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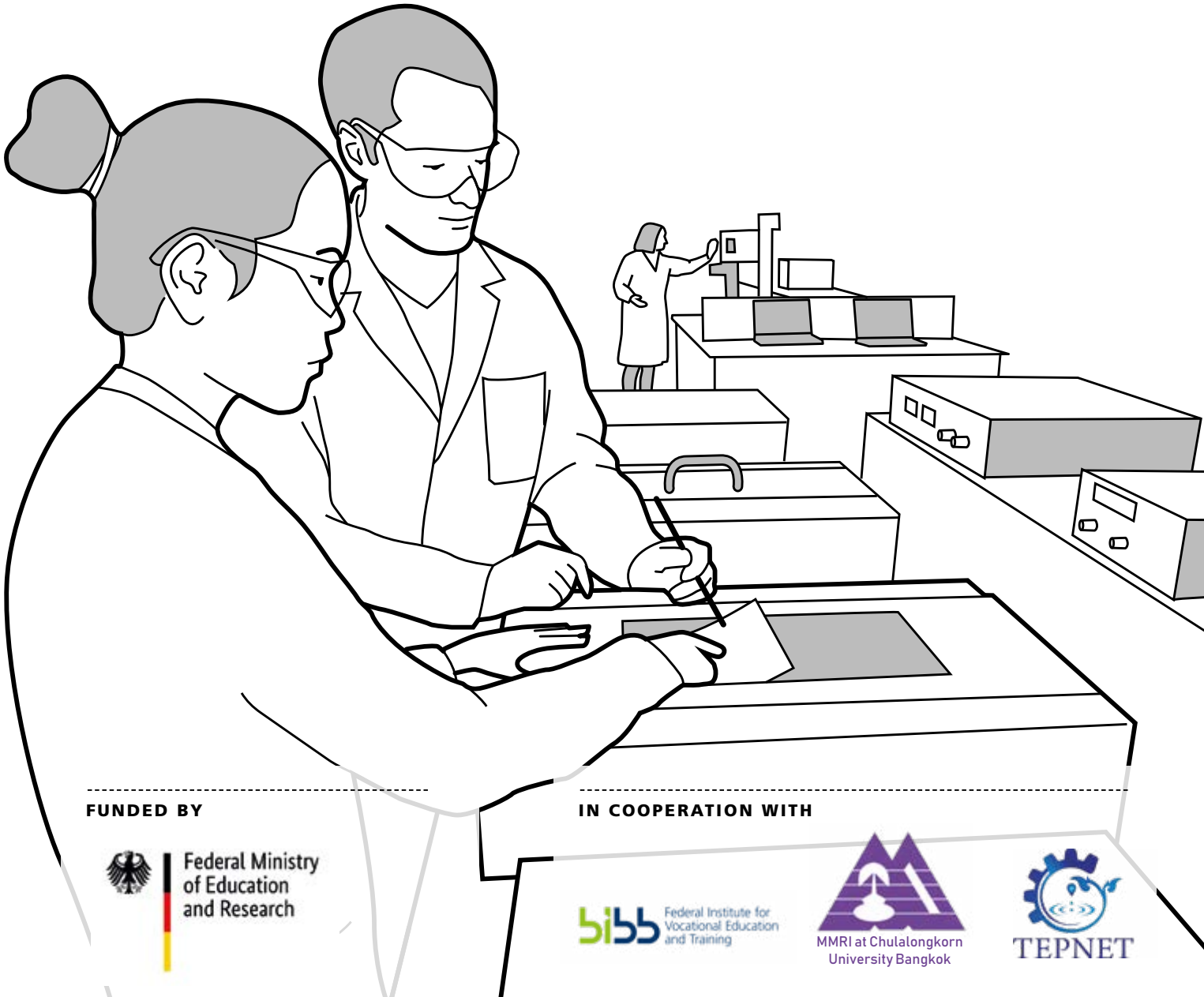
PROJECT SCHOOLPLATE: COMPANY SURVEY RESULTS REPORT

Characteristics and qualification needs of the Thai electroplating industry



FUNDED BY

Federal Ministry of Education and Research

IN COOPERATION WITH

bibb Federal Institute for Vocational Education and Training

MMRI at Chulalongkorn University Bangkok

TEPNET

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Characteristics and qualification needs of the Thai electroplating industry.

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Metallurgy and Materials Science Research Institute (MMRI) at Chulalongkorn University Bangkok

Supported by: Thailand Electroplating Professional Network (TEPNET)

The project on which this report is based was funded by the Federal Ministry of Education and Research (BMBF) under the grant number 01BE19001A. The responsibility for the content of this publication lies with the authors.

IMPRINT

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Date of publication:

April 2021

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EXECUTIVE SUMMARY

- This report outlines the results of an online company survey that was carried out by the German-Thai SCHOOLPLATE project between July - Sep. 2020 and was able to generate insights about the characteristics of electroplating companies and qualification needs of employees from 63 electroplating companies. The objective of the survey was to analyze the current and potential future demand for skilled labor in order to plan demand-oriented vocational education and training measures for the Thai electroplating industry.

- The survey results illustrate the importance of the Thai electroplating industry for Thailand's strong export-oriented industries that are also in the focus of the "Thailand 4.0" economic strategy, such as the automotive and electronics industry. Likewise, the electroplating industry will likely face a stronger demand by so-called "New S-Curve industries" such as aviation, automation and robotics in the future. More specifically, contract manufacturing - so-called job plating - that is carried out mainly by small- and medium-sized enterprises (SMEs) plays a crucial role in the supply chains of these industries. Furthermore, the survey results confirm that Thai electroplating companies apply complex processes and methods that require considerable specialized knowledge and expertise (see chapter 1).

- Data about the employment structure and employees' job tasks show a strong vertical organization of work, with 2/3 of employees performing mainly simple tasks that do not require any specific technical skills, whereas 1/3 of employees perform either routine tasks that require more advanced technical skills and competencies (26%), or complex, rather non-routine tasks with a strong focus on development that require broad technical knowledge and expertise of the respective employees (13%). Notably, 2/3 (66%) of employees specifically employed in electroplating are women (see chapter 2).

- Although these findings underline the high importance of industry-specific qualifications, data on skills requirements and skill gaps of employees indicate that a majority of employees lack fundamental skills in electroplating including both basic, as well as highly specialized skills and knowledge. The results can help to determine the scope and content of demand-oriented qualification offers in electroplating (see chapter 3).

- Currently, a majority of companies provide basic training activities, such as on-the-job training of newly hired employees or short-term trainings. However, these training activities appear more often than not rather provisional in nature and lack a systematic approach with regard to the organization, duration and content of training. Furthermore, the results about (potential) obstacles in the provision of training offers make it clear that the planning of possible training formats as well as adequate funding models must take place in coordination with the industry to ensure the feasibility and relevance of training offers (see chapter 4).

- The findings also show that a majority of companies is committed to continuous organizational development to remain competitive and keep pace with developments in the industry and customer requirements. At the same time, the Thai electroplating industry is under increasing pressure to improve the quality and cost efficiency of production processes. This is due to external factors, such as increasing competition, rising wages and stricter legal requirements particularly in the field of environmental protection and safety. The more recent economic effects of the Covid-19 pandemic put additional pressure on the industry and increase companies' focus on further professionalization and modernization of methods, processes and technologies to balance rising costs (see chapter 5).

- Overall, the results underline the importance of training and qualification offers that target current and future employees alike to support the further professionalization of the industry and provide better employment perspectives for companies and job seekers alike. As electroplating products play an integral role for key industries in Thailand that are highly dynamic in terms of technological development and innovation, the development and provision of training and qualification offers is also of major importance to the Thai economy as a whole to ensure the electroplating industry's capacity to adapt to new requirements and meet the demand for high-quality products in the long term.

1
Information about companies in the sample

Main findings

- In order to analyze the labor demand of the electroplating industry, the SCHOOLPLATE project conducted an online company survey between July - September 2020 in which 22% of the 288 contacted electroplating companies participated. The survey focused on questions concerning characteristics of electroplating companies and qualification needs of employees. In the final sample, the answers of 91 experienced company representatives from the management level of 63 companies were considered. The information in the online survey was complemented with additional information of guided interviews that were conducted with 8 company representatives from 5 companies (see chapter 1.1).

- Electroplating companies have a strong regional focus on the Eastern Economic Corridor (EEC) and the greater Bangkok area that are the center for the export-oriented industry in Thailand. This focus also illustrates the significance of contract manufacturing for the electroplating industry carried out by so-called "job plating" companies. The most common company type in the industry are small-and medium-sized job plater companies (see chapter 1.2.1 and 1.2.2).

- The Thai electroplating industry is supplier for Thailand's strong automotive and electronics industry. These sectors will likely gain further importance in the future as so-called "First S-Curve industries" in the context of the "Thailand 4.0" strategy. In addition, the electroplating industry will likely face a stronger demand by so-called "New S-Curve industries" such as aviation as well as automation and robotics. Furthermore, electroplating plays a crucial role for Thailand's large-scale export-oriented jewelry industry (see chapter 1.2.3).

- Overall, the survey results confirm that Thai electroplating companies apply complex processes and methods that require considerable specialized knowledge and expertise. The industry's characteristics underline the high importance for industry-specific qualification offers to ensure that the Thai electroplating industry will remain able to meet the demand for high quality plating products and keep up with ever rising requirements by evolving industries.

1.1
Information about survey respondents

- In total, 288 companies were contacted via email[1] between 13.07.2020 - 06.09.2020 of which 172 companies participated in the survey (response rate of original sample = 60%). The following company questionnaires were considered in the final sample:
  - Companies that completed the majority of the survey, i.e. until part 6 about questions about job tasks and qualification requirements (chapter 3), and
  - Companies that replied to the majority of questions in the survey.

[1] Contacts and email addresses were provided by MMRI (Chulalongkorn University).

Information about companies in the sample

- As a result only 56 companies could be considered in the final sample, which was used for the following data analysis.
- Furthermore, 7 companies participated in the pre-test of the survey. These cases were included in the major sample, as no changes were made to the questionnaire.
- In total, the final sample for the data analysis consists of answers from 63 companies with a 22% response rate.
- In total, 91 company representatives provided answers for the 63 companies that were considered in the final sample.
- The majority of respondents belong to the management level (see table 1).
- On average, respondents have 10 years of experience in the electroplating industry, and have been working for 9.5 years in the company that participated in the survey.
- In addition, telephone (video call) interviews were conducted with 5 companies, in which 8 company representative from the management level participated.

Table 1: Position and gender of respondents (total number)

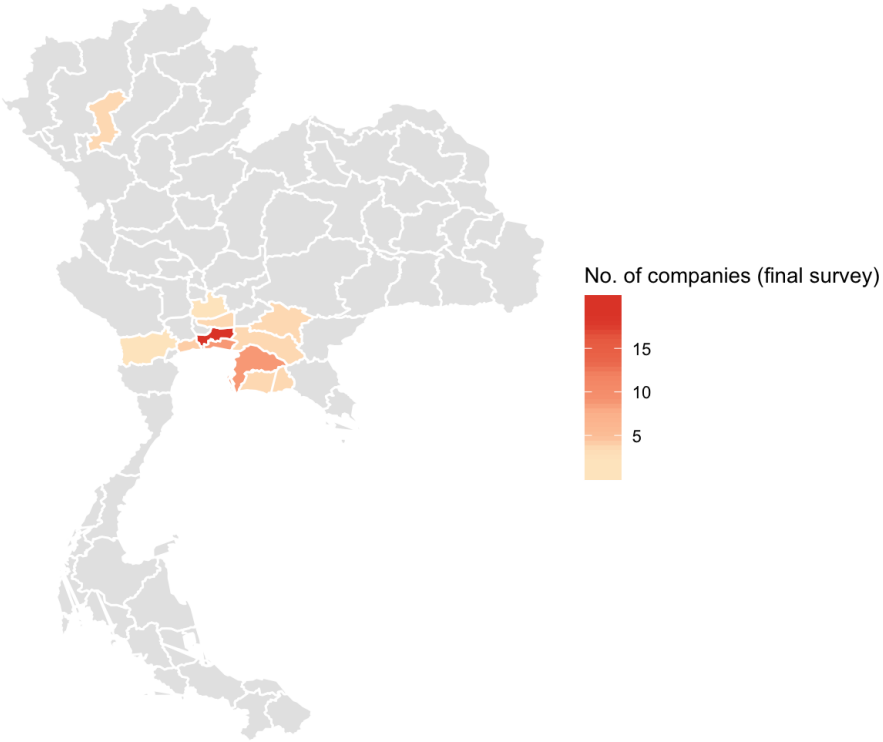
	Male	Female	Sub total
President/Chairman	8	1	**9**
Vice President	2	1	**3**
CEO/Managing Director	11	4	**15**
General Manager	9	5	**14**
HR Manager	-	5	**5**
Manager	19	6	**25**
Supervisor	7	7	**14**
Other	2	4	**6**
Sub total	**58**	**33**	**91**

1.2
Information about company characteristics

1.2.1
Regional distribution

- The majority of companies in the sample are from Central (30%) and Eastern (29%) Thailand as well as the Bangkok area (30%). Furthermore, Lamphun in Northern Thailand, which forms part of the economic center around Chiang Mai appears to be a further area of electroplating production (see Graph 1, for detailed figures see Table 3, Annex)
  - The regional focus of electroplating companies on the Eastern Economic Corridor (EEC) in Eastern Thailand illustrates the significance of contract manufacturing for the electroplating industry: In recent years, the EEC has developed into Thailand's center for export-oriented industry.
  - In view of the survey results, TVET measures focusing on Bangkok and the Eastern Economic Corridor (EEC) appear suited to cater for the labor demand of the electroplating industry in Thailand.
  - Further analysis is required, as to whether the regional distribution of companies in the sample (e.g. the small share of companies from Northern Thailand) is representative for the Thai electroplating industry as a whole (e.g. due to a potential sampling bias). As for the distribution of companies in the survey, no bias is observed in the regional distribution of companies in the original survey (i.e. non-adjusted sample) and those companies that were considered in the final sample.

Graph 1: Distribution of companies by region and provinces (total numbers)



1.2.2
Company types

Information about companies in the sample

- As illustrated in Table 2, of all participating companies in the final sample,
  - 24% (n=14) are small enterprises (<50 employees),
  - 36% (n=21) are medium-sized enterprises (50-200 employees), and
  - 40% (n=23) are large companies (more than 200 employees).

- Differentiating by company type
  - app. 59% (n=35) are job plating companies, and
  - app. 41% (n=25) are companies that have an in-house electroplating department.

- Differentiating by company affiliation
  - 71% (n=41) of the electroplating enterprises in the sample are single, non-subsidiary enterprises, which means that they operate independently,
  - 19% (n=10) are part of an international enterprise, and
  - 10% (n=8) are part of a national enterprise.

- Accordingly, single small- and medium-sized job-plater companies with less than 200 employees in total (i.e. not exclusively in electroplating) form the majority of electroplating companies in the sample (app. 40%).

- Likewise, companies with in-house electroplating departments are largely single enterprises, of which 13% have less than 200 employees (SME) and 11% are large enterprises.

- 50% of the companies in the sample were established between 1990 and 2000 CE (2533 - 2543 BE), i.e. they have a company history of 20-30 years.

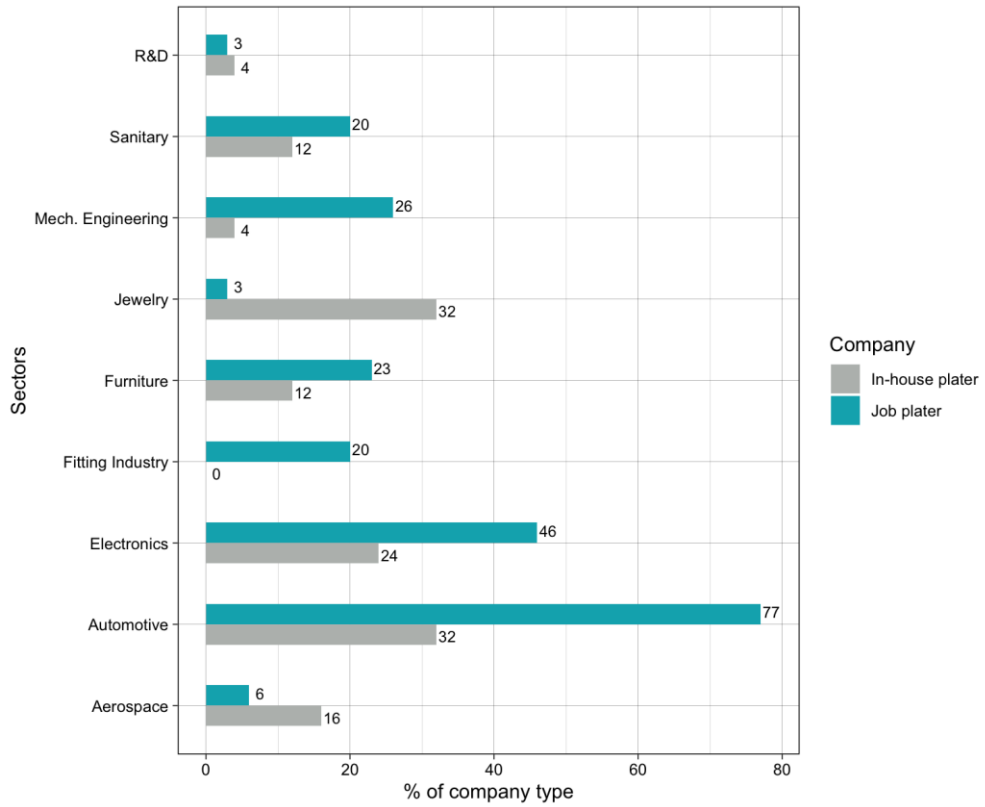
Table 2: Classification of electroplating companies by company structure, size and type (% of total)

		Job Plater	In-house Plater	Sub Total (%)
National enterprise	SME	-	-	**-**
	Large enterprise	6	4	**10**
International enterprise	SME	2	4	**6**
	Large enterprise	4	9	**13**
Single enterprise	SME	40	13	**53**
	Large enterprise	7	11	**18**
Sub Total (%)		**59**	**41**	**100**

Definition of company size by Thailand's Ministry of Industry (2002):
An enterprise in the production sector is categorised as a small and medium-sized enterprises (SME) if it has less than 200 employees. SMEs can be further divided into small enterprises with fewer than 50 employees and medium-sized enterprises with 50 to 200 employees.

Definition of company types:
A 'job plater' is a company whose business model is the sole plating of products for different customers from mostly various industries.
In contrast, an 'in-house plater' plates parts which are manufactured by themselves. In-house platers are therefore usually, but not always, departments of larger companies.

1.2.3
Fields of activity: Sectors of business and applied electroplating methods



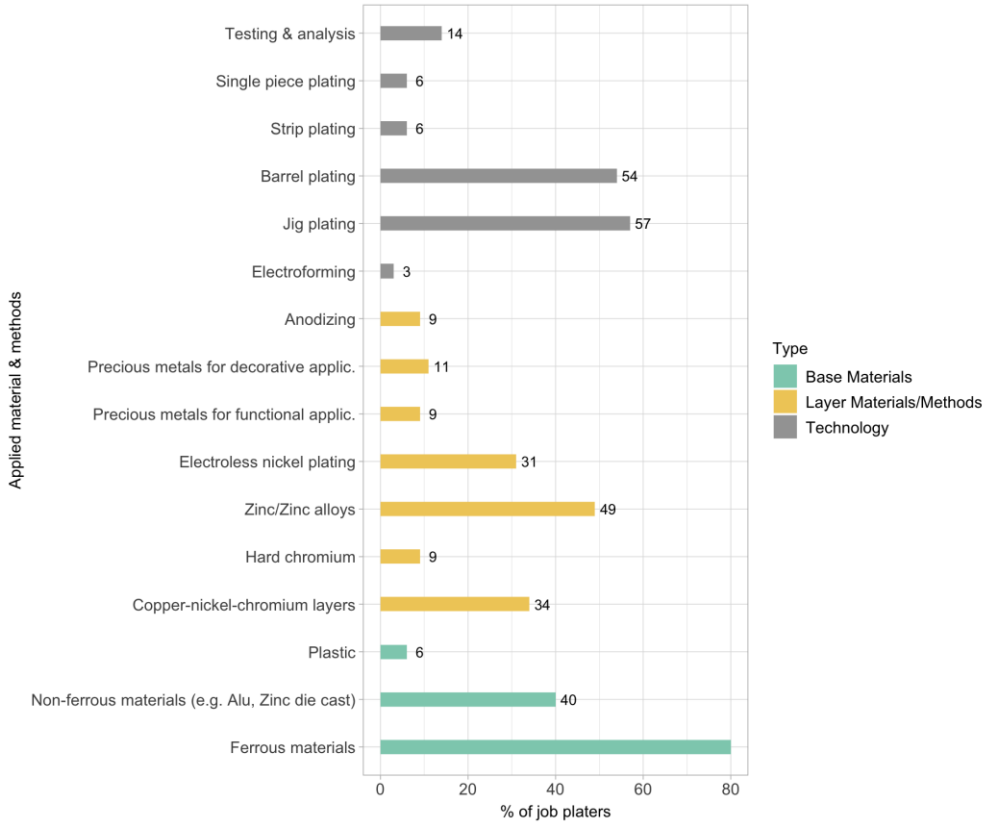
Graph 2: "In which sectors is your company doing business?" (Q8)

- The electroplating companies in the sample have a clear focus on the automotive (59 % of all companies) and electronics (37%) sector. Other industries relevant to the electroplating industry are Mechanical Engineering (16%) and Fitting industry (11%), Furniture (19%), Sanitary (16%), Jewelry (14%) and Aerospace (13%).

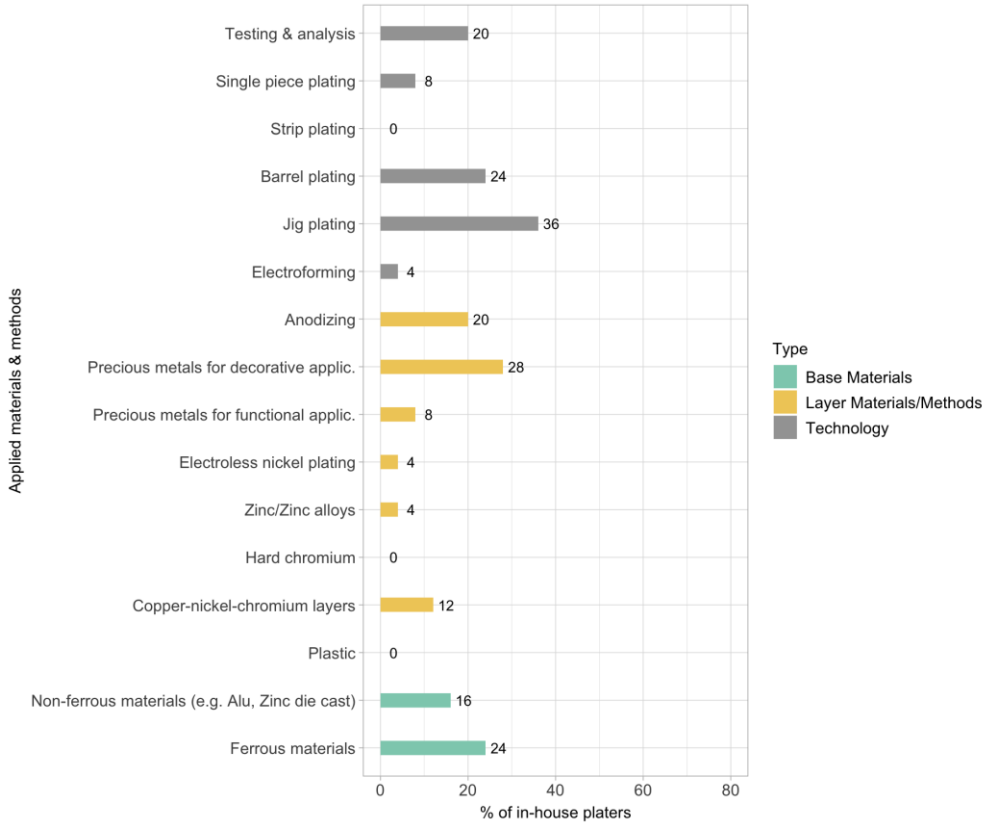
- As illustrated in Graph 2, job plater and in-house plater companies differ substantially with regard to business sectors:
  - On average, *job platers* are active in two business sectors, whereas *in-house platers* carry out electroplating in one sector.
  - *Job platers* prevail in almost all sectors, the predominant focus being on the Automotive (77% of job plater companies) and Electronics (46%) sector.
  - This focus can be explained with the importance of the two sectors for the Thai economy in general: Thailand is the largest manufacturer in the automotive industry in South-East Asia (SEA) and ranks among the 15 largest automotive exporters worldwide. The share of locally manufactured components is 80-90%. In the electronics industry, ASEAN (Association of South East Asian Nations) is the

second largest electronics exporter globally after China, with Thailand being one of the major players in the region.

- These industries will gain further importance in the future as they are also in the focus of the Thailand 4.0 development strategy (as so-called "S-Curve industries") which the government is specifically supporting as drivers of digital transformation (i.e. E-Mobility, Smart Electronics) in particular and economic growth in general.
- It is to be expected that the automotive industry will face major technological changes according with the change from fuel-based drive concepts to e-mobility, for example. Although it cannot be predicted which changes will prevail in the end, it is expected that an increased flexibility of workers based on higher skills and deeper knowledge will be needed for the plating companies to go along with these changes and so to survive economically (see chapter 5.1).
- At the same time, the automotive industry is strongly affected by the current Covid-19 pandemic (see chapter 5.2) and the effects on the sector, e.g. in terms of development of sales and revenues as well as labor demand, remain to be seen.
- In contrast, *in-house platers* dominate in the sectors Jewelry (32%), Aerospace (16%) and Research & Development (R&D) (4%).
- Although a smaller share of electroplating companies is doing business in these areas, it must be taken into account that the Jewelry and Aerospace industry in particular play an important role for the electroplating industry as they have a comparatively big impact regarding sales and added value.
- In particular, the Aerospace sector requires well skilled personnel, which could be an interesting future market for Thailand.



Graph 3a: "Which of the following methods are executed within the company?" (Q9) / Job Platers (Multiple-choice → % do not equal 100)



Graph 3b: "Which of the following methods are executed within the company?" (Q9) / In-house Platers (Multiple-choice → % do not equal 100)

- The survey differentiates between *technology* (i.e. which kind of processes are applied), *base materials* (i.e. what is being plated on) and *layer materials* (i.e. what is being deposited and how).

- On average, the companies each focus on one method/layer material (see yellow bars).

- Answers about the companies` applied technology and methods in electroplating are in line with the relevance of the various business sectors for job plater and in-company plater companies respectively (see Graph 2). This connection will be illustrated through two examples:
  - *Automotive* (important sector for job platers): Ferrous materials (see green bars) as well as the layer materials Zinc and Nickel (see yellow bars) are particularly important for job plater companies in Thailand as they have a strong focus on the automotive sector and these materials are used to build corrosion-resistant parts, which play an important role in automotive manufacturing. Such commonly applied electroplating processes that make use of Zinc/Zinc alloys, Copper-nickel-chromium layers and electroless nickel plating are complex processes that require relevant knowledge and expertise in their application.
  - *Aerospace* (important sector for in-house platers): Non-ferrous materials (see green bars), for example aluminium, that is being anodized (see yellow bars) as lightweight material for airplanes. Again, these processes require highly skilled workers, especially as the aerospace sector is dealing with high specifications regarding the work pieces and parts.

- Surprisingly few companies in the survey apply plating on plastic (PoP) (see Graph 3 job-plater: "Plastic" 6% (n=2)) despite its relevance for the automotive industry (e.g. plastic parts for cars).
  - PoP is considered a comparatively demanding method and hence not many electroplating companies may apply PoP.
  - In Germany only a few companies apply PoP, of which app. 50% is conducted in-house. It is likely that the same applies for the Thai electroplating industry and not all (of the few) companies that apply PoP were reached in the survey. This is linked to the fact that many companies with in-house electroplating departments may not consider themselves as "electroplaters" in the first place and hence, are not active in the industry's network (e.g. MMRI, TEPNET).

- Overall, the results confirm that Thai electroplating companies apply complex processes and methods and are hence quite similar to other electroplating industries worldwide. This also underlines the importance for industry-specific qualification offers to ensure that the Thai electroplating industry is able to meet the demand for high quality plating products.

2
Information about employment in electroplating

Main findings

- Analyses of the employment structure show that the majority of employees in electroplating companies perform mainly simple tasks (66% i.e. 2/3 of employees), whereas 26% of employees (approx. 1/4 of employees) perform mainly advanced tasks and 13% of employees are responsible for complex tasks. This distribution of employees is in line with the experience of the IPA in regard to the employee structure in electroplating companies in Germany and worldwide. The group with advanced tasks corresponds to the group of skilled workers in Germany with a TVET qualification (see chapter 2.1).

- Clear income differences can be observed between these groups, with an average gross monthly salary ranging from 10.000 THB for employees with simple tasks, 15.000 THB for employees with advanced tasks and 25.000 THB for employees with complex tasks. A greater variation in the incomes can be observed between companies for the two latter groups of employees (see chapter 2.1).

- Notably, 2/3 (66%) of employees specifically employed in electroplating are women. This remarkable characteristic in the employment structure can be possibly explained by the fact that (laboratory) analysis and quality control are important areas of work in electroplating technology, in which female personnel are often employed (see chapter 2.1).

- Electroplating companies experiences a high level of staff turnover: App. 50% of companies in the sample offered jobs and app. 80% of companies had employees leaving the company in electroplating & adjacent areas in 2019 CE (2562 BE). The reasons for the high staff turnover in the industry are largely unknown, however, comments by respondents indicate, that in general employment in the electroplating industry is not considered attractive. At the same time, systematic recruitment strategies e.g. on the basis of cooperation with education institutions (e.g. TVET schools) and/or recruitment agencies barely play a role. Instead, companies usually organize recruitment of employees individually (see chapter 2.2).

2.1 Employee characteristics and employment conditions in electroplating

Definition of job groups: For analytical purposes, the survey differentiated three different job groups according to the level of requirements. The following definitions that were validated by Thai industry experts were provided to survey participants as orientation:

Group with simple tasks=
The staff fulfils simple and routine physical or manual work tasks. Employees in this group maximally require basic skills in literacy and numeracy that were obtained through completion of primary education.
A short period of on-the-job training may be necessary to develop an understanding about how to execute tasks.
This group's responsibility is to comply with assigned tasks. They will consult supervisors for help and guidance. *(Examples: Jigger, Grinder, Polisher)*

Group with advanced tasks=
The staff fulfils work tasks, which require advanced literacy and numeracy skills, good interpersonal communication skills and/or high level of manual dexterity.
More specific knowledge and skills necessary for the competent performance of work tasks were either obtained through completion of (upper) secondary education or vocational education and training and/**or** through many years of professional experience and on-the-job-training.
This group's responsibility is to complete assigned tasks more autonomously and to ensure quality of their work. Handling machinery is part of their routines. They might also work closely with and support their colleagues.
(Examples: Machine Maintenance (with a low level of machine automation), Bath Maintenance (e.g. mixing chemicals), Lab Chemist, Quality Controller, Plater (e.g. plating manually), Machine Operator (e.g. operating automated plating lines)

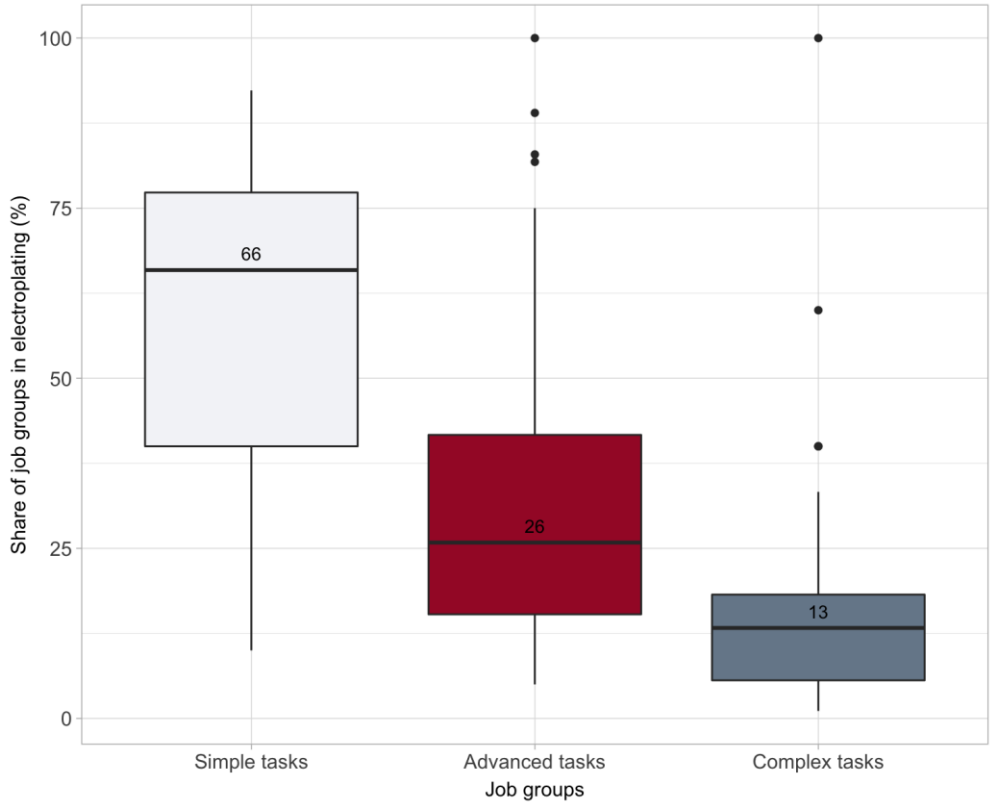
Group with complex tasks=
The staff fulfils complex work tasks (this may include planning and decision-making) which require extensive factual, technical and procedural knowledge and skills in a specialized field, including a high level of literacy and numeracy, well-developed interpersonal communication skills and problem-solving skills.
Their specialist knowledge and skills were usually obtained through corresponding studies at a higher education institution and may require further work experience and on-the-job-training.
This group's responsibility lies in coordinating and supervising the work process and improving quality. They might also ensure occupational health and safety for the team.
(Examples: Maintenance (with a high level of machine automation), R&D (incl. Failure Analysis and Product Development), Process Engineer, Process Planning, Automation Programming / Application Development, Technical Support, Quality Engineer)

Information about employment in electroplating

- To illustrate the typical composition of employee groups (according to the definition of 'job groups') in electroplating companies and/or departments with regard to the quality and level of work tasks and skills required, the ratio for each employee group in electroplating was calculated.
  - Example: number of employees in electroplating with simple tasks / total number of employees in electroplating in company X

- Graph 4 shows the average (=median, therefore not equaling 100%) ratio of employees in electroplating that belong to the respective job groups: Typically, electroplating is conducted by
  - 66 % of employees with mainly simple tasks,
  - 26 % of employees with mainly advanced tasks, and
  - 13 % of employees with mainly complex tasks.

- Job platers and in-house platers show no fundamental differences in the composition of employee groups in electroplating.
  - The result roughly corresponds with the share of the respective job groups in German companies, whereby the group with advanced tasks corresponds to the group of skilled workers in Germany with a TVET qualification.



Graph 4: "How many of the employees working in electroplating and adjacent areas mainly carry out the following work tasks and activities?" (Q16)[2] (% of total)

[2] Each box indicates the most frequent employee ratios observed in the sample, i.e. the most common ratios of employees with simple, advanced and complex tasks of 50% of companies in the sample. The median of the respective employee ratio is marked as a horizontal line in the middle of the boxes. The vertical lines (whiskers) signify employee ratios that were less often quoted by companies in the sample, whereas outlying points i.e. extreme values are plotted individually.

Information about employment in electroplating

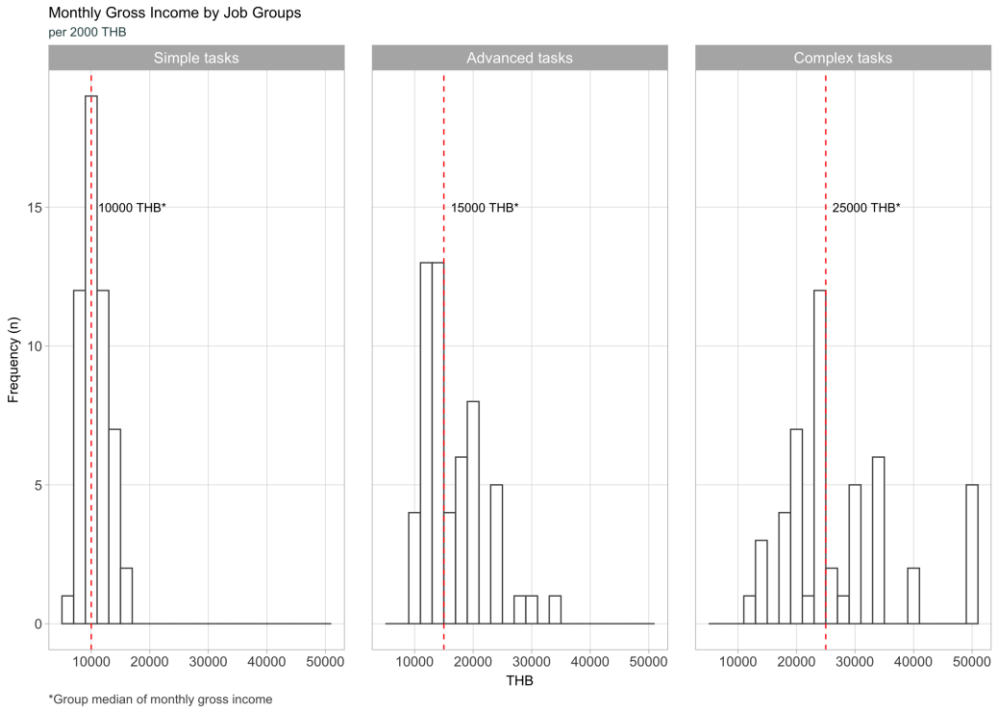
Furthermore, the following characteristics describe employment in electroplating companies:

- On average, app. 85% of employees in electroplating companies are permanently employed, whereas app. 15% of employees have fixed-term contracts (Q26)
  - 20 % of companies in the survey replied to the category "Other type of employment" (without further specification). This indicates that there appears to be alternative employment arrangements in a certain proportion of electroplating companies.

- The average gender ratio of employees working in electroplating and adjacent areas is 66% women vs. 33% men (Q14).
  - This dominance of female employees in the electroplating industry can be explained by the fact that (laboratory) analysis and quality control are important areas of work in electroplating, in which female personnel are typically employed.
  - Further information is needed with regard to the positions held and typical areas of work of women in electroplating companies.

- Although only a small share of companies in the sample provided answers with regard to the educational background of their employees, the results suggest that the majority of employees working in electroplating companies have completed either lower or upper secondary school. Interestingly, the share of employees (of which employers know) with an upper secondary TVET qualification is on average quite small in comparison to the share of employees with a general lower or upper secondary qualification. Furthermore, companies on average report only a small share of employees having completed no or only primary education, whereas app. 10% of employees have a higher education degree (e.g. Bachelor, Master, PhD).

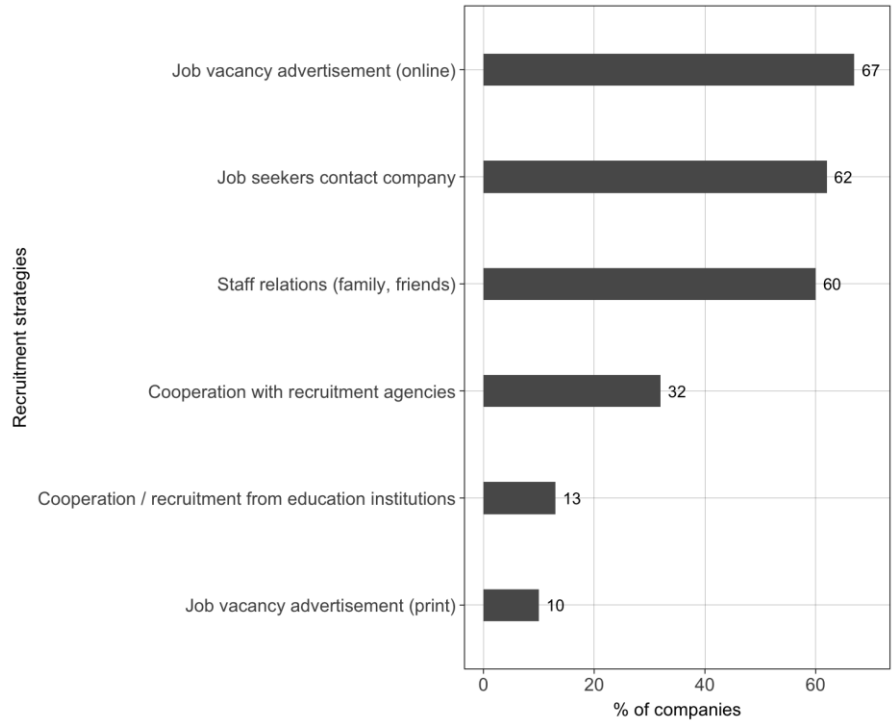
- The median monthly gross salary of employees with simple work tasks is 10.000 THB (~ 270 Euro), 15.000 THB (~400 Euro) for employees with advanced work tasks and 25.000 THB (~670 Euro) for employees with complex work tasks.
  - Salaries for employees with advanced and complex tasks show more variation among companies. It is not possible to explain this variation in salaries in the sample with potential determinants such as the company type (job platers / in-house plater), affiliation (single/national/international enterprise), company size or sectors of business.
  - Further information is required on how these salaries compare to other industries, as earning opportunities are an important determinant for the attractiveness of employers.
  - Future activities that aim at the planning and development of training and qualification measures also have to address such questions in order to ensure sufficient incentives for employees to participate in further training.



Graph 5: "What is the current average gross monthly salary of a full time employee with the respective work task in electroplating and adjacent areas?" (Q27)

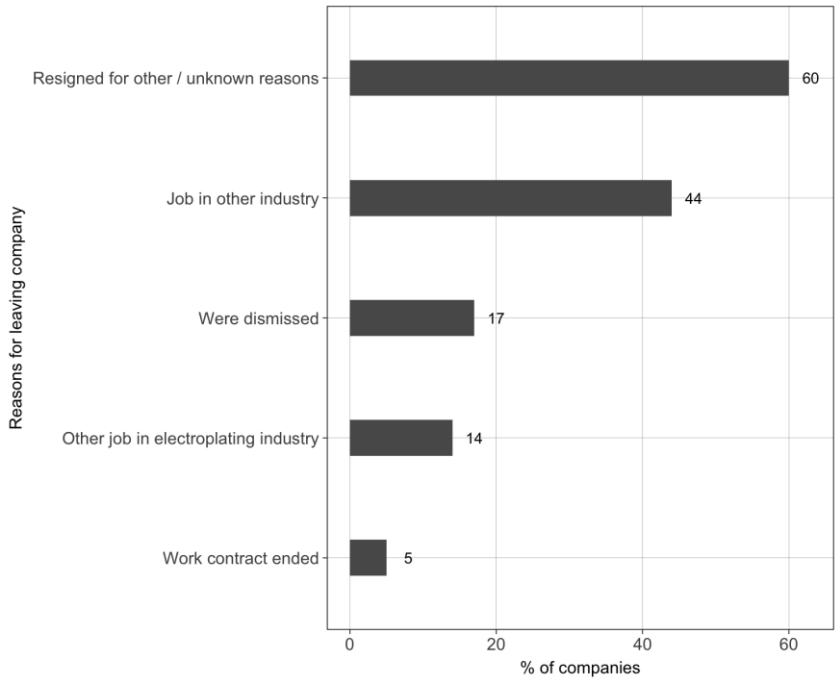
2.2
Recruitment behavior of electroplating companies

- 54% of companies offered jobs in electroplating & adjacent areas in 2019 CE (2562 BE) (Q17)
  - The results about common recruitment strategies indicate that the majority of companies organize recruitment individually, whereas cooperation with education institutions (e.g. TVET schools) barely seem to play a role for the industry (see Graph 6 as well as chapter 5.3).
  - In light of the regional focus of the electroplating industry on Bangkok and the EEC, the strengthening of cooperation between selected TVET institutions and the companies could greatly benefit the industry and improve the quality of TVET electroplating programs in the future.



Graph 6: "Which of the following recruitment strategies does your company use to hire new personnel?" (Q22) (Multiple-choice → % do not equal 100)

- 81% of companies had employees leaving the company in in 2019 CE (2562 BE) (Q23)
  - The results indicate that the majority of employees leave their companies on their own initiative - mostly for unknown reasons - in contrast to those that the company let go. A relatively large share of companies in the sample state that employees left to other industries (44%) (see Graph 7).
  - The reasons for employees leaving are largely unknown, however, comments by respondents indicate, that the electroplating industry in general is often not attractive for employees and Thai people don't want to work in Electroplating (n=8 companies). Reasons named by companies were, e.g. that electroplating is considered a dirty job and people nowadays prefer other jobs than working in a factory. One company (n=1) mentioned that there are no advocates for the industry.



Graph 7: "What have been the most common reasons for employees leaving the company?" (Q25) (Multiple-choice → % do not equal 100)

3
Analysis of job tasks & characteristics

Main findings

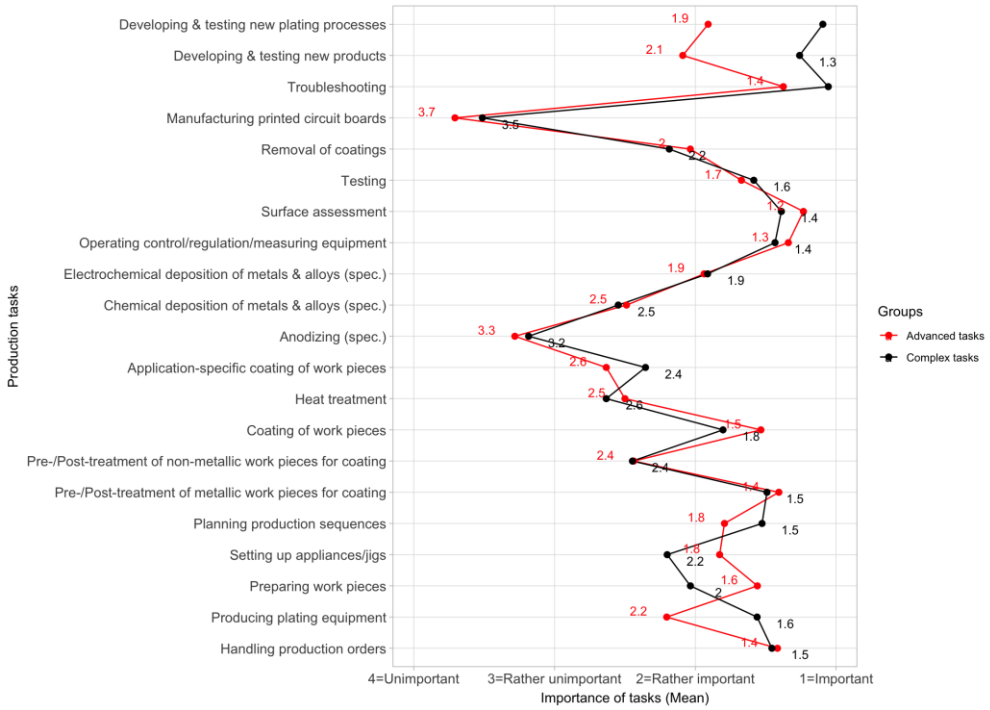
- Results about the importance of work tasks indicate that the job characteristics and typical work tasks of employees with advanced tasks and employees with complex tasks mainly differ with regard to the character of their responsibilities: Employees with advanced tasks are mainly responsible for daily "routine" tasks, within one company cost center, whereas employees with complex tasks are more involved in "non-routine", i.e. not necessarily daily tasks within various processes (e.g. more cost units) that require a broader overview. Nonetheless, a substantial "overlap" with regard to the importance of tasks can be observed for both groups of employees. This "overlap" is interpreted as a necessity, since people executing complex tasks, need to be able to execute advanced tasks (at least in theory) and need to understand the whole process and the respective tasks in order to fulfil their role (see chapter 3.1).

- With regard to characteristics of work, employees with advanced tasks and employees with complex tasks mainly differ in the extent of routine tasks, the variety of work tasks in their respective jobs and with regard to the level of autonomy in their jobs (see chapter 3.2).

- With regard to skill requirements and existing skill gaps of employees, the results indicate that a majority of employees lack fundamental skills in electroplating including both basic skills and knowledge (such as basics of electrochemistry) as well as highly specialized skills and knowledge (such as troubleshooting and failure analysis). Furthermore, the survey results about common reasons for quality problems in electroplating companies suggest that a lack of communication/ communication skills of employees can be considered a root cause for many problems. Overall, the results provide clear indications for the content and design of qualification offers in electroplating in both initial TVET for students/future employees as well as continuing TVET for current employees (see chapter 3.3).

The current chapter focus on similarities and differences in the characteristics of work tasks, required skills and observed skill gaps of employees with advanced tasks and complex tasks to gain a better understanding about skill requirements in the electroplating industry.
No focus was put on employees with simple tasks, as they fulfil simple and routine work tasks that do not require any specific knowledge or skills (see definition of job groups in chapter 2). Hence, this group is not in the focus of future TVET measures.

3.1 Importance of work tasks for employees with advanced tasks vs. complex tasks



Graph 8: Importance of work tasks in production (Q28a)

- As Graph 8 shows, the importance of work tasks in production is often very similar between employees with advanced tasks and employees with complex tasks (illustrated in the overlapping of lines). Hence, the knowledge about the respective tasks should ideally by similar, although employees with complex tasks may require broader background knowledge to fulfil their tasks.

- Statistically significant differences[3] in the importance of work tasks between the employee groups can be observed for
  - Producing plating equipment***
  - Preparing work pieces***
  - Planning production sequences***
  - Troubleshooting**
  - Developing and testing new products***
  - Developing and testing new plating processes***.

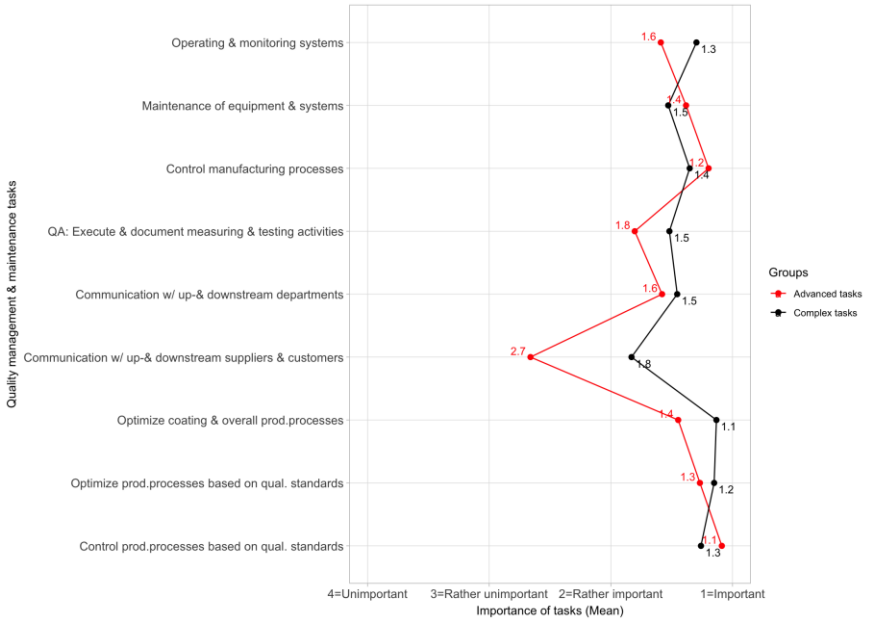
[3] A statistical significant result in the comparison of the importance of work tasks between the two groups suggests, that the observed differences are very likely systematic (i.e. the differences are not attributed to chance). The level of statistical significance is indicated with *** = p<0.01 and ** = p<0.05.

- These differences illustrate that the two job groups mainly differ with regard to the character of their responsibilities:
  - (1) Employees with advanced tasks (comparable to a "Vorarbeiter" in Germany, which typically is a person with a dual vocational training background) are mainly responsible for daily "routine" tasks, within one company cost center such as preparing work pieces or un-/jigging of parts.
  - (2) Employees with complex tasks (comparable, e.g. to a "Techniker" in Germany, which is typically a person with a dual vocational training background and specific further education and training on top) are more involved in "non-routine", i.e. not necessarily daily tasks within various processes (e.g. more cost units) that require a broader overview, such as
    - Producing plating equipment,
    - Planning production sequences,
    - Troubleshooting,
    - Development and testing of new products and/or plating processes.

- The same differentiation with regard to the area of responsibilities (i.e. routine tasks for employees with advanced tasks vs. more non-routine tasks for employees with complex tasks) is observed for work tasks in the areas of quality management & maintenance as well as environmental engineering (see Graph 9 and Graph 10).

- Interestingly, not all typical routine tasks in electroplating production, such as setting up appliances, coating work pieces, operation of control, regulation and measuring equipment as well as surface assessment show significant differences in their importance for the respective employee groups. Rather they are considered on average as equally important for both, employees with advanced and complex tasks. This is because in order to fulfil complex tasks, an employee needs to understand the whole process and should be able to fulfil advanced tasks, too, even if they mainly execute complex tasks.

- Specialized work tasks such as anodizing, chemical deposition of metals and alloys and manufacturing of printed circuit boards are on average less important/rather unimportant for electroplating companies in the sample. This indicates that these methods are usually not applied.



Graph 9: Importance of work tasks in quality management & maintenance (Q28b)

- As discussed before, the differences in the importance of work tasks in quality management and maintenance between job groups can be explained with differences in the responsibilities for daily tasks vs. broader processes. In particular, statistically significant differences[4] are observed for the following (non-routine) tasks:
  - Optimizing production processes based on quality standards**
  - Optimizing coating and overall production processes***,
  - Communication with up- and downstream suppliers and customers***,
  - Executing and documenting measuring and testing activities (QA)**,
  - Operating and monitoring systems***.

- External communication, i.e. with suppliers and customers marks the biggest difference, as it is overall rated as the least important task in comparison to other tasks.

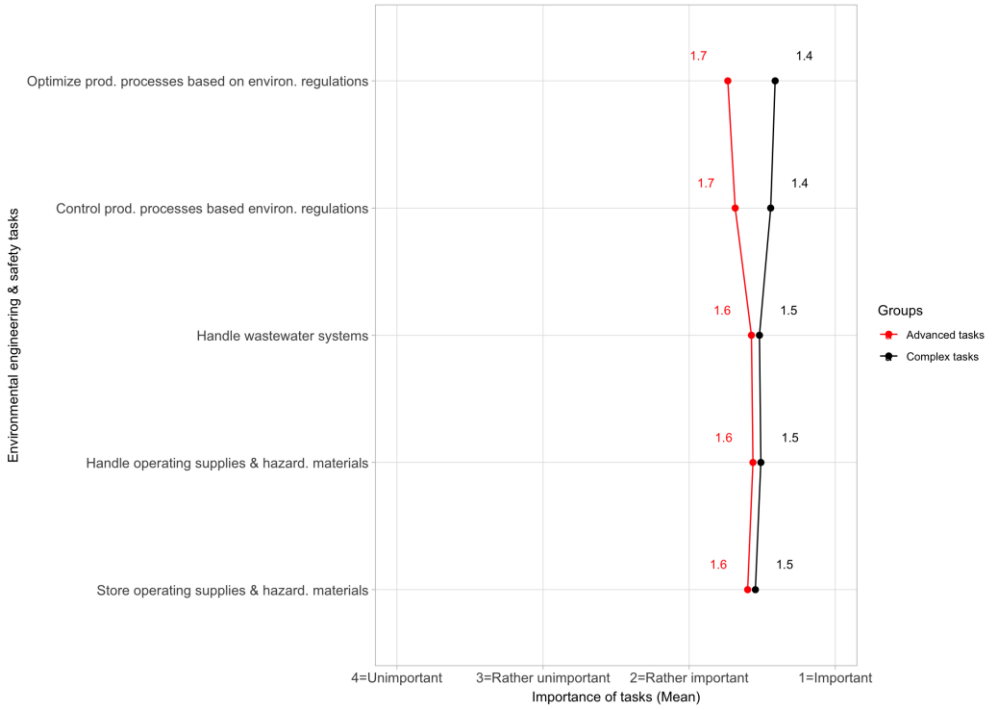
- Furthermore, companies consider this task as rather unimportant for employees with advanced tasks. One possible explanation is that external communication is considered a non-routine task by the companies, which is usually not taken over by this group of employees. This is potentially reinforced by the importance of hierarchy in the Thai society.

- In light of the common problems that electroplating companies face (see Graph 13), it is important to note that the root of the problem can be often considered a lack of communication.

- This result is also in line with statements from company interviews that issues in quality management and maintenance are "more about people, rather than machinery" and that "problems arise in the communication chain".

- IPA and MMRI experience, especially regarding troubleshooting, confirm the potential lack of communication and/or skills in electroplating companies in Thailand. Employees are often not able to communicate well enough with customers and suppliers, as the following comment illustrates: "Companies would like a technician to make the call because he/she knows about the technical details, but in reality it is the company management who makes the call."

[4] See explanation in footnote 3.



Graph 10: Importance of work tasks in environmental engineering and safety precautions (Q28c)

- Similarly, the differences in the importance of work tasks with a focus on environmental engineering and safety precautions between job groups can be explained with differences in the responsibilities for daily tasks vs. broader, non-routine processes. In particular, statistically significant differences are observed for the task of optimizing production processes on the basis of environmental regulations (**p<0.05).

- The results raise questions about a potential social desirability "bias" in the answers of respondents (at least to an extent), as all tasks are on average rated as (rather) important and there is hardly any distinction made between the two groups.
  - Since the consequences of potential skill gaps and/or the neglect of these tasks will occur only at a later point, the importance that companies attach to these tasks doesn't allow any conclusion about whether employees can actually handle tasks.
  - Being able to handle work tasks regarding environmental safety is thus important for both job groups and hence should be considered in any TVET measure.

3.2 Characteristics of work in electroplating

"Please rate to which extent the following opposing statements adequately characterize the nature of the jobs of employees with advanced tasks vs. those with complex tasks:" (Q29)

Degree of complexity

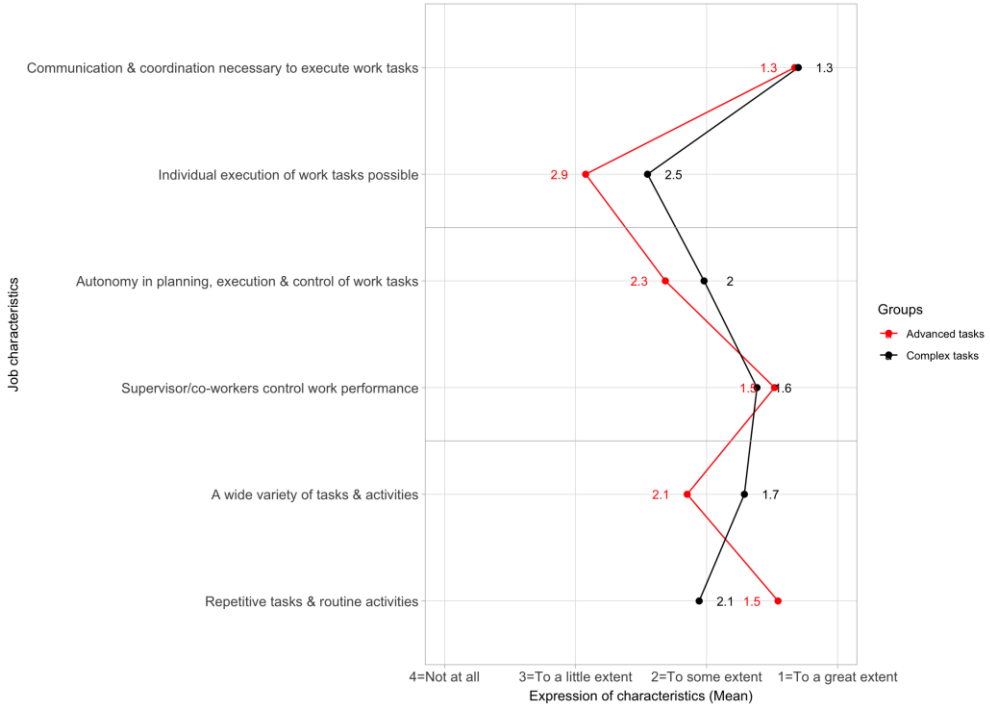
- Their job mainly encompasses repetitive tasks & routine activities vs.
- A wide variety of tasks and activities

Degree of autonomy & responsibility

- A supervisor/co-worker usually oversees tasks & activities and controls the work performance vs.
- The employees are autonomous in planning, execution & control of their work tasks

Degree of interaction/self-initiative required

- The execution of work tasks usually can be handled individually vs.
- Communication & coordination with co-workers is usually necessary to successfully execute work tasks



Graph 11: Job characteristics (Q29)

- In general, the results confirm the analysis results about main differences between job groups with regard to their responsibility for work tasks:
  - On average, the work of employees with advanced tasks encompasses more repetitive and routine activities (mean=1.5) and a smaller variety of tasks and activities (mean=2.1). They are less autonomous in the planning, execution and control of work tasks (mean=2.3) and can execute work tasks individually only to a small extent (mean=2.9).

- In contrast, employees with complex tasks on average face a wider variety of tasks and activities in their work (mean=1.7), and only to some extent repetitive tasks and routine activities (mean=2.1). They have more autonomy in the planning, execution and control of work tasks (mean=2.0) and more possibilities to handle the execution of work tasks individually (mean=2.5)[5].
- Nonetheless, both groups largely require communication and coordination (within the company/work team) to execute work tasks (mean=1.3). This result confirms the overarching significance of communication and teamwork skills for electroplating employees.

- The results also confirm, that supervisors play a crucial role in the organization of work processes in Thai electroplating companies: For both employee groups, the supervision by a (senior) co-worker takes place to a considerable extent (mean=1.6 vs. 1.5). This was repeatedly confirmed during interviews with company representatives.
  - Further analysis is needed with regard to the role & position of supervisors in the work organization of electroplating companies.

3.3 Skill requirements and skill gaps in electroplating

- The results in Graph 12 show that the importance of skills and competencies for employees in electroplating differs considerably (in the present and in the future) according to the assessment of companies in the survey.

- Whereas most skills and competencies are rated (rather) important, the importance of math skills, reading of mechanical drawings, (Technical) English, handling of IT as well as networked systems is rated below average.
  - Experts confirm that the importance of math for electroplating processes is often underestimated.
  - The comparatively low importance of reading mechanical drawings can be explained with the fact that this skill is relevant only for very specific work tasks and hence not as important as other skills that are usually required in electroplating.
  - The low importance of English confirms the fact that the use of English in the professional context is not yet the norm in Thailand, although it would be required at least for certain tasks to ensure the smooth performance of work tasks (e.g. reading of instructions e.g. for operating machines, handling chemicals etc.)
  - The comparatively low importance of IT-related skills can be possibly explained with an - on average - low level of automation of electroplating plants. Furthermore, it is possible that companies employ specifically skilled staff for tasks that require the handling of IT and networked systems.

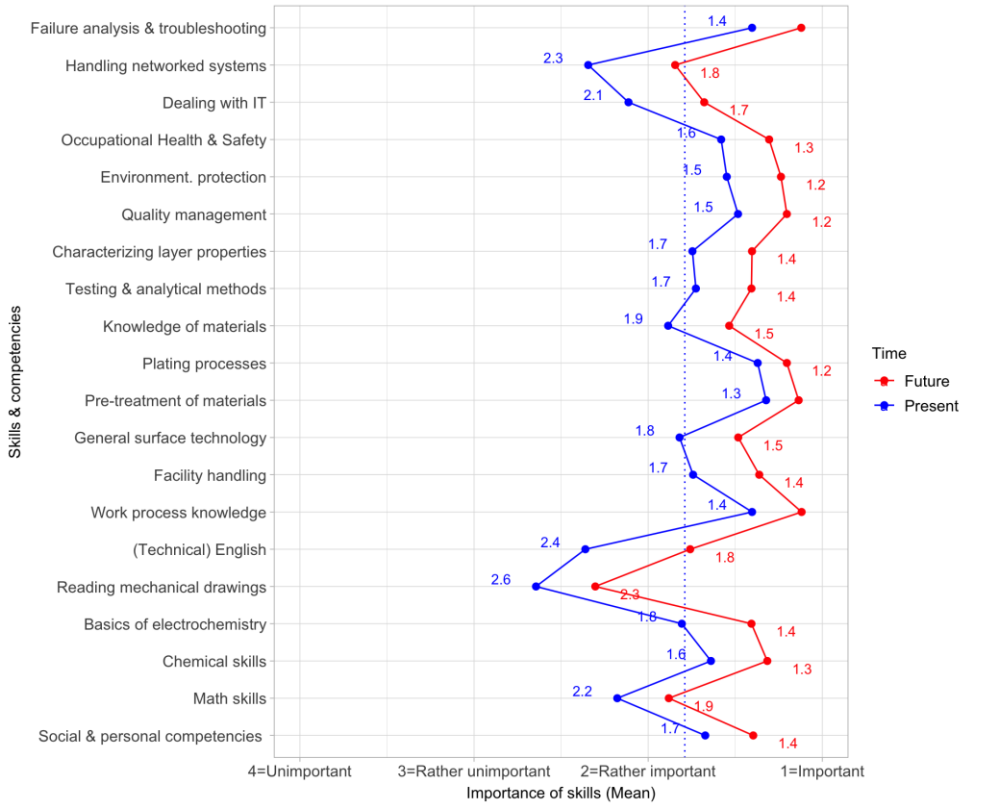
- On average, companies consider all skills to become more important in the future. One plausible explanation is that most electroplating companies in Thailand currently consider themselves to perform "below international standard" and hence their answers illustrate the general aspiration of the industry to improve in every aspect.

- The results in Graph 13 illustrate three major findings with regard to skill gaps that employers have identified among their employees in electroplating.

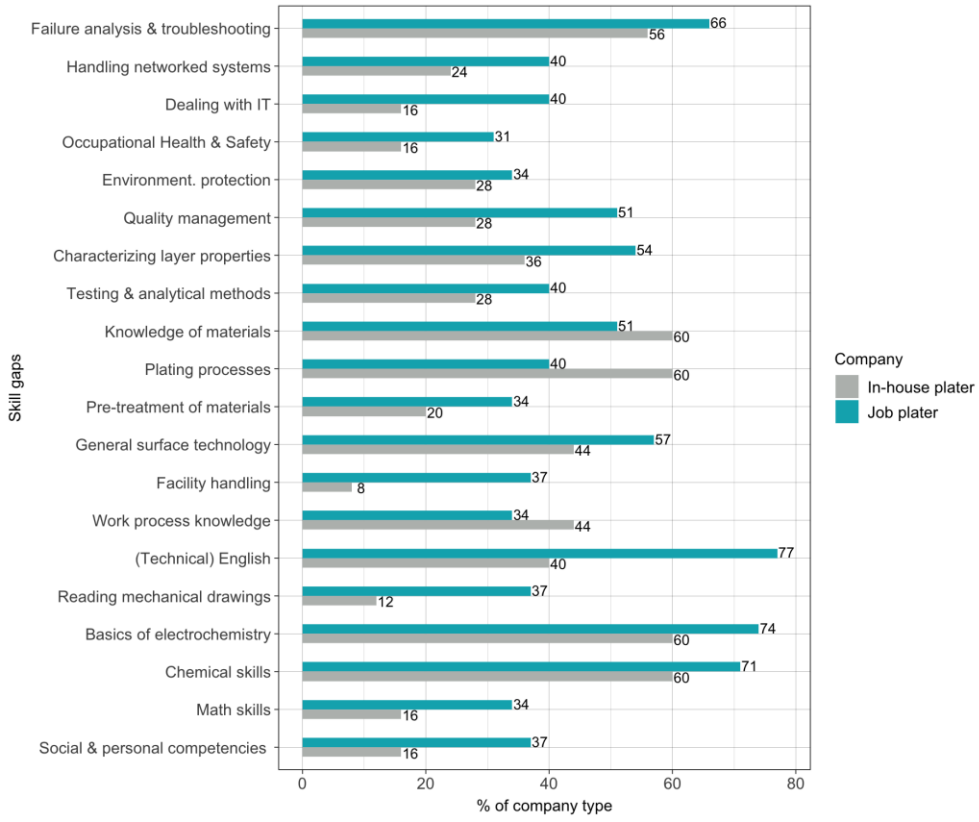
[5] The described differences between the employee groups are statistically significant ($p<0.01$).

- (1) The answers of in-house and job platers differ considerably: For most skills, a higher share of job platers state skill gaps of their employees. Particularly marked differences (+/- 20 %) can be observed for
  - Social and personal competencies,
  - Math skills,
  - Reading mechanical drawings,
  - (Technical) English,
  - Facility handling,
  - Quality management,
  - Dealing with IT.
- (2) Certain skill gaps appear to be a general concern in the electroplating industry, as the majority (+/- 50%) of job platers and in-house platers reports skill gaps:
  - Chemical skills,
  - Basics of electrochemistry,
  - General surface technology
  - Knowledge of materials,
  - Failure analysis and trouble shooting.
- (3) Interestingly, a higher share of in-house platers in comparison to job platers (+/-20%) state skill gaps with regard to
  - Plating processes,
  - Knowledge of materials
  - Work process knowledge.

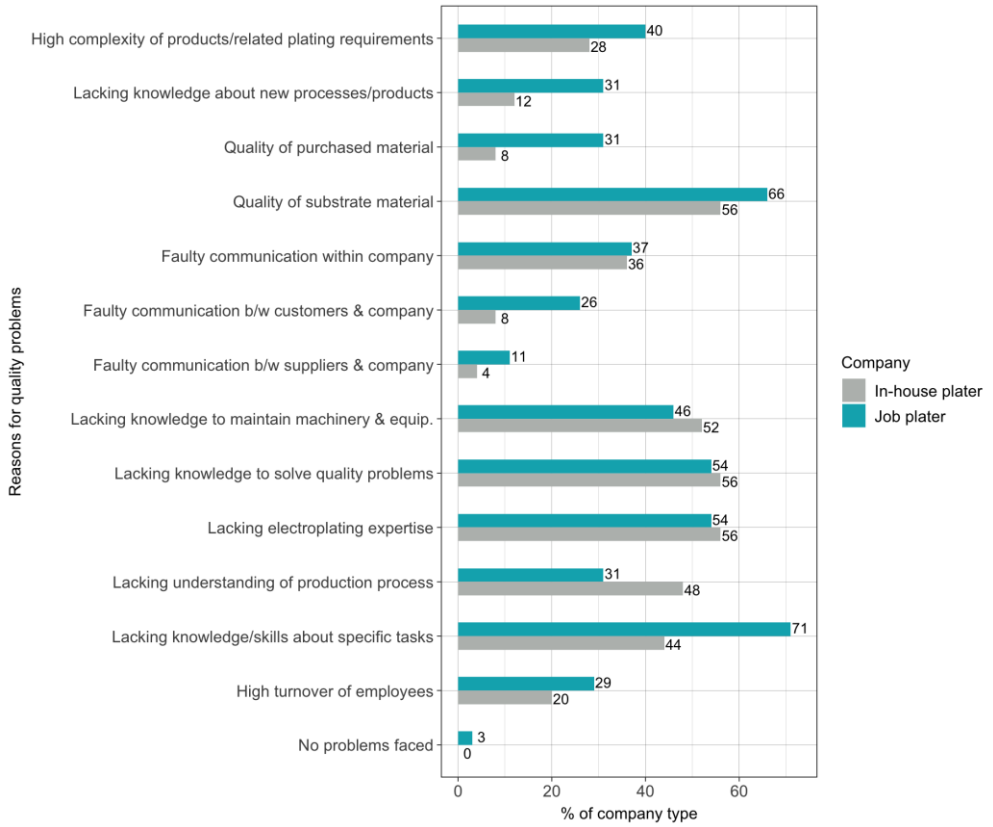
In particular, the skill gaps reported by the majority of all companies (see point 2) are alarming, as these skills are on average rated as important by electroplating companies (see Graph 13 left).
Thus, the results indicate that current employees lack fundamental skill requirements in electroplating including both basic knowledge (such as basics of electrochemistry) as well as highly specialized knowledge (such as troubleshooting and failure analysis). Therefore, future TVET programs should put a particular focus on these skills and competencies (in both initial TVET for students/future employees as well as continuing TVET for current employees and future specialists).



Graph 12a: Analysis of important skills & competencies in electroplating (Q31)



Graph 12b: Analysis of current skill gaps (Q32)



Graph 13: "If you think about problems with regard to the quality of electroplating products and/or processes, what are the main reasons for such problems in your company?" (Q30)

- The results in Graph 13 illustrate two major findings with regard to reasons for quality problems in electroplating companies:
  - (1) The main reasons identified by the majority of in-house platers and job platers (+/- 50%) are
    - Lacking knowledge about specific tasks,
    - Lacking electroplating expertise,
    - Lacking knowledge to solve quality problems,
    - Lacking knowledge to maintain machinery and equipment, and
    - The quality of substrate material[6].
  - (2) Although not quoted in the questionnaire, a lack of communication can be considered as one root cause of those problems.
    - For instance, there is no standard solution to address the issue of faulty substrate materials. Teaching employees about material science might be one step. However, to avoid problems with the quality of substrate materials communication with suppliers is key.
    - The same applies for the lack of knowledge to solve quality problems: It is important to have a broad background knowledge and knowledge about methods to solve problems, but communication is important, too.
    - The small shares of companies (predominantly job platers) that consider "faulty communication" (both ways) as reasons for quality problems indicates, that company representatives possibly don't see the connection to quality problems and/or don't see communication as a solution to actively work on issues with regard to faulty substrate materials and quality problems.

[6] Substrate material is the material that is being coated. If this material, or work pieces made of this material, is faulty and for example comes with fine cracks and fissures, the electrodeposition won't work well. Problems arising because of this, cannot be fixed by electroplaters.

- In this context, communication also implies, how information is presented to suppliers (e.g. is there data, how can I show it, make examples etc.)
- Interestingly, Graph 11 shows that company representatives are in principle aware about the importance of communication to execute work tasks.

The following additional information regarding required quality control knowledge within companies was gathered during expert interviews with company representatives:

- 1 company had introduced a 30-min daily shop floor meeting every morning in which all employees participate to discuss work to be done (not common in companies, but a potential "good practice")
- 3 out of 5 companies emphasize that employees not only need the "the right" qualification, but they also need to be motivated and willing to learn new things, require discipline and flexibility and be able to properly communicate.
- This confirms earlier assumptions about the importance of communication.
- Amongst other things, company representatives mentioned that it is important that employees also have a broad knowledge and understanding of the processes and the competence to apply this knowledge to practical problems (so-called action-competence).

4
Existing training activities

Main findings

- The majority of companies (97%) provide basic on-the-job training to ensure basic work skills and capabilities of newly hired employees. However, such training activities are by no means systematic with regard to the organization and content of such training activities, they are usually conducted by senior employees (supervisors and/or managing staff) and vary considerably in duration (see chapter 4.1).

- Likewise, a majority of companies (75%) report to provide short-term training for employees that usually take place on site either with the support of an in-house trainer and/or external trainer. However, such trainings usually seem to address rather general skill and/or knowledge requirements that are not necessarily focused on technical skills and knowledge in electroplating (see chapter 4.2).

- Answers about (potential) obstacles in the provision of training offers indicate that limited time and financial resources are a major limiting factor in the planning and provision of systematic training for current employees. Hence, the feasibility of possible training formats as well as adequate funding models should be discussed early with the industry and taken into account for further planning to ensure the relevance of training offers (for first suggestions see chapter 4.3).

4.1
On-the-job training for newly hired employees

- 97% of companies provide specific instruction (on-the-job training =OJT) to newly hired employees
  - In 76% of companies, senior co-workers (and/or supervisors) are responsible for OJT, in 17% of companies, management is responsible for OJT, and 8% of companies have external training agencies providing training to new employees.
  - The average duration (=median) of OJT varies across companies between 9 days (n=40) up to 3 months (n=18).
  - In the former group of companies that provide several days of OJT, differences occur in the length of OJT between job platers (median = 7 days) and in-house platers (median =10 days), whereas no differences exist in the latter group.
  - The typical level of performance of newly recruited employees vs. a skilled worker with a working performance of 100% is assessed
    - at an average level (=median) of 20% before OJT,
    - at an average level (=median) of 70% after OJT.

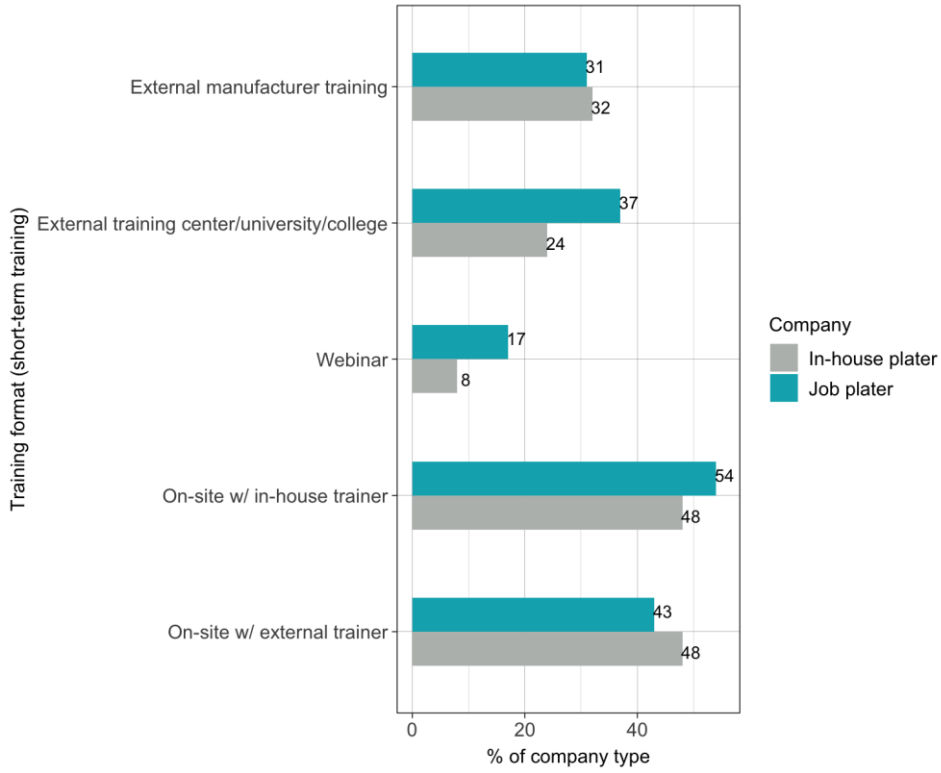
- During expert interviews with company representatives the following information with regard to the organization of OJT was collected:
  - In line with the survey results, 4 out of the 5 companies stated that they offer OJT on a regular basis, although duration and methods vary (here: between a few hours up to six months). 1 company only offers OJT from time to time and need-based, e.g. when problems arise.
  - In all 5 companies, employees on worker level receive instructions about how to fulfil their works during the regular work process. 2 companies focus on the provision of background information and knowledge, but only for employees in technical positions.

- All companies say that supervisors mainly conduct OJT. Sometimes other experienced workers or even managers also give the instructions to new employees.
- 4 out of 5 companies expect that the provision of training to supervisors could benefit the company and the quality of OJT provided to new employees. 2 companies say that supervisors still lack theoretical knowledge and need a broader background, e.g. about processes.
- 1 company says that time is a crucial factor regarding training and getting behind the "why" of certain tasks.

4.2 Further training offers in the past year

- Beyond basic OJT, further training opportunities that are already being offered by electroplating companies can provide important insights about existing approaches to ensure further training of employees.

- 75% of companies in the sample enabled employees to participate in further short-term training measures in 2019 CE (2562 BE).
  - Training duration ranged from 1 to 8 days; the average duration was 1 day (median)
  - Short-term trainings of the companies in the survey addressed the following topics:
    - Basics of electroplating (n=10)
    - Quality management = ISO Systems/5S/Production Processes (n=9)
    - Safety = Chemicals/Firefighting/General OHSP (n=8)
    - (Plating) Process knowledge (n=5)
    - Use of measurement equipment (n=4)
    - Technical knowledge (n=3)
    - Soft skills (n=3)
    - Machine maintenance (n=3)
    - Wastewater treatment (n=2)
    - New plating methods (n=2)
    - Mixing chemicals, Leadership, Troubleshooting, Material testing, Compliance, Ability assessment, Crane controlling, Electrophoretic deposition, Electrochemistry (n=1 each)
  - The content of the training suggest that many short-term training address general skills and knowledge that are not necessarily focused on electroplating work tasks (e.g. quality management systems, safety training, machine maintenance, soft skills etc.), whereas only a small number of companies cite training topics that address specific aspects of electroplating (e.g. plating process knowledge, plating methods or wastewater treatment etc.).



Graph 14: "In what kind of format were those short-term training measures offered?" (Q38) (Multiple-choice → % do not equal 100)

- As Graph 14 illustrates, most in-house plater and job plater companies provide short-term training on site either with the support of an in-house trainer and/or an external trainer.
  - The high percentage of external manufacturer trainings can be possibly explained with the important role that (chemical) suppliers seem to play in the electroplating industry with regard to training (mentioned in expert interviews)
  - A higher share of job platers in the sample offered external trainings at a training center or similar (37% job plater vs. 24% in-house plater)
  - Webinars currently don't seem to play a role as means of short-term training: 17% of job platers and 8% of in-house platers in the sample used this format to provide short-term training to employees.

- Only 6% of companies enabled employees to participate in further long-term training measures
  - Formats of long-term training: On-site training with internal trainer (n=2), on-site training with external trainer (n=2), at a training center/university/college (n=2), external manufacturer training (n=1)
  - In light of the average duration of short term training (1-8 days), it remains open what is understood as "long-term" training by companies

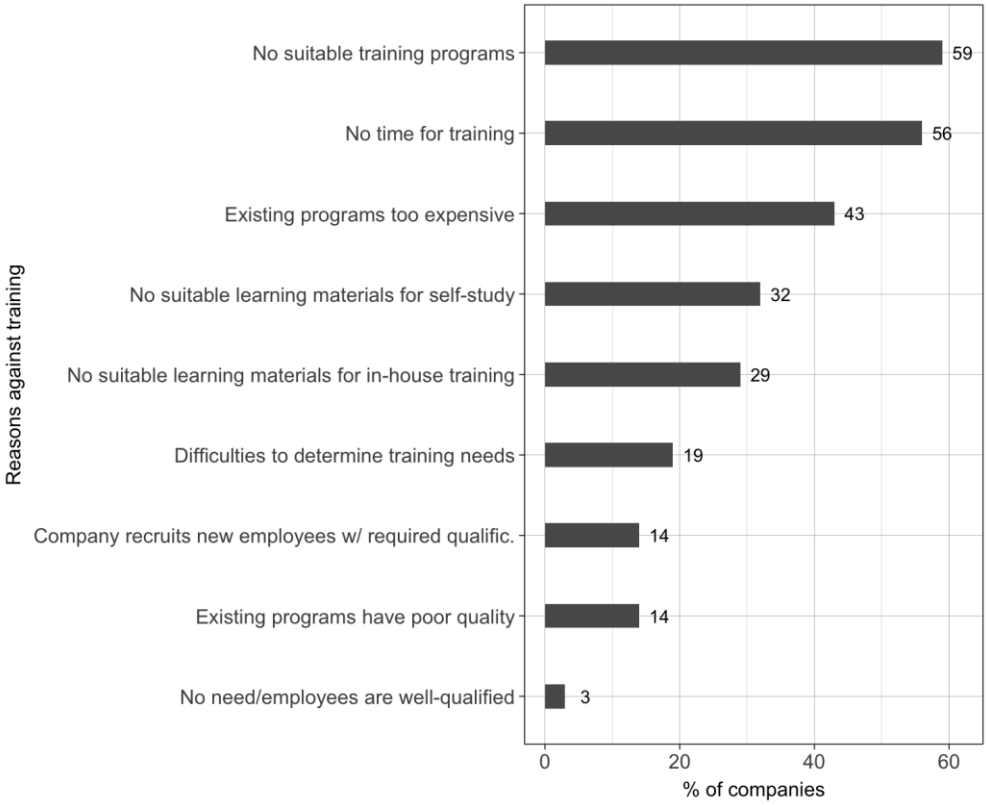
- 24% of companies did not offer any opportunity for further training

4.3
Reasons for or against offering training to employees in the electroplating industry

- Regardless of whether companies provided further training or not, 95% of companies see a need for (more) training and qualification measures in the electroplating industry in general.

- Further training is considered most useful/beneficial for the following groups of employees by x % of companies that see a need for training:
  - Long-term employees (87%)
  - Newly-hired employees (46%)
  - Applicants[7] (14%)

- This underlines statements from expert interviews regarding OJT, that the training of supervisors – usually experienced, long-term employees – could be potentially beneficial for companies.



Graph 15: "Regardless of whether your company has offered training measures or not, what are the concrete obstacles or reasons for not offering any training measures for employees?" (Q43) (Multiple-choice → % do not equal 100)

- Graph 15 shows that the major obstacles cited by companies in the sample[8] with regard to training provision are
  - A lack of suitable training programs (59% of companies in the sample),
  - A lack of time for training (56%), and
  - The costs of existing offers are considered too expensive (43%).

[7] This answer option was possibly misleading for companies in case they assumed that the training should be provided and/or paid for by the companies.
[8] No major differences are observed in the answers of in-house plater and job plater companies.

- With regard to the latter, it remains to be discussed, what companies consider "a too expensive" training.

- 2 companies mentioned during expert interviews, that trained employees are not necessarily able to apply the new knowledge; so they do not see a proper outcome of training. This indicates that existing (TVET) measures do not necessarily focus on applicability of course content.

- With regard to the planning of TVET measures, the results of the chapters 4.1 – 4.3 indicate, that apart from the planning and provision of training that meets the demand of employees and companies, it is crucial that TVET measures also take the limited resources of companies (in terms of time and money) into account. Accordingly,
  - TVET measures should focus on both, initial TVET for students as well as continuing TVET for current employees.
  - TVET measures for current employees should be designed as short-term trainings that follow a modular principle, so that companies can individually decide how much they are willing to invest, while ideally also taking the training needs of their employees into account.
  - A particular focus on the training of supervisors could be a cost-effective approach to raise the quality of on-the-job training provided to new employees and hence have a positive effect on the skill development of employees as a whole.
  - The feasibility of combining remote (online) learning with face-to-face trainings should be assessed, as a blended-learning approach offers a potential solution to mitigate time and financial constraints of companies.
  - A main focus should be on the early discussion and design of an adequate funding model for continuing TVET offers to ensure the long-term success of such offers.
  - Furthermore, with regard to the cited lack of (self-)learning material as a reason against offering training, it could be considered to make learning materials available for TEPNET member that are designed as part of the training measures in the context of the SCHOOLPLATE project (generate added value).

5
Organizational changes & external factors

Main findings

- A majority of electroplating companies are engaged in a process of continuous organizational development to remain competitive and keep pace with developments in the industry and customer requirements. Such professionalization processes of the industry go hand in hand with increasing requirements regarding the scope of tasks, responsibilities and skill requirements that employees face (see chapter 5.1).

- At the same time, the Thai electroplating industry is under increasing pressure to improve the quality and cost efficiency of its production due to external factors, such as increasing competition on national and international level, rising wages and stricter legal requirements particularly in the field of environmental protection and safety. The more recent economic effects of the Covid-19 pandemic put additional pressure on the industry and may have considerable effects on the labor demand in the electroplating industry. Further professionalization and modernization of methods, processes and technologies is seen as the solution to the rising costs in the industry (see chapter 5.2).

- While many companies are only cautiously optimistic about their future labor demand due to the current pandemic, their expectations of finding suitable workers now and in the future are undoubtedly low. The low supply of adequately qualified employees that should have the necessary knowledge, practical expertise and the right attitude, as well as the unattractiveness of the electroplating industry are quoted as main reasons for the bad prospects (see chapter 5.3).

- Overall, the results underline the importance of training and qualification offers to support the further professionalization of the industry and provide better employment perspectives for companies and job seekers alike. As electroplating products play an integral role for key industries in Thailand (e.g. automotive, electronics, see chapter 1) which are highly dynamic in terms of technological development and innovation, the provision of training and qualification offers is also of major importance to the economy as a whole to ensure the electroplating industry's capacity to adapt to new requirements and meet the demand for high-quality products in the long term.

5.1 Organizational changes

Graph 16: "Have there been any changes in your company in the past 3 years regarding the following topics?" (Q46) (Multiple-choice → % do not equal 100)

- As Graph 16 shows, a majority of companies in the sample reported organizational changes in the past three years.
  - The answers indicate a further professionalization of the electroplating industry (new/changed organizational structures, changes responsibilities and work areas, new (quality) management methods etc.), which can be potentially explained with the growth of companies as illustrated by the expansion of customers (66% job platers, 40% in-house platers) as well as the development of new products and services (49% job platers, 60% in-house platers)
  - In addition, more job plater companies invested in new production technologies (43%) and ICT (31%).
  - Further analysis is needed, to identify why recent changes took place in so many companies.

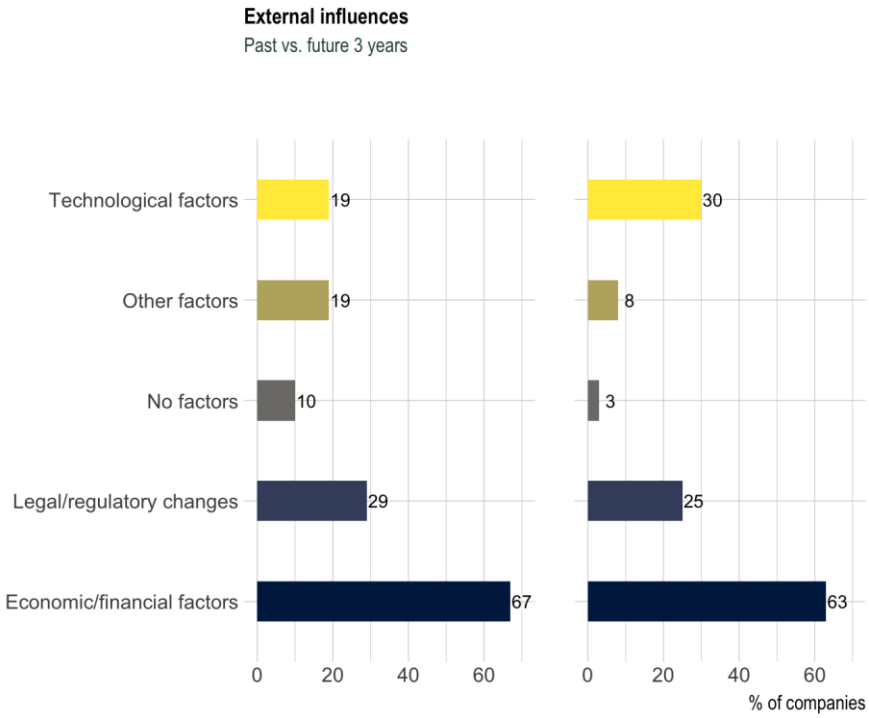
- The following consequences were reported as a result of organizational changes by the companies in the survey:
  - The majority of companies reported an increase in the number of existing (68%) as well as new (72%) responsibilities and work tasks, and an increase in new skills requirements (78%).
  - Effects on the number of employees don't show a clear trend: 29% of companies report an increase in the number of employees, in 34% of companies the number remained stable and in 36% of companies the number of employees decreased

- The high share of companies that reported changed responsibilities and work areas in the past 3 years as well as the effects of these changes are in line with the statements of the company representatives regarding employees` needed flexibility and willingness to learn.

Overall, these trends underline the importance of training and qualification measures to enable employees and companies to keep up with new developments in the industry.

5.2 External factors influencing the Thai electroplating industry

Graph 17: "Are there any external factors that had/will have an impact on your company in one way or the other in the past/ future 3 years?" (Q48a+b)



- As Graph 17 shows, the majority of companies in the sample quoted economic and financial factors as a major external influence that impacted (and will impact) electroplating companies (67% past vs. 63% future)

- The following factors that had an impact *in the past* were named:
  - Decreased economy (due to COVID), less orders (n=14), reduced demand (n=4),
  - Higher wages and production costs (n=5),
  - Trade wars and high competition (n=7), High exchange rate (export) (n=1), foreign investment and government support (n=1).

- The following factors that are expected to have an impact *in the future* were named:
  - COVID/Economic decrease and turmoil (n=18),
  - Higher production costs and fewer customers due to competition (n=1), high-priced raw materials and fluctuations (n=2), higher wages (n=1), reduction of costs is necessary (n=2),

Organizational changes & external factors

- Relocation of production base (n=1),
- Access to funding (n=1), financial burden/loan (n=1),
- Only a few new job models (n=1).

- Furthermore, legal and regulatory changes had and will likely have an impact on companies (29% past vs. 25% future)

- The following factors that had an impact *in the past* were named:
  - Various (unnamed) environmental regulations (n=4), new regulations for wastewater disposal (n=2),
  - Demand for Cr3[9] (n=1), increased demand for (unspecified) banned substances (n=1)
  - Migrant workers (n=2), minimum wage (n=1),
  - Implementation of ISO systems (n=1),
  - Tax war with Vietnam (n=1),
  - Laws and guidelines are unclear to the company (n=1), stricter laws increase production costs (n=1), new laws regarding motorcycle exhaust pipes (n=1).

- The following factors that are expected to have an impact *in the future* were named:
  - Stricter laws regarding safety and environment (n=1), laws for wastewater treatment (n=1), unspecified tighter laws (n=1),
  - Increased Cr3 demand (n=2),
  - Increased personnel costs (n=2),
  - Tax war with Vietnam (n=1), Trade wars (n=1),
  - Migrant workers (n=1),
  - Higher management costs due to more regulatory monitoring (n=1), new laws regarding motorcycle exhaust pipes (n=1).

- With regard to technological factors, companies in the sample expect more impacts on their company in the future than in the past (19% past, 30% future)
  - The following factors that had an impact *in the past* were named:
    - New plating methods (n=4),
    - New machinery and materials (n=2),
    - Shortening product cycles and reduce costs (n=2), improve products (n=1)
    - Reduced demand (n=1), dwindling workload (n=1).
  - The following factors that are expected to have an impact *in the future* were named:
    - New machinery (n=2), new plating methods (n=1), less chromium plating (n=1), new methods need to fit laws at lower costs but still provide quality (n=1), new technology can improve production and competitiveness (n=1),
    - Product specification changes (n=2),
    - Automotive trends (n=1),
    - New job models (n=1).

- Other changes quoted are as follows:
  - *In the past*:
    - COVID (n=6), Increased competition (n=2), education doesn't meet the industry's needs (n=1), increased order demands can't be met (n=1), declined demands (n=1), implementation of ISO Systems (n=1).
  - *In the future*:
    - COVID and therefore reduced demands (n=3), increased costs for raw materials (n=1).

[9] "Chromium3" - In relation to the EU REACH Agreement and the replacement of Cr6 (=Chromium6)

Organizational changes & external factors

In 5 interviews with industry experts, the following additional information was gathered:

External influences with regard to key market sectors and the perspectives on product and/or market diversification:

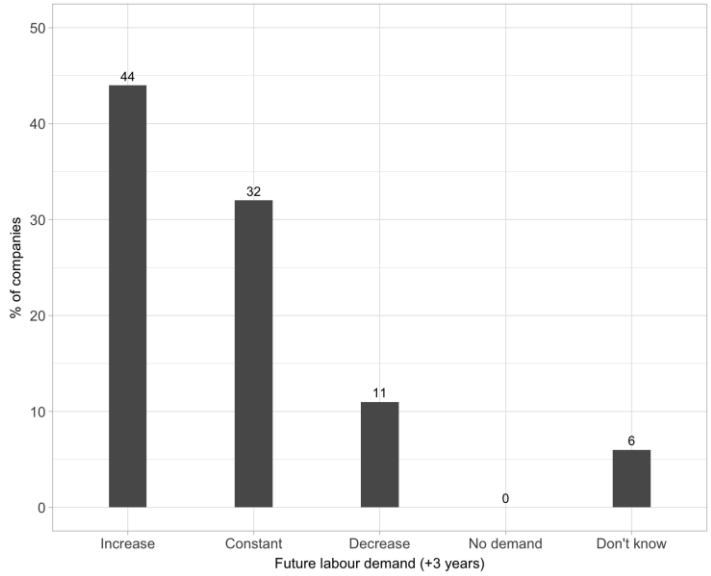
- The biggest challenge for all five companies is the current pandemic and the associated economic decline.
- The importance of employees being able to adapt to changes and being motivated to learn is mentioned in association with the current economic difficulties that companies face (n=3).
- As potential ways out of the current situation, companies consider the following: broadening the product range (n=2), improve product quality (n=2), finding new products (n=3) and markets (n=2), pay more attention to cost efficient plating (n=2)/ saving money, time, energy and chemicals (n=1), implement automation (n=1).
- At the same time the company representatives acknowledge that employees need to be able to do so, which requires learning about the "how to".
- 2 companies mention the need for employees with a broad knowledge in "atypical" fields not directly related to production like marketing & sales (n=1) and communication in general (n=1): Staff in these positions must know about product and the respective product/electroplating characteristics, in order to be successful with customer acquisition.
- 1 company representative mentions that recently many Chinese plating factories that are being set-up in Thailand. They produce cheaper and pursue an aggressive approach against their Thai competitors, which results in considerable competition and price wars. Consequently, companies are trapped in the middle between costs and quality.
- Additional information about companies' sources of information about state-of-the-art processes etc. was gathered through expert interviews:
- (Chemical) Suppliers (n=4), internet resources (n=2), fairs and exhibitions (although considered not really sufficient) (n=3), customers (n=1), nearby University (n=1)

Additional information about environmental issues potentially affecting the industry:

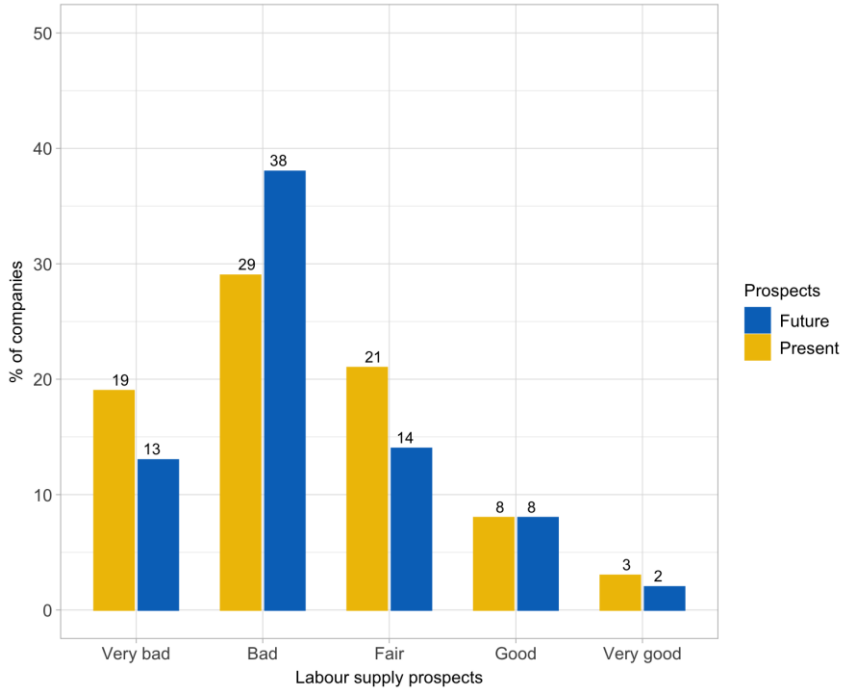
- Companies are mostly faced with (relatively) new regulations regarding wastewater (e.g. in the Bangkok area) that results in strict limits for heavy metals in wastewater.
- 2 company representatives admit that their staff needs better understanding of how to handle environmental issues.
- The "Green Industry Program" is a state-run program (Ministry of Industry) that might be interesting to discuss in the future regarding environmental protection schemes. Companies can reach an ISO-like certification and there are five levels to achieve. An external consulting team helps the ministry to pour knowledge about environmental regulations into companies (1 company of those interviewed is currently involved).
- 1 company representatives (with foreign background) says that in Thailand less attention is paid to safety and precision of processes. Hence, the adherence to internal regulations (e.g. 5S) is often more concerning than external regulations,

- 2 company representatives mention examples of "good practice" for addressing external influences: 1 company has a team to help achieve the "Green Industry Program" levels and 1 company has a team that works on various "emergency" topics, e.g. COVID.

5.3 Labor demand and supply



Graph 18a: Future (+3 years) labor demand in electroplating (Q50)



Graph 18b: Future (+3 years) labor supply prospects in electroplating (Q49)

- As Graph 18 shows, at the time of the survey (i.e. mid 2020) 44% of companies in the sample expected that their demand for labor in electroplating will increase over the next three years, 32% assume that their labor demand will remain constant and only 11% of companies expected labor demand to decrease.
  - However, additional answers suggest that the majority of companies (71%) expect that the Covid-19 pandemic will influence their future demand for workers in electroplating. More specifically the following effects on employment and production are expected:
    - Workload Decrease (n=11), No new employees (needed) (n=7), Resignations (n=3), Now impossible to employ foreigners for easy, but "dirty" work (n=1), Lower Wages (n=6),
    - Reduced Production Volumes (n=5), Lower Customer Demands (n=11),

- Regardless of the future labor demand that may be affected by the economic effects of the current pandemic, the majority of companies rate their future prospects of finding suitable workers for electroplating jobs in their region as (very) bad (51%), whereas only 10% of companies rate their future prospects as (very) good. Overall, companies do not seem to see signs of improvement, as present prospects of finding suitable workers are rated as equally (very) bad (48%). Companies provided the following reasons for this rating:
  - *Low supply of adequately qualified people*:
    - People lack (special and necessary) knowledge and experience (n=11),
    - People need training anyway (n=5) / Need for better trained and educated employees (n=3),
    - No cooperation between industry and educational facilities (n=3),
    - No information for neither jobseekers nor companies (n=1),
    - People need both academic knowledge and work experience (n=1),
    - Fewer tech students (n=1),
    - No advocates for the industry (n=1).
  - *Unattractiveness of the industry*
    - Thai people don't want to work in Electroplating (n=8),
    - Wages and conditions - competition with other industries (n=2),
    - High labor turnover (n=1).
  - *Potential improved perspectives due to the economic effects (of Covid-19?)*
    - Due to the economic turmoil, it will be easy to find new workers (n=5).

In the expert interviews, additional information was gathered about the prevalence of employees with a background in TVET (Por Wor Chor (Upper Secondary Education) and Por Wor Sor (Higher Professional Education)):

- 1 company representative says that people from a vocational track don't usually directly start at their company, but have usually worked in other companies before.

- 2 company representatives say that bachelor students aren't necessarily better than people coming from a vocational track. In the end, a person's character and attitude are more important than their qualification. Often people with a TVET background have better practical skills/knowledge than new employees with a college or university degree. Employees with a TVET background receive a lower salary, which can be increased based on their experience.

- 1 company says that employees in the position of supervisors are both undergraduates and people coming from a vocational education track.

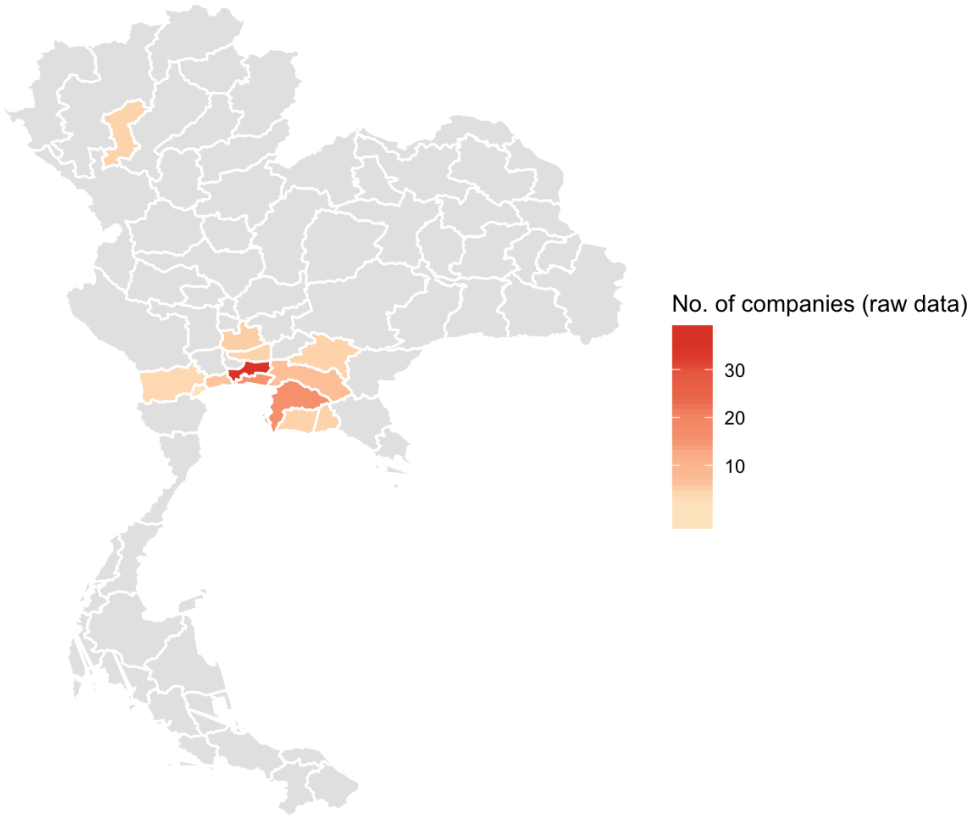
- 1 company doesn't employ people with a Por Wor Chor qualification at all. They do employ Por Wor Sor students but only, if these people are willing to learn.

ANNEX

Table 3: Distribution of companies by region and province (original vs. final sample)

Region	Province	Companies (original sample)		Companies (final sample)	
		n	%	n	%
Bangkok	Bangkok	35	32%	19	30%
Northern Thailand	Lamphun	4	4%	3	5%
Eastern Thailand	Chon Buri	17	31%	9	29%
	Rayong	4		3	
	Chachoengso	8		3	
	Prachin Buri	4		3	
Western Thailand	Ratchaburi	3	3%	2	5%
Central Thailand	Samut Prakan	16	31%	9	30%
	Pathum Thani	4		3	
	Phra Nakhon Si Ayutthaya	5		2	
	Samut Sakhon	7		4	
	Samut Songkhram	1		-	
No answer		71	-	3	-
Sub total		**179**		**63**	

Graph 19: Distribution of companies by region and province (total numbers, original sample[10])



[10] The number of companies in the original sample gives a more accurate picture about the number of electroplating companies in the respective regions and provinces.

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