R&D team and workplace supervisors. Supervisors would help target employees to learn to understand the signals (for instance what to do when a red signal is projected instead of a green signal) and how to initiate additional instruction videos via the help function. The training programme consisted of daily practice with a helping hand from support employees nearby. Based on the progress observed and the feedback given, the R&D team would calibrate the steps (shortening the instructions, increasing the autonomy) in line with the capacities of each target employee.

This was a team effort, and by inviting target employees to test the system their curiosity was triggered. They also felt part of the process and proud of the results achieved. A collective sense of pride emerged through all interviews. This was often supported by interviewees referring to the positive media attention that the new technology received, putting the spotlight on target employees, who became ambassadors for the LGS and working at Mariasteen. It was not anticipated that the introduction of the AR technology could foster such sense of pride, but it proved to be beneficial. Employees shared this positive experience which further increased the outreach of Mariasteen, leading to new customers.

#### Commentary

- • The human-centric approach adopted at Mariasteen is in line with the company's main function as a sheltered workshop and vision of being a provider of sustainable, safe and rewarding employment. If employees cannot cope, this can lead to stress and an increase in work-related absences. Processes in place should all support the wellbeing of target employees, the LGS therefore needed to seamlessly fit with the capabilities of employees, not the other way around.
- • Overall job quality has improved for all employees: the R&D team has learned digital skills and adopted a more effective and analytical approach for developing work instructions. The target employees learned new skills in the area of electric engineering and were able to work more autonomously. They also felt supported from the start, which resulted in low levels of stress and fear for the technology. Prior to LGS some target employees felt overwhelmed as they could not properly oversee their tasks.
- • Data monitored via LGS can be related to personal performance. Although the LGS is different from a supervisor looking over your shoulder it is apparently not perceived as different nor as a potential threat. From a legal standpoint, the type of data being collected (production quality and quantity, progress in terms of learning curves) is similar to information already collected in personnel files, so no renewed consent was needed.
- • The organisation of support and employees' feeling supported are fundamental to the introduction of change whilst keeping stress levels low – this arguably holds true for any working environment, but especially in a sheltered workshop that is organised around the wellbeing of its workers. Considering the low employee turnover levels at Mariasteen, many employees could rely on informal support to begin with. However, to successfully provide the target employees with support, a structured and empathetic implementation approach has been vital for the successful adoption.

#### Information sources

Interviews conducted with the company's director, the R&D director, the HR Supervisor, the innovation project leader and two shop floor workers, of whom one is an employee representative.

Company web site: <https://mariasteen.be/> (<https://mariasteen.be/>)

Gidts Group website: <https://www.gidts.be/> (<https://www.gidts.be/>)

Mariasteen spin off Licht Werk: <https://licht-werk.be/> (<https://licht-werk.be/>)

Video on first experiences with LGS at Mariasteen: <https://vimeo.com/236918814> (<http://vimeo.com/236918814>)

#### Author

Anna Menenti, Technopolis Group

#### Revision log summary