

# Cognitive skills, tasks and job mobility

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# Motivation and background

- Educational qualification do not sufficiently explain observed career development and compensation patterns on microeconomic level
- Attempts to classify occupations and/or individuals by tasks are riddled with numerous measurement issues such as lack on international agreed upon standards and norms and all the typical problems related to interview based self-reported values.
- In 2013 PIAAC will provide us with both individuum based direct observations of skills and self-reported tasks. However, PIAAC cannot provide us with sufficient contextual detail about the occupational circumstances of those individuals.
- Therefore, we conducted an industrial survey where we could observe in a highly homogeneous environment directly assessed Dynamic Problem Solving skills and tasks.
- Dynamic Problem Solving skill assessments for adults has been long on the wishlist of the skills research community (since earliest IALS/IALLS discussions) but technical and pragmatic issues have so far prevented this. Ours is the first time ever that a DPS assessment has been conducted in an professional environment.

# Survey in an industrial environment

- Survey conducted in 2010 and 2011
- Sample Size: 305 individuals
- 5 Factories of four companies
- One of this company is a large German industrial firm with more than 100.000 employees. The other three companies are small scale enterprises with comparable job contents
- In three factories, the participants to the tests were randomly invited by letters to their private homes to attend designated testing sessions. Randomization and letter dispatch has been done by us.
- In the remaining two companies participants were selected randomly and spontaneously from the shop floors on the day of the test.
- Survey contains 2 skills measurement and an extensive questionnaire

# Definitions

## Skills:

Cognitive skills such as general intelligence (fluid intelligence) or Dynamic Problem Solving (DPS)

## Tasks:

13 Tasks dimensions similar to Spitz-Oener (2006) and Antonczyk et al. (2009)

Task category	Tasks
Non-routine-analytic	developing, researching, designing, investigating, gathering and evaluating information
Non-routine-interactive	informing, advising and training, teaching, tutoring, educating and organizing, planning/preparing working processes and promoting, marketing, public relations and buying, providing, selling and to be supervisor
Routine-cognitive	measuring, inspecting, quality checks
Routine-manual	producing and fabricating goods, supervising and operating machines or conveyors
Non-routine-manual	repairing, overhauling, serving

$$Task_{ij} = \frac{\text{number of frequently performed activities in category } j \text{ by individual } i}{\text{total numbers of activities in category } j}$$

# Definitions

## **Job mobility:**

Occupational mobility is defined as ISCO classification changes on the *x*-digit level. Previous and following occupations have been classified by us according to the job description which is required for remuneration.

Another grouping of jobs more independent to ISCO has been applied. This does not change the results much.

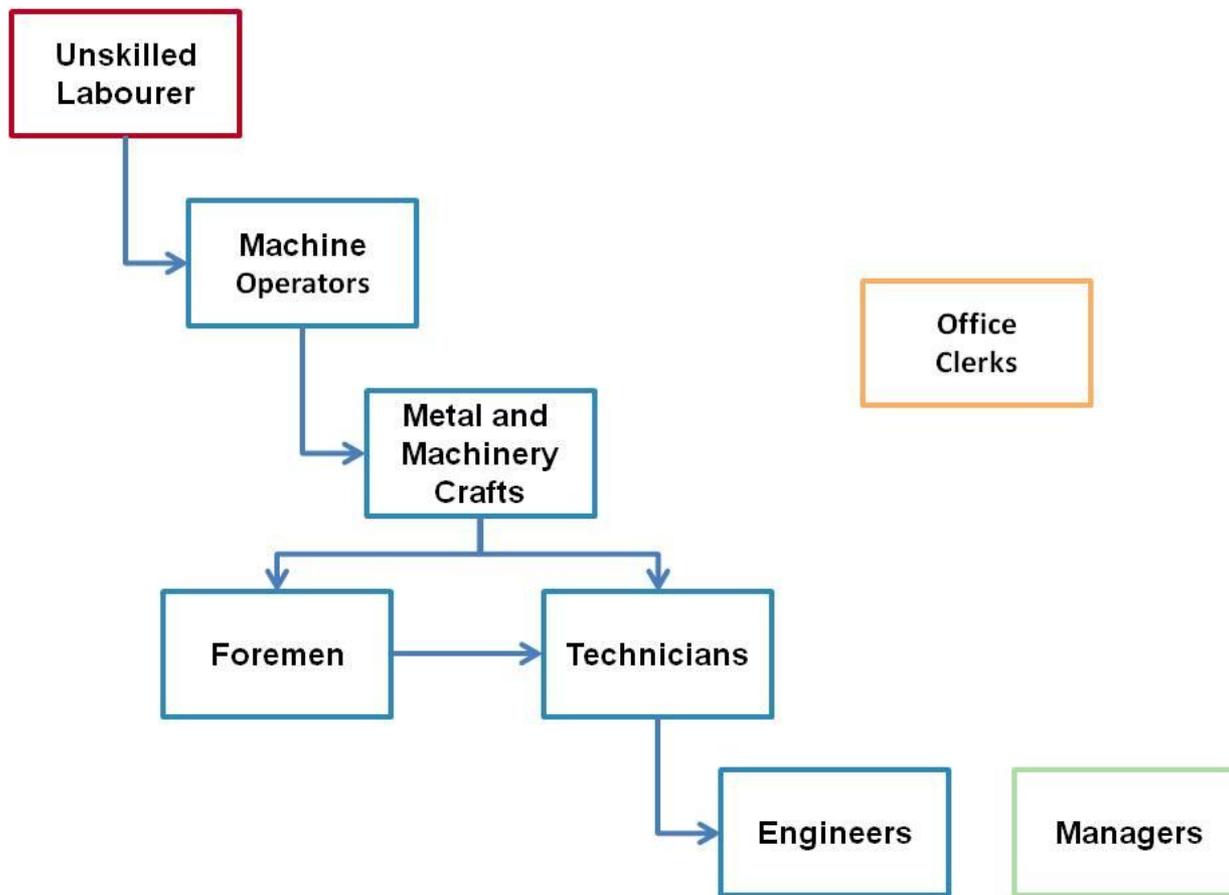
# Occupational pathways in an industrial environment

Occupational Group	Share in the company
Labourer	>2 %
Machine operators and assemblers	28%
Metal and machinery craftsmen	14%
Foremen	<2%
Technicians	11%
Engineering professionals	10%
Managerial Occupations	7%

# Advantages of analyses in an industrial environment

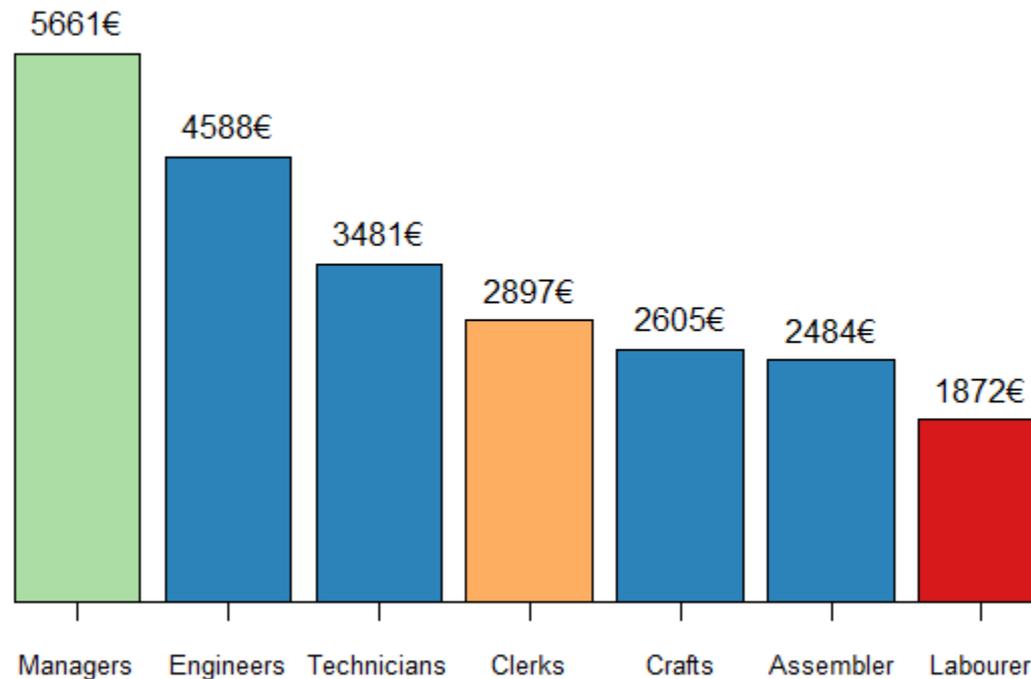
- Less heterogeneity because **occupations are more comparable within an industrial environment** than in the whole economy.
- Less heterogeneity **through reduced measurement error** since almost all individuals are subject to a collective wage agreement which remunerates tasks and do not depend on the educational attainment or the professional qualification of an individual. Therefore, the job contents have to be clearly defined.
- Better analysis of job mobility because the collective wage agreement ensures that **occupational mobility is in fact a change of the job content**. We should not see ‘occupational mobility’ or relabeling of occupational notations due to promotions. Occupational mobility could be enhanced because occupations do not depend on educational or professional attainment.

# Occupational pathways in an industrial environment



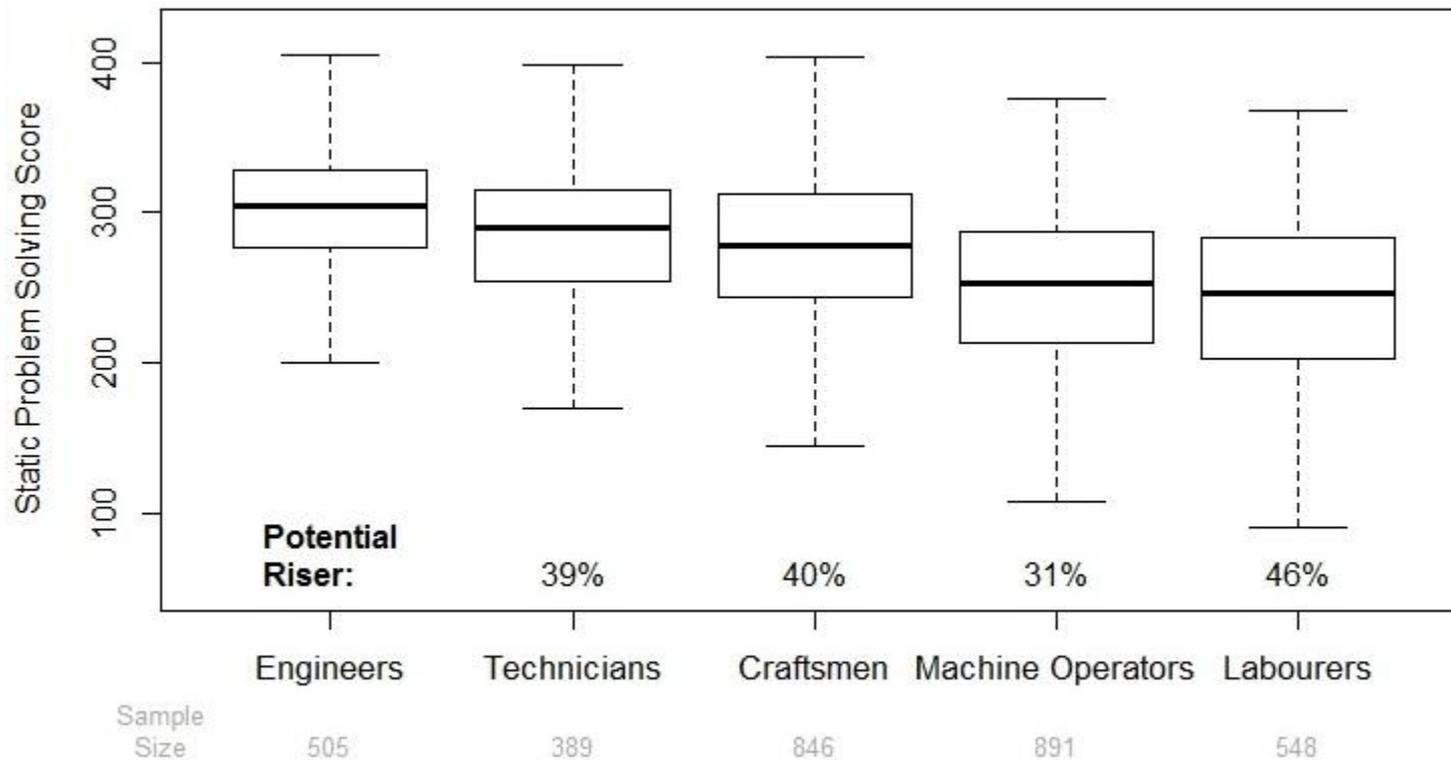
# These occupations can be ordered according to their salaries in Germany...

Median gross monthly earnings for men in Germany in selected occupations, 2006



# ... the same holds for a skill measure in Canada...

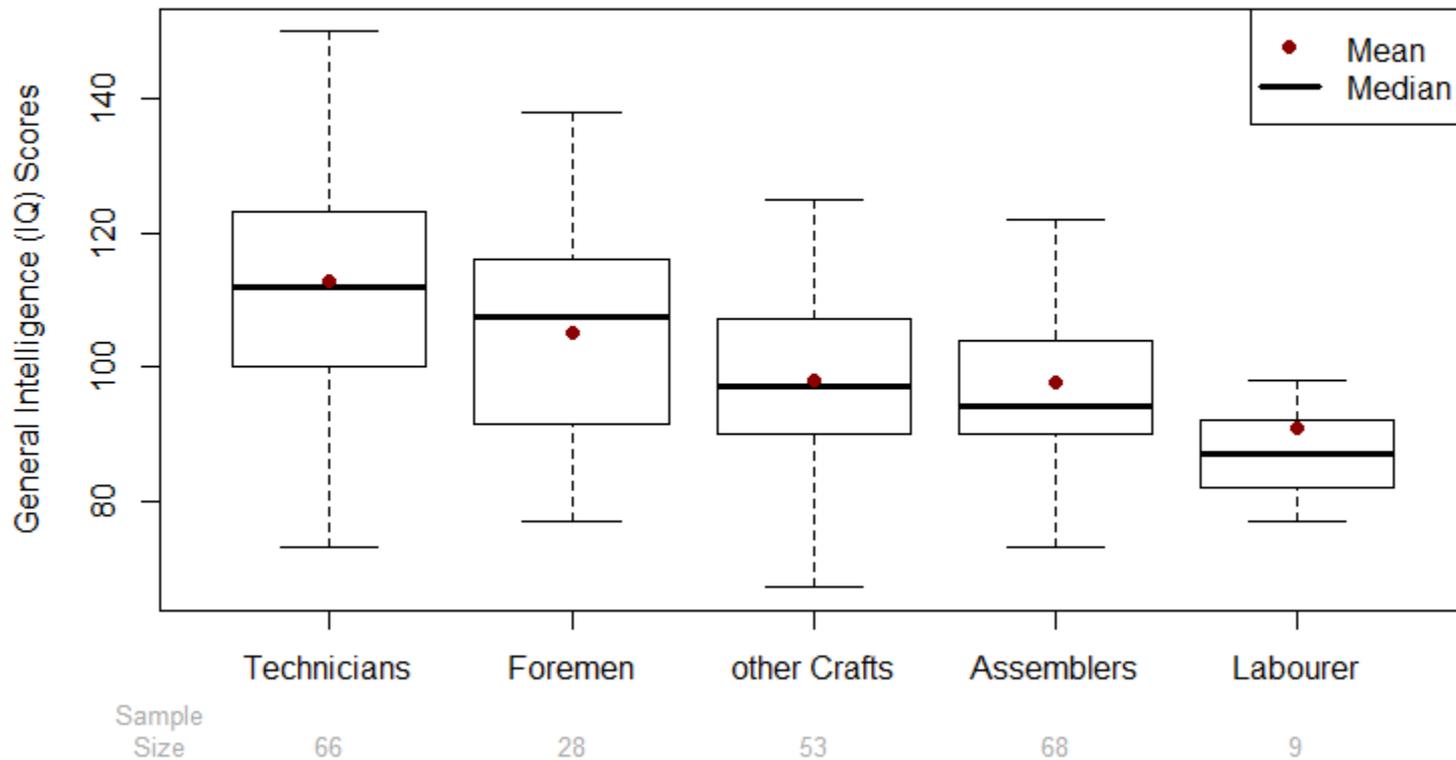
Canada, 2003-2004



We calculated the share of potential risers as the fraction of individuals in each occupational group who perform better than the median individual of the immediate more complex occupation.

# ... or for a general intelligence measurement in an industrial environment

Fluid intelligence distribution in five industrial factories in Germany, not standardized for age differences, 2006



# Dynamic Problem Solving (DPS) a new skill measurement

Finde die Zusammenhänge heraus und trage sie in das Modell ein! Runde 13 106

**Florabor**

-- - o + ++

**Natromic**

-- - o + ++

**Solurax**

-- - o + ++

**Größe**

0

**Nährstoffgehalt**

0

**Milbenbefall**

40

Hilfe
Alles löschen
Ausführen!
Beende Aufgabe

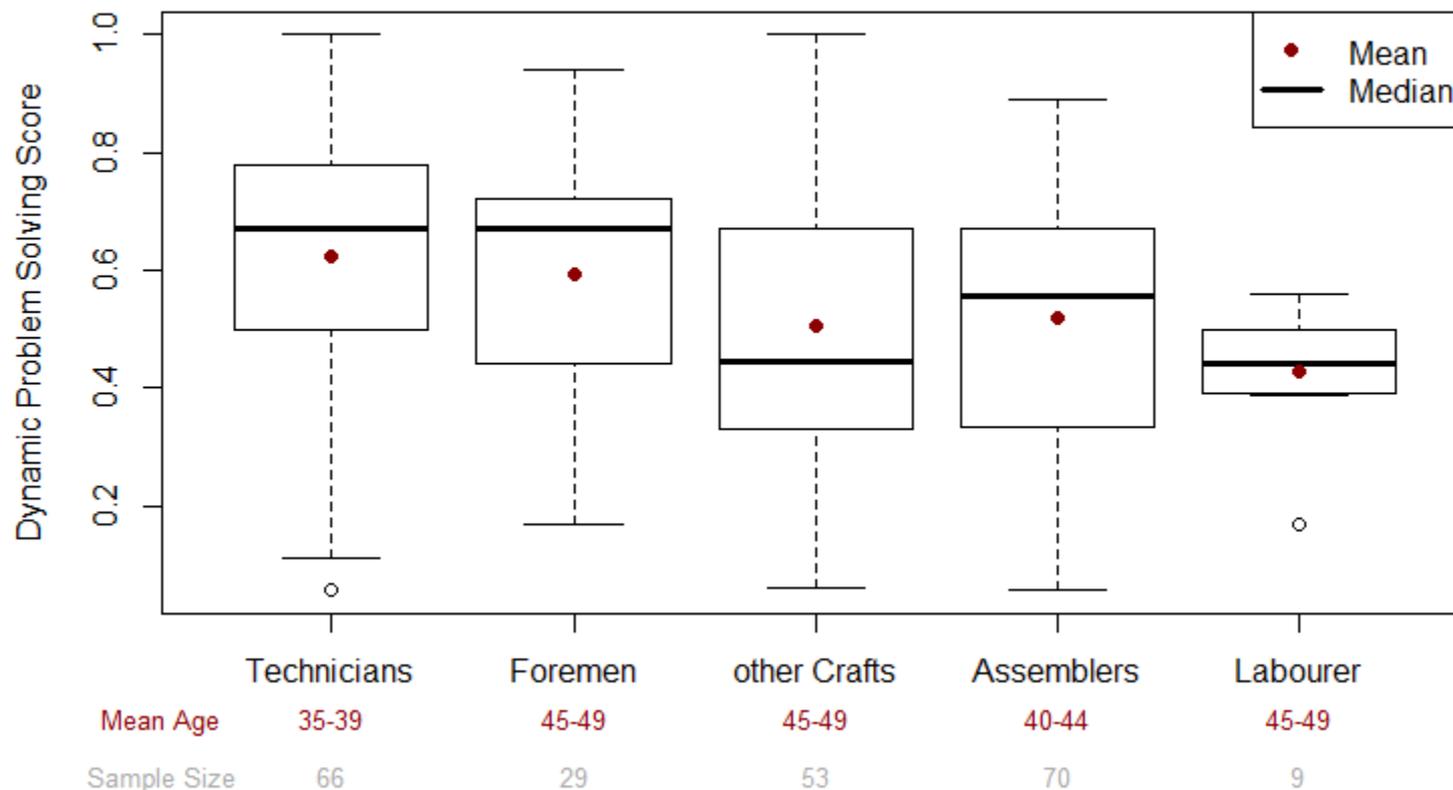
Modell

```

graph LR
    Florabor --> Größe
    Florabor --> Nährstoffgehalt
    Solurax --> Milbenbefall
    Milbenbefall --> Milbenbefall
    
```

# Differences are smaller for DPS

Dynamic Problem Solving distribution in five industrial factories in Germany, not standardized for age differences, 2006



# Upward occupational mobility is limited for crafts...

Mean annual occupational mobility (2-digit level) in Germany, 2000-2009

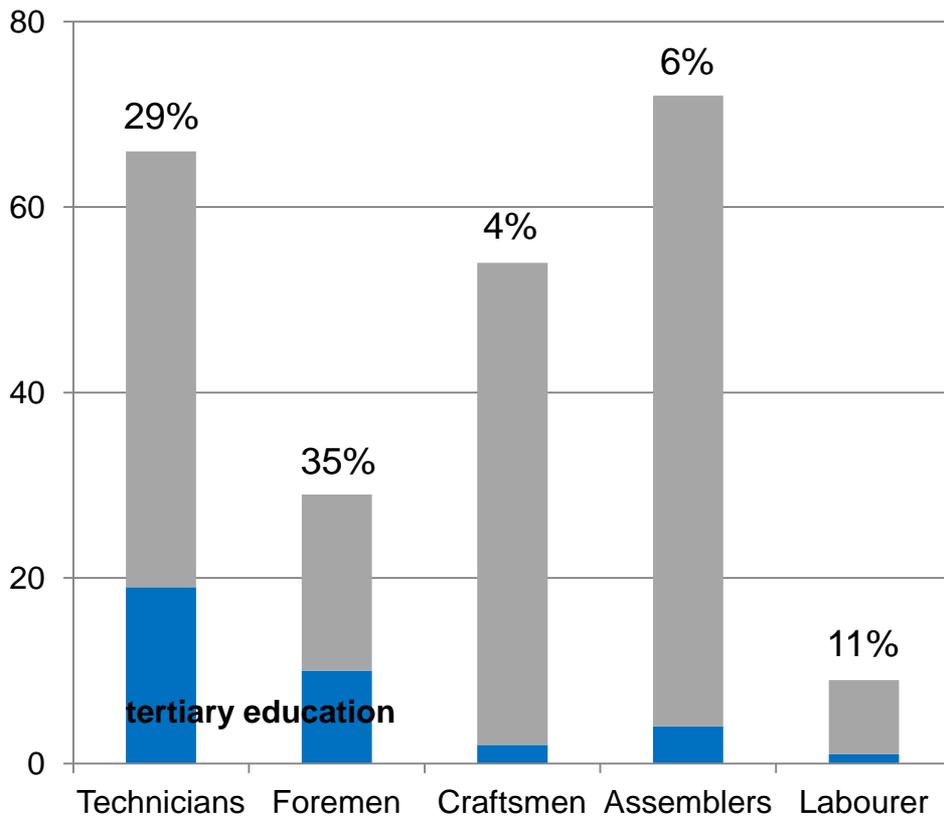
Occupational group next year	Engineers	Technicians	Craftsmen	Machine operators and assemblers	Labourer	Other craftsmen or operators (3 groups)	Other (23 groups)
Occupational group previous year	Engineers	Technicians	Craftsmen	Machine operators and assemblers	Labourer	Other craftsmen or operators (3 groups)	Other (23 groups)
Engineers	84.1%	5.3%	0.3%	0.1%	0%	0.2%	9.9%
Technicians	5.5%	83%	2.1%	0.7%	0.4%	0.9%	7.3%
Craftsmen	0.3%	1.6%	89.2%	2.6%	0.9%	1.9%	3.6%
Machine operators and assemblers	0.1%	1%	3.9%	85.8%	2.6%	2.8%	3.8%
Labourer	0.3%	0.4%	2.2%	5.4%	76.0%	4.2%	11.5%
	Move to a more complex occupation	Same occupation in both years		Move to a less complex occupation			Other occupations not in focus

Source: Own computations based on SOEP 2000-2009

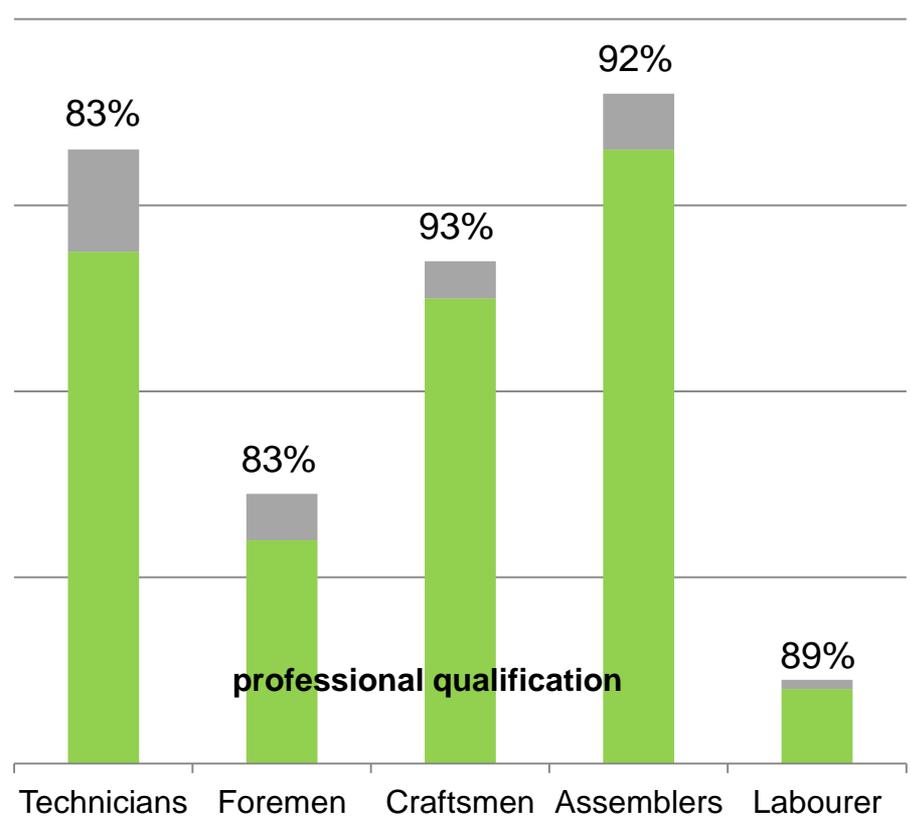
# Only limited educational differences between occupational groups

Educational attainment within occupations in focus

Share tertiary education

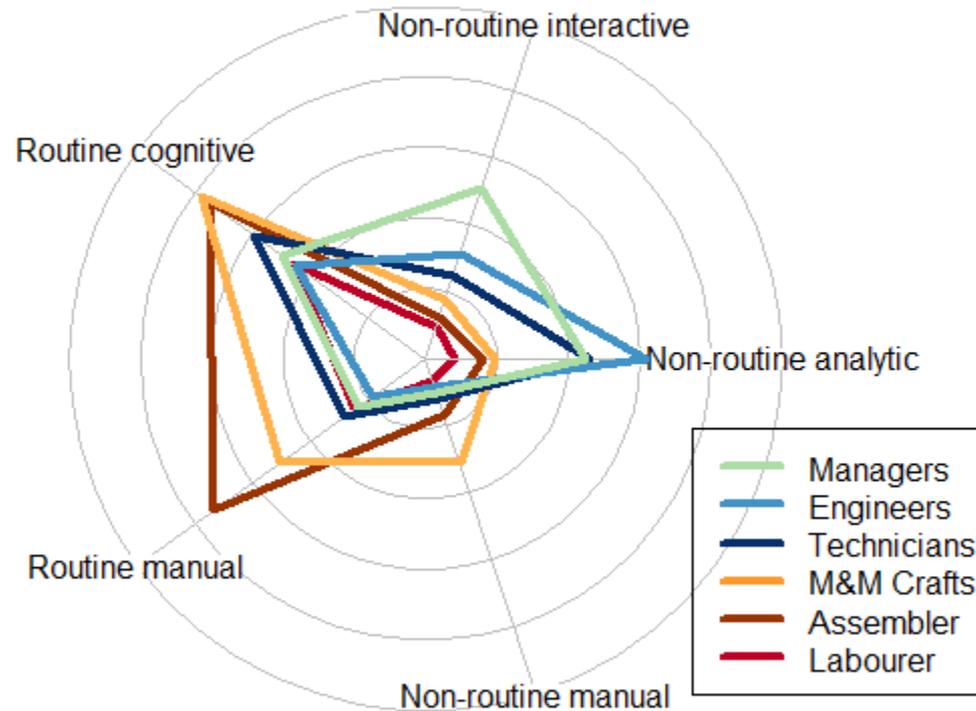


Share professional qualification



# Tasks and skills are correlated

Tasks dimensions according to Spitz-Oener (2006) for technical occupations, Germany, 2006



# Tasks and skills are positively correlated

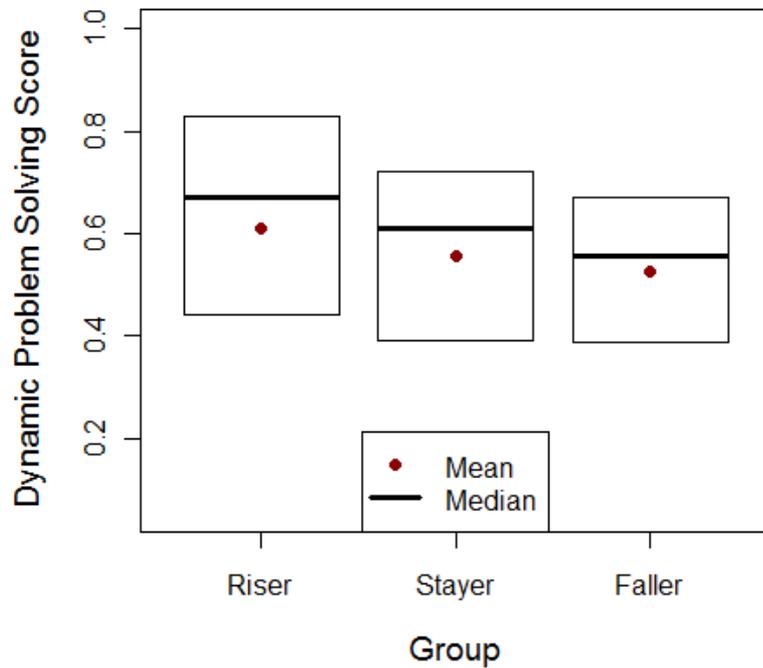
Correlation coefficients between tasks and skill measurement; p-values of skill coefficients in a bivariate

Task category	Correlation between task frequency and DPS		Correlation between task frequency and IQ	
	Overall	Technical workers	Overall	Technical workers
Non-routine-analytic	<b>0.13*</b>	<b>0.15*</b>	0.11°	<b>0.13*</b>
Non-routine-interactive	<b>0.15*</b>	<b>0.17**</b>	<b>0.21***</b>	<b>0.20**</b>
Routine-cognitive	-0.02	0.04	-0.06	-0.07
Routine-manual	-0.02	0.01	0.06	0.03
Non-routine-manual	0.04	0.07	0.01	-0.00

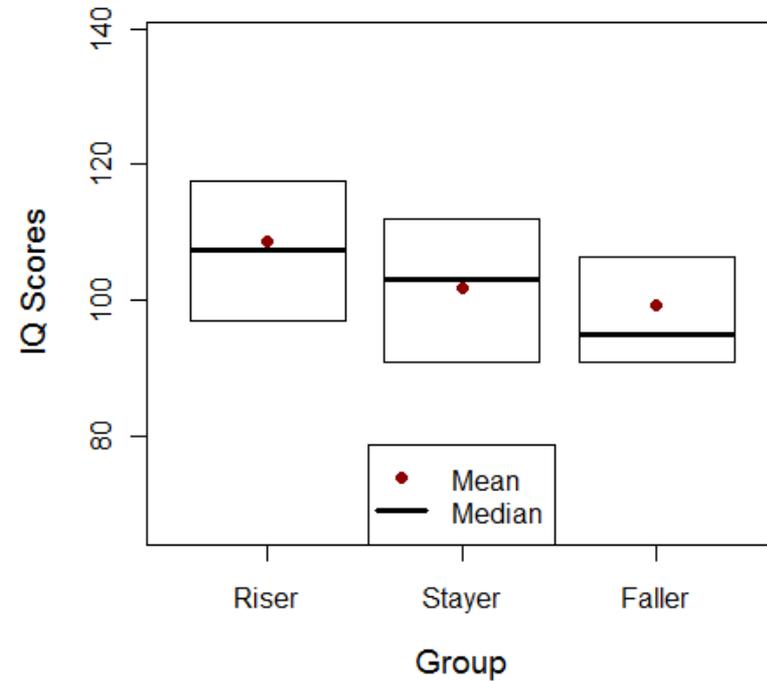
Significance codes: '\*\*\*': p-value < 0.0001; '\*\*': 0.001 < p-value < 0.01; '\*': 0.01 < p-value < 0.05; '°': 0.05 < p-value < 0.1

# Individuals who move to more complex jobs possess on average higher skills

DPS scores and Occupational Mobility



IQ scores and Occupational Mobility



# Individuals who move to more complex jobs possess on average higher skills

Independent Variables	Dependent Variable			
	(1) DPS		(2) IQ	
(Intercept)	0.40 **	(2.26)	90.7 ***	(7.09)
Occupational Riser	0.09 *	(2.08)	9.9 **	(2.97)
Occupational Stayer	0.04	(1.03)	1.0	(0.36)
<i>Occupational Faller</i>				
<i>(Reference Group)</i>	-		-	
Years of Schooling (only High-School)	0.03	(1.89)	0.7	(0.58)
Tertiary Degree	0.06	(1.05)	7.7	(1.82)
Age (5-Years-Steps)	-0.03 ***	(-3.91)	-0.1	(0.08)
Sex Female	-0.08	(-1.48)	4.0	(1.09)
	R <sup>2</sup> =0.18; n=182		R <sup>2</sup> =0.11; n=180	
Significance codes: '***': p-value < 0.0001; '**': 0.001 < p-value < 0.01; '*': 0.01 < p-value < 0.05 t-statistics in parenthesis				

# Summary

1. Within a company occupational pathways exist which can be organized hierarchically according to wages or skills.
2. Occupational mobility is confirmed in a micro-setting where measurement errors or re-labeling of similar job contents can be mostly excluded.
3. There is evidence that those individuals who move to more complex jobs are endowed on average with higher skills (independent of their educational qualification).
4. But there seems to be a barrier between crafts and technicians which can not fully explained by skills required.
5. The tasks-based approach can help to explain this barrier.
6. Individual skills and complex non-routine tasks are significantly positively associated.