



Innovation, Job Quality (JQ) and Employment Outcomes in the Aerospace Industry: Evidence from France, Sweden and the UK

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Introduction

- Aim of the paper: analysing the interactions between:
 - JQ = *employment* (job security-employment contract; and training opportunities - skill acquisition; career opportunities) and *work* conditions;
 - Innovation (both in terms of process / product / organization)
- Aeronautics industry particularly interesting:
 - one of the most innovative sector (both in terms of process / product / organization); very exacting safety standards, long lead times for technological product innovation;
 - less explored than automotive; with some similarities but also strong specificities;
 - influence of regional clusters with geographic concentration of firms in the supply chain
 - less hit by the 2008 crisis than most of the other manufacturing sector (increasing production)

Introduction

- The choice of 3 countries: FR, SW, UK:
 - *similarities*: strong aeronautics-aerospace industry in the 3 countries, with the whole supply chain (from small parts manufacturers to Original Equipment Manufacturers - OEMs);
 - *contrasts*: in terms of institutional (including cultural / organizational) context
- Connecting our work to the economic literature on the impact of technological change on employment (“TC” literature) :
 - The “skill-biased” technological change literature;
 - The “task content of occupations “ approach - see [Autor, Levy and Murnane \(2003\)](#).; “routine” tasks are automatable ; but not the non routine manual, and more generally tasks that require creative and/or social intelligence ([Frey and Osborne, 2013](#); [Arntz et al.2016](#))

Introduction

➤ Connecting our work to the "*work organisation <-> innovation nexus*" ("*WOI*") literature :

- different work organizations (learning / lean / Taylorist / traditional-simple - see [Lorenz and Valeyre, 2005](#)), with differing prevalence across industries (e.g. "learning" overrepresented in transport equipment, underrepresented in textile /leather manufacturing industry) and across countries (e.g. learning more prevalent in SW, while "lean" more prevalent in the UK and FR);
- connection between work organisation and "modes" and "systems" of innovation - see [Arundel, Lorenz, Lundvall, and Valeyre \(2007\)](#). Cf. the two innovation strategies distinguished by [Jensen, Johnson, Lorenz and Lundvall \(2007\)](#): the "*Science, Technology, and Innovation*", (**STI**) mode that gives main emphasis to promoting R&D and creating access to explicit codified knowledge; and "*Doing, Using, and Interacting*" (**DUI**) mode" mainly based on learning by doing, using and interacting;

Introduction

- Our value added to the existing literature:
 - Like the WOI literature we are interested in how work organization (and potentially associated JQ) may impact innovation, but that like the TC literature, we are also interested in how innovation may impact on JQ (work organisation being a potential mediator, among others), but also on employment, and on social inclusion
 - Bringing in JQ more explicitly and more comprehensively (i.e. taking into account all the dimensions of JQ);
 - Opening the black box, with qualitative case studies in a given industry (whereas the starting point of both the TC and WOI literature is quantitative, using national or international surveys, across industries);
 - Providing insights concerning the role of national context by focusing on only 3 countries

Introduction

- 6 cases of very different sizes, with different positions in the supply chain:
 - Tier 1 / tier 2 subcontractors making parts / pieces (**FR-Parts 1, FR-Parts 2, SW-Parts, UK-Parts**) or segments (departments of **SW-Plane**)
 - OEMs (**FR-Plane** and **SW-Plane**)
- Outline of the presentation
 - The impact of technical process innovations on JQ, employment and social inclusion
 - Looking for innovative workplaces: organizational innovations and the JQ issue

1. What impact of innovations?

- No product innovation with significant impact on JQ (in our cases) => More about technological change and process innovation, such as:
 - the introduction of 3D computer aided design and manufacturing => impacts the whole chain from the design bureaus engineers to the operators;
 - the introduction of CNC (computer numeric control) machines, and other forms of automated equipment;
 - digitalization and the new information systems of monitoring;
- >>> Among our case studies: some commonalities, but also specificities concerning the timing and magnitude (radical / incremental)

1. What impact of innovations?

- White collars (engineers, technicians) were highly impacted by some innovations (e.g. 3D computer aided design and manufacturing)
 - More age-biased than skill-biased technological changes: i.e. new skills rather than higher skills
 - The consequences on employment were mediated by managerial choices - the renewal of generation implying a decrease in the share of older workers was more rapid in the French cases than in Swedish ones – also influenced by institutional context - e.g. the use of early retirement schemes in France
 - Reallocation of tasks within the chain from R&D and design to manufacturing and assembling, with a squeeze on some intermediary functions. It also contributed to the reinforcement of the interdependence between the different functions and stages in the chain, with some work intensification and stress, maybe higher in France than in Sweden and the UK

1. What impact of innovations on JQ?



Concerning operators:

- The use of CNC machines had ambiguous effects in terms of JQ: it increased the quality of the work done and required new skills, but it transformed the work activity by putting more emphasis on “controlling” and less on “making”, with negative impact on the “craft” dimension of the job. This raised issues in terms of interest for the work, and overall job satisfaction. Feeling among older operators of some de-skilling (loss of “craft” competencies) => overall, the impacts are more complex than the simple “*skilled-biased / suppression of routine tasks*” view
- A given innovation may be used differently, depending on managerial choices; with different consequences in terms of JQ [e.g. digitalisation and the “*manufacturing execution system*” (MES) - i.e. the control system for managing and monitoring work-in-process on the shop floor, which keeps track of all manufacturing information in real time]
- these tools also create new opportunities to better take into account working conditions - e.g. the 3D virtual reality which is also used to simulate the work posts for better ergonomics.

1. What impact of innovations on JQ?



Concerning more specifically automation:

- Full automation (i.e. robots) has been limited so far not only for technological reasons:
 - for economic reasons (smaller batches than in automotive)
 - too much automation may have negative consequences on the capacity for incremental innovations through the "*Doing, Using, and Interacting* (DUI)" mode of innovation, which relies on human learning that cannot be fully replaced by data processing.
- In some cases: "intermediate level" automation => assembly lines => Taylorization with standardization, reduction in job discretion and work intensification => some deskilling and more temp agency work (notably in the French cases); but easier for social inclusion ("stepping stone", but less "sticky" and less "springboard")

2. Work organization, JQ and the making of innovative workplaces

- Our focus here is *how JQ articulates with work organization to foster the emergence of an "innovative workplace"*; organizational concerns are more important during periods where no (technological) radical innovations, and articulated with incremental innovations;
- "*Lean*" in all the cases but significant differences between the way it had been implemented and was impacting on organisations => "*technocratic (rigid) lean*" in France *versus* more agile/flexible lean in Sweden (and UK) => differences in the "*work organization-innovation nexus*) across cases and countries
- In *UK* : only one case, small firm, between "*simple/traditional*" and "*learning*" type of organization, with recent "*lean*" elements implemented => so far a rather good balance between (work organisation / JQ / innovation), and in particular between the *STI-mode* and the *DUI mode*; mainly based on mostly informal system of employees suggestions.

2. Work organization, JQ and the making of innovative workplaces

- *Sweden*: a rather good illustration of virtuous circle (learning organisation / high JQ / innovation) put forward by the WOI literature (but with some differences between SW-Plane and SW-Parts)
 - "*innovation is part of daily work life*" >> good balance between the *STI mode* and the *DUI mode* of innovation; i.e decentralised "learning" type of organisation, with "process and learning" type of organisational change, and high emphasis on the *DUI mode* of innovation,
 - the use of temporary workers is very low, in particular among operators; pay is relatively high, as compared to other manufacturing sectors, and connected, by an annual individual assessment, to skill, collaboration, performance and "engagement" (which includes the innovative behaviour)

2. Work organization, JQ and the making of innovative workplaces

- Whereas the 3 French cases, are more illustrative of tensions between the different elements (work organization / JQ / innovative workplace)
 - The very top-down formal and rigid way of implementing lean principles (illustrative of the “*planning and control*” mode of organisational changes) => puts stress on the employees at all level; lower job discretion, higher pace of work, tightening of the deadlines;
 - This technocratic way of implementing lean, is also coherent with the high predominance up to recently of the *STI mode* of innovation (high prestige of the technological R&D ; emphasis on formalized and codified knowledge);
 - But management is more and more conscious of the limits of the existing system - and notably too much bureaucracy, and poor JQ as an obstacle to an innovative workplace => attempts to move towards a more "learning" type of organization; and in some cases even radical experiments to do so (e.g. the “liberated company” experiment in some departments of **FR-Plane**)

2. Work organization, JQ and the making of innovative workplaces

- Explaining the differences across firms and countries
 - The position in the supply chain
 - The position in the product and innovation life cycles
 - The role of unions and labor market institutions and regulations
=> in Sweden, unions play an active role both formally and informally in the maintaining of the "virtuous circle"; in France, unions are divided, and more on a defensive strategy, also in line with the more hierarchical "top-down" "planning and control" modes of innovation and organisational changes
 - Social and cultural factors? Cf. the "*lean à la française*", ([Danielou, 2015](#)), the role of the caste of engineers....