Quality of jobs and
Innovation generated
Employment outcomes

QuInnE.eu

NIELA KLEINSMITH[1]
BAS KOENE[2]
ROLAND AHLSTRAND[3]

Flying Parts: Best Practices in Organisational Innovation Following Implementation of New Technologies

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[1] *Erasmus University, Rotterdam School of Management, Netherlands*
[2] *Erasmus University, Rotterdam School of Management, Netherlands*
[3] *Malmö University, Sweden*

QuInnE - ***Qu****ality of jobs and* ***Inn****ovation generated* ***E****mployment outcomes* - was an interdisciplinary project investigating how job quality and innovation mutually impact each other, and the effects this has on job creation and the quality of these jobs.

Drawing on the Oslo Manual, both technological and non-technological innovation were investigated. Through quantitative analyses and qualitative organization-level case studies, the factors, as well as the mechanisms and processes by which job quality and innovation impact each other were identified.

The QuInnE project brought together a multidisciplinary team of experts from nine partner institutions across seven European countries.

QuInnE Project Member Institutions:

- *Lund University, Sweden*
- *The University of Warwick, UK*
- *Universitaet Duisberg-Essen, Germany*
- *Centre Pour La Recherche Economique Et Ses Applications (CEPREMAP), France*
- *Magyar Tudomanyos Akademia Tarsadalomtudomanyi Kutatokozpont, Hungary*
- *Universiteit van Amsterdam, The Netherlands*
- *Erasmus Universiteit Rotterdam, The Netherlands*
- *Universidad de Salamanca, Spain*
- *Malmö University, Sweden*

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More information about the project and project generated publications and material can be found at www.quinne.eu.

QuInnE contact person: Chris Mathieu, Christopher.Mathieu@soc.lu.se or quinne@soc.lu.se.

The QuInnE teaching cases and teaching notes are based on the confidential field research conducted in the context of the QuInnE project. They are written to provide material for training and class discussion rather than to illustrate either effective or ineffective handling of a management situation. Personal names and identifying information from the research cases have been altered for the purpose of confidentiality. The case studies and teaching notes have been developed in cooperation with RSM Case Development Centre of Rotterdam School of Management, Erasmus University (www.rsm.nl/cdc).

Flying Parts: Best Practices in Organisational Innovation Following Implementation of New Technologies

Introduction

Flying Parts, a European component manufacturer, grew from a small family-owned business, machining gas turbine parts in 1963, to a high-tech aerospace Tier 1 subcontractor with 100 employees in 2017. 70% of its workforce was blue-collar, principally turning- and milling-machine operators, with some welders and logistics workers. 95% of its workforce was full-time and permanent; temporary workers comprised 5%. Nearly all employees had graduated from an industrial upper secondary school; one employee boasted a university degree. All technicians and managers in the company had started their careers as operators, learning the trade and the company from the shop floor upwards. Promotions could be accompanied by internal and external courses in machining, modelling, programming and leadership skills, among others.

The growth of Flying Parts ran in parallel with its involvement in innovation networks. The company collaborated with universities and companies heavily involved in research, but also began participating in national and international research networks, developed between universities, professional and industrial organisations, and government authorities. Flying Parts was involved in projects sponsored by national agencies and departments, as well as the EU.

Flying Parts' growth to a Tier 1 subcontractor position in the highly technical aerospace industry led to a number of organisational and process innovations within the company. As one technician summarized:

> It was really something else. You knew that the details would go up in the air, and fly. Now, the job changed. There were so many requirements. […] It was new for everyone. It became stressful in all senses, so to speak.

New customers with new demands, increased variation of ordered components, huge investments in new CNC machines, and the implementation of management systems according to international standards for quality, contributed to:

- increased variation of 3D drawings to be transformed by manufacturing technicians into 3D manufacturing instructions, software programs, and 2D manufacturing instructions for the operators
- increased number of adjustments of the CNC machines to be made by the operators
- increased demands on quality, placing greater responsibility on technicians and operators.

Taken together, these new demands contributed to greater job intensity and uneven job distribution (i.e. a higher workload for some, less for others), and put pressure on management to transform their traditional and hierarchical organisation into a more decentralized and flexible organisation, through several organisational innovations.

Organisational Innovations

The company began by adopting lean principles, using different analytical tools (e.g. SWOT methodology) to identify and streamline value flows. In a dedicated lean-room, managers, technicians and appointed employees analysed value flows concerning the working environment and ergonomics. The analyses resulted in the implementation of flextime for white-collar workers, social support groups, the installation of defibrillators and systematic follow-ups of occupational accidents. On the shop floor, eight employees began working as a pilot team with a team leader, holding morning meetings for problem solving on whiteboards.

The changes also contributed to increased uncertainties among employees, in that employees were at times unsure of what to do in specific situations, thereby affecting product quality. On the shop floor, this meant that operators had to trust that colleagues further downstream in the manufacturing process would be able to catch any mistakes that they made. Because of this situation, management decided to decentralize decisions on daily problem solving and improvement activities. Managers themselves felt that they were working all over the place and answering all kinds of questions. Employees were therefore organised into teams (Strategy, Operations, and other teams). In addition, production results, staffing situations and problems of different kinds became more visible on whiteboards across the shop floor. Management further introduced kanban systems, principles of orderliness (5S) and daily steering meetings (held in the lean-room) between team leaders, the production manager and technicians.

As a result, employees felt more involved in decision-making. On the shop floor, operators emphasized the importance of the new team leader position: the six team leaders coordinated information between managers and operators. An operator and trade union representative described the changes: the organisation was "a lot more controlled" and employees had "a lot more responsibility." In addition, it had become:

> … easier to find the person that can answer your questions. Before, it was just one person for all of us. Now, you can get hold of the team leader, fast, and he can take your question further, if you don't have time to chase somebody responsible for the thing you want to ask about. In my opinion, it's really good.

Every morning, the team leaders organised 15-minute meetings with their respective team members around their whiteboards implementing continuous systematic improvements through small changes (i.e. instead of looking for radical process changes). Accordingly, the morning meetings mainly concerned daily problem solving, smaller improvement work and the distribution of upcoming job tasks. Questions to be discussed concerned absences, follow-ups, production results, budgets, causes for not being aligned with goals, quality, accidents, and, for instance, how to improve the production process. After the morning meetings, the team leaders participated in daily steering meetings in the lean-room with the production manager and technicians. In these meetings, they coordinated their activities and made monthly planning and follow-ups: which components would be manufactured, are we in line with the production plan, do we have any health and safety questions, what about quality, and how to improve the value flows?

The new structure for coordinating the operations was popular among the employees. For instance, one team leader reflected on how the organisation was becoming more effective:

> Six months ago, the former production leader just gave us tasks to do. He ran around chasing us. These steering meetings are much better. We can hear all the problems. The information is not lost along the way...It’s all about communication; it’s been much better. There's still a lot to do, but it’s really improved. This is the reason for our better results.

Mainly, the morning meetings and the steering meetings focused on daily and monthly problem solving, and smaller improvement activities; but management wanted larger improvements to happen. To facilitate this, the company implemented 45-minute improvement work sessions one day a week: “Otherwise nothing happens!" they argued. In addition, management put in place an improvement team responsible for larger and longer-term improvements. Included in this team was the manager for improvements (a member of the Strategy team), a lean-assistant working with value flows and layout drawings, and two technicians. In spring 2017, this team led the analyses of the value flow of the manufacturing process in the lean-room and concluded that the CNC machines should be reorganised in three flows according to specific product lines.

Finally, management decided to participate more in research carried out by universities and clients with R&D departments, and to deepen the collaboration with universities around courses of relevance for the company. This strategy contributed, for instance, to the company’s first 3D printings of components for one of its customers. Additionally, welders and manufacturing technicians from the company were able to attend university courses in laser welding and production techniques. By late 2016, the company had also hired a manager of R&D, positioned in the Strategy team.

Process innovations

To become a high-tech company meant increased digitalisation of the production process. This, in turn, influenced employee job requirements. The technicians had been working for years according to model-based definition (MBD) working methods, but now they had to adapt their way of working to specific customer requests. For instance, some clients required that Flying Parts use the client's version of MBD. Employees had to have specific MBD training.

> The designers at [the client's company] do not design the detail from a machining point of view but from the assembling point of view.

As a result, manufacturing technicians had to transform the client's product files into 3D working instructions, to then use these for the creation of computer programs for Flying Parts' CNC machines. These programs first had to be tested on virtual machines which simulated the machining process. When this was done to quality standards, the programs were installed and linked to the CNC machines on the shop floor. Follow-up was always initially required to make sure that everything worked as planned. Technicians then converted the 3D working instructions into 2D, paper-based documents for the operators. Overall, the increased digitization appeared to be good for the skill development of the technicians. As one of them commentedd:

> It develops our competencies. It’s positive because that’s what the company needs: complex job tasks.

The operators, on the other hand, had to accept some degree of loss in their job autonomy because of the manufacturing technicians’ programming of the machines. Seen over a longer period of time, the job of machine operator had drifted away from handcrafted work, to the setting, adjusting and controlling of CNC machines. The operators were no longer able to use their hands-on knowledge and experience, but relied on encoded knowledge that anyone could apply. In days gone by, operators had more genuine knowledge about the material and the turning and milling tools. Now, as one 50-year-old team leader noted:

> This competence disappears; it’s a craft that disappears here. Youngsters, that only use steered machines, they don’t get that feeling...from turning manually and...being closer to the material.

He also noted:

> It's not much problem-solving. In case of problems, we call the repairer.

But, he added:

> It’s good to escape problem solving. It’s stressful, when you know there is an urgency...

The outcomes for the operators from the company's process and organisational changes were therefore contradictory. On the one hand, even though they had to have training to work the CNC machines, their overall feeling was that their jobs had been de-skilled, as experience-based "feeling" for the quality of the work was no longer required. Additionally, they had lost some job discretion, in terms of controlling the manufacture of the part and solving problems. However, there was also relief over the reduced job stress.

Conclusions

When Flying Parts became a Tier 1 subcontractor for the high-tech aerospace sector, the mid-sized company had to adapt to the industry and customer demands. These included:

- a greater variety of components to be manufactured
- greater digitalisation and flexibility requirements in manufacturing operations
- certification according to international quality standards and higher quality demands.

As a consequence, Flying Parts initiated a series of changes, introducing innovations in manufacturing technologies, participating in innovation networks to remain competitive and agile in the industry, and implementing process and organisational changes necessitated by these new technologies. Effects on employee groups from technological innovations were significant:

- New CNC machines were introduced, and operators had to learn to work them. As a result, operator jobs moved away from craftwork, based on embrained knowledge, towards control of machine work, based on encoded knowledge. Operators lost some job autonomy in becoming more reliant on technicians. Job variation came exclusively from the increased number of adjustments to the CNC machines, based on the greater variety of parts to be manufactured.
- Manufacturing technicians had to become proficient in computer programming for CNC machines based on 3D computer-aided design and manufacturing: translating 3D drawings to 3D manufacturing instructions, to software programs for simulated machining, and to 2D manufacturing instructions for operators. Manufacturing technicians developed their skillsets and had increased areas of responsibility.
- Quality technicians had to learn to control parts production for the increased quality requirements, resulting in more training and skill development.

The company transformed itself from a traditional, hierarchical organisation into a more decentralised and flexible organisation. This transformation yielded a number of organisational innovations:

- All employees were grouped into teams.
- A team leader position was created for each of the six teams. Team leaders were appointed from among the machine operators.
- Management systems for continuous improvement work were implemented.
- Daily morning meetings were implemented between team leaders and their teams.
- Daily steering meetings were implemented between team leaders, technicians and the production manager.
- Improvement teams were appointed for larger, long-term projects.
- Weekly improvement work was formally scheduled during one day per week.
- Management teams were created for Strategy, Operations, etc.
- New positions were appointed for improvement manager and R&D manager.

The implementation of teams and the team leader position, in particular, was vital in improving communication flows and daily problem-solving and decision-making activities, as well as in balancing responsibilities between management and workers.

The company's collaboration with and participation in innovation networks with universities, R&D centers, and government agencies also triggered a wave of company- and employee-development opportunities. These included product and industry knowledge development, managed by the new R&D manager, and skill development for technicians and welders who were able to take university courses in welding, programming and manufacturing techniques.

A large number of process innovations were also implemented. The company adopted lean principles based on:

- Analyses of value flows of working environment and ergonomics. This resulted in the implementation of flexitime for white-collar workers, social support groups, systematic follow-ups of occupational accidents, the installation of defibrillators and an increased awareness for health and safety.
- Management systems for problem solving and continuous systematic improvement through small changes. This rebalanced somewhat the workflow and responsibilities, as management regained control of the labor process instead of running around answering all sort of questions, and employees actively participated in problem solving and improvement activities.

The expansion of the company, including new customer demands, increased product variation, new quality demands, new CNC machines, and organisational and process innovations, was the basis for the establishment of the first trade union clubs ever in the company, first by blue-collar workers in 2016, then by white-collar workers in 2017. Reasons for this, raised in the interviews, was the increased workload, work-life balance and the deteriorated psychosocial working environment:

> At times, it can be extremely stressful. The psychosocial environment is very tough, I think. I know that some, here, are very stressed. It's something we have to work with.

Although the company organisation changed to become less hierarchical and more decentralised and flexible, the relations between employees and company leadership became more formalised through the unions. However, management claimed to be happy about the establishment of the trade union clubs, as they looked now to the union delegates to facilitate information flows and to contribute to the development of the company by strengthened participation in production issues.