

Moving Across the Middle Income Trap (MIT) Border through Human Capacity Building. Thailand 4.0 - Industry 4.0 Emerging Challenges for Vocational Education and Training

Abstract

The quest for success in global competition in general - but particularly in times of fast-changing global digitisation with respect to production and life - incorporates the search for highly efficient ways of optimising the productivity and mobility of a nation's workforce. Consequently, national education and vocational training systems are called upon to be prepared for rapid changes in life and production and to meet the new challenges of the future digital age. The call for more foreign investments into target industries needs to be extended by additional investments in education and vocational training focussed on Industry 4.0 (cf. Apisitniran 2016). Vocational training institutions must be modernised and able to cooperate with companies. The skill sets of vocational personnel need to be upgraded significantly towards higher qualifications and more cooperative behaviour. It seems to be proven that experience-based vocational training models are most consistent in supporting highly efficient and effective human capacity building for Industry 4.0. The digitised technological developments should be seen by all – governments, companies and training providers alike – as a chance to further enhance workplace-based vocational training at all qualification levels and to provide vocational learners and workers with personal and professional competencies for the future. The subject of the present paper has been delivered to the audience at the International Forum: “Moving Across the Middle Income Trap (MIT) Border through Human Capacity Building” at Rajamangala University of Technology Lanna, on January 18th, 2017 in the Kingdom of Thailand.

Keywords: *Industry 4.0, Thailand 4.0, changes in vocational training and production, experienced-based vocational training, workplace-based training, competencies for the future*

1 Short problem statement

Economic senior experts have pointed out that Thailand needs human capital development to catch up with new global economic trends. The fast-changing global economic landscape shapes the strategies of countries and firms and is crucial to the future of Thailand 4.0 (cf. Pananond 2017).

This development has far-reaching consequences for economies, labour forces and the entire Thai society, as well as for its neighbouring countries. The pivotal question now is how politicians, business and education experts and institutions can handle the additional and steadily growing challenges of Industry 4.0 with far-sightedness and care. In this context the Bangkok Post (cf. Apisitniran 2016; cf. Mala 2016; cf. Pananond 2017) has recently published three interesting articles:

The first article, “OVEC behind on target student count”, describes the efforts of OVEC to attract vocational learners to the offer of dual vocational education and training based in company workplaces. A recent study by the Office of the Education Council (ONEC) found that the number of vocational students signing up for the Dual Vocational Education and Training (DVET – furthermore called dual vocational training) rose to nearly 90,000 in the current academic year, from 61,000 in the previous year and 43,000 in 2014. DVET in Thailand is a collaboration between entrepreneurs and vocational schools created in 2013 to offer apprenticeships to vocational students in leading companies during their studies. The vocational training academy provides theoretical knowledge, while the companies offer practical training for the students. Under the initiative, students will spend one year at school and two years training participating companies. Students will also get paid when they work at the companies.

The study also found that the number of business enterprises joining the curriculum increased from 7,826 in 2014 to 8,098 in the last year and 10,527 for the present academic year. “It is a good sign that Thailand is producing more and more young people who obtain high-level technological knowledge and skills through on-the-job training” (Mala 2016). However, the steady increase in numbers of students choosing this mode of training remains far from the target set by OVEC.

“The 190,000 participants joining dual training in total is only 9.6 % of the students enrolling in vocational courses nationwide, which is far from OVEC's target of 30-50%.”

One ONEC expert suggested that a negative attitude towards dual vocational training is most likely the main contributor to the slow growth of the scheme. “Parents' prejudice against dual vocational training has played a vital role, while the tax benefits to encourage companies to join DVET are not enough to attract the private sector” (ibid.).

This article conveys what is widely accepted but often ignored – it is imperative that more is done to improve the image of vocational training for learners – and their parents – and to elevate the quality and effectiveness of TVET by promoting more workplace based training programs.

The second article, “Push for foreign investment in the context of Industry 4.0” refers to the foreign investment policy of the government of Thailand with a focus on the challenges and opportunities of Thailand 4.0. The article pointed out that the overall goal of the Thai government regarding Thailand 4.0 emphasises keeping the momentum and boosting the Thai economy by supporting new investments in future high-tech industries (4.0) as the country aims to become the ASEAN hub of such sectors.

Minister in the Office of the Prime Minister, Suvit Maesincee, says Thailand is on track for change from a middle-income to a high-income country by promotion of new investments. The government plans to issue three new laws known as “BOI plus” which would grant greater privileges to new investors. There are 10 targeted industries under the heading of Thailand 4.0. The 10 target industries are *next-generation automobiles (electric cars), smart*

electronics, affluent medical and wellness tourism, agriculture and agriculture processing industries, biotechnology, food processing (ready to eat and food for the future - also called as “Digital food”), robotics, aviation and logistics, biofuel and biochemical, and the digital sector.

All of the targeted industries will focus on added value through advanced technology and innovation, which means that Thailand requires investment in those areas – but first of all a competent workforce is demanded in order to give investors a real incentive and to make those ambitious investment targets realistic (Apisitniran 2016). This government announcement is one example that signifies the beginning of a new technological era – some even call it a new technological revolution - which will in fact have enormous consequences and challenges for the education and training systems, and for the society as a whole.

The third article, “Beyond lofty “Thailand 4.0” rhetoric” points to the core of the problem related to the “fashionable” 4.0, specifically the consequent need for skilled and sophisticated activities in HRD, innovation and value creation. The intent of Thailand 4.0 to attract higher value-added and technology-intensive industries like digital food production, robotics and biotech is heading in the right direction, but it requires much more than provision of tax incentives or road-shows in investment-interested potential countries (such as Germany). “Skilled human resources in science and technology are crucial for any firm in these industries. But the recent Programme for International Student Assessment (PISA) rank Thailand's performance at the bottom of Asia. The result is anything but comforting” (Pananond 2017).

“As for firms, the integration into global value chains is not an end in itself, particularly when value is created and captured more by other firms in the chain. The more important question is what Thai firms can do to leverage their position to generate and capture more value that goes beyond low-skilled tasks like production or assembly. The changing competitiveness calls for value creation from more skilled and sophisticated activities” (Pananond 2017).

The messages from these articles strongly suggest that it is high time to multiply efforts in terms of upgrading the country’s most important resource- its human capital- and to push education and training systems forward in the right direction. Governments, employers, researchers and vocational educationalists, as well as regional developmental bodies, should bundle their varying resources in order to identify emerging needs and prioritise measures for achievement of advanced policies and implementation strategies for work force development within national and regional dimensions, such as AEC integration.

2 German experiences (the dual way of vocational education)

In Germany, where the dual vocational or workplace based education and training model has been adopted as the main mode of delivery, vocational education and training (VET) continues to be held in high regard. The quality and efficiency of dual training is based on close cooperation between federal and state governments and social partners, with businesses

also playing a major role. The well-recognised training system is regarded as essential for economic growth, prosperity and social cohesion and opens up promising career paths, developing high employability of individuals due to the wide range of training and career opportunities. Internationally, in this context, it is often pointed out that the number of unemployed young people in Germany is relatively low (cf. 4,3 %, cf. Statista 2016) compared to other European countries (unemployment rate of young people in some European countries: Greece >46,1 %, Spain >44,4 %, Italy 39,4 %, France 25,9 %, Austria 10,4 %, Nederland 10,3 %, Germany 6,6 %) (cf. *ibid.*).

The work process- oriented teaching and learning in the dual system provides young people with an opportunity to acquire specialist skills, knowledge and abilities, in addition to personal competences, through exposure to professional experiences at the workplace. This guarantees their professional competences regarding latest technologies and facilitates their transition into employment (cf. Sabbagh 2016). In 2016 more than 1.4 million students, or about 70% of all students, and 450,000 business enterprises have been involved in the programme. Approximately 522,000 new training contracts were concluded, which roughly corresponds to numbers in the previous year (cf. BMBF 2016).

The willingness of German stakeholders to continually train young people within companies is based on both tradition and proven business success, offering:

- Contract based partnership, which offers a win-win situation for all involved partners – the companies, vocational training institution (VTI) and vocational learners. These advantages are detailed as follows:
 - Companies: Getting well-qualified employees with cooperative behaviour and insider experience of their technological processes and products, and
 - Tax incentives (higher revenues than investments) (cf. OECD 2010).
 - Vocational learners: Getting solid monthly payment (In Germany in average 860 Euro/Month/2015) (cf. BIBB 2016).
 - VTI's (and universities): Benefitting from the latest technological developments of their partner companies.

In light of newest technical and technological development, the so-called Industry 4.0, we clearly realise that the dual vocational training system (DVET) is facing fresh challenges. The pivotal question is whether DVET is capable of serving higher qualification requirements and capabilities of the future work force, or whether the preference is for higher education levels (such as engineers) for such digitised work processes in the future.

3 Industry 4.0 and the consequences for VET

Within the context of Industry 4.0 it cannot be denied that work organisation and work processes will change along with automation and real-time oriented control. The same is true

for work contents and the interaction and communication between man and technology, which have many consequences for users and providers of the vocational training system.

It is known that there are many definitions of Industry 4.0. A very short one is as follows: *“Industry 4.0 is the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems (CPS), the Internet of things (IoT) and cloud computing”* (cf. Kagermann, Wahlster & Helbig 2013 and Brainbridge 1983).

The German Government, together with representatives of relevant industries and universities, has launched several research projects on Industry 4.0 in recent times. A solid study by the University of Bremen, “Industry 4.0 – Impacts on Initial and Further Training in the Metal and Electrical Industry,” has been recently carried out regarding the qualification requirements for employees on both the “shop-floor” and middle employment levels (cf. Spöttl et al. 2016). The guiding question has been: *How far have companies advanced with the implementation of Industry 4.0 and what should be done by VET to respond to the needs and expectations of the new technological challenges?*

The survey also provided recommendations to tackle the question as to whether a new shaping of occupations in production and/or occupational profiles should be initiated and what its focus should be. Furthermore there are recommendations for the shaping of production work in the context of Industry 4.0 for companies and vocational institutes. The challenges resulting from the implementation of Industry 4.0 can be summarised as follows (cf. *ibid*):

1. The qualification of skilled workers, master craftsmen, and technicians, i.e. persons with an occupational technical education and training and corresponding further training, in specialisations relevant to Industry 4.0. They must be able to master processes in their complexity and safeguard a flawless operation of plants.
2. The mastering of networked systems with decentralised intelligence, and the ability to deal with data and its analysis, which count among the most important requirements for work on production sites. (*Apart from this, it is inherently expected that the existing traditional tasks for skilled work are also managed.*)
3. The extension of on-going priority setting on general questions of Industry 4.0 by considering technological priorities (such as CPS, cf. Acatech 2011), issues of work organisation, questions of work design, data security, programming techniques, troubleshooting and problem solving with the aid of assistance systems and data analysis.

“The software for technical networking and its related CPS elements are continuously becoming prevalent. Aligned with the increasing diffusion of Industry 4.0, plants and machines must be conceived and handled by starting with networking of CP-systems, the respective software and their embedding into processes” (*ibid.*).

“This amounts to the question of how “Industry 4.0” will change the organizational processes and thus the hierarchies in companies. There are not many unambiguous research findings available in literature. Therefore it still remains vague how certain decision making processes spur changes on the skilled-worker-level. Is there still room for co-shaping by human beings in “Industry 4.0” or will “Industry 4.0” promote a “Taylorism 4.0”? The developers and the drivers of the idea “Industry 4.0” keep on underlining that they are aiming at a cooperative interaction between all levels. Humans should be given the chance to exert influence on the shaping of their work within production” (ibid.).

This leads to a new valuation of skilled workforces by companies getting in touch with Industry 4.0. The trends can be summarised best as:

1. Trend A: Companies without Industry 4.0. No changes in direct production; however, effects on indirect production (e.g. workplaces for the future implementation of Industry 4.0).
2. Trend B: Companies with a low “Industry 4.0” depth. Stagnation or slight increase in highly qualified skilled personnel such as skilled workers, master craftsmen, and technicians, as well as a noticeable increase in productivity.
3. Trend C: Companies with high “Industry 4.0” depth. Increase by 20–30 % in the upper qualification level (well-qualified skilled workers, master craftsmen, and technicians). [Substantial] reduction of low-qualified workforce (semi-skilled and unskilled) (cf. Spöttl 2016).

“These trends show that skilled workers with a high-quality initial and further training oriented to Industry 4.0 will probably have very good employment and career opportunities. This is contradicted by some experts who state that the skilled worker will be chanceless or even at risk due to the developments towards Industry 4.0” (cf. Spöttl 2016). Management and technical personnel from surveyed German companies are convinced that the dual training approach is the appropriate training model for Industry 4.0. They expressed no doubt, based on their collective experience, that graduates from DVET would be capable of easily dealing with requirements resulting from Industry 4.0, given that the training content and methodologies stay in line with the steadily changing work requirements.

In other words, dual or workplace-based training is not out-dated, but rather strongly needed to fill the gap of well-qualified workforces with target-related technological qualifications and work experience.

This leads to another important question: *What are those requirements and how can determination of relevant training contents be made for upgrade of vocational training programs?*

The above-mentioned study refers to the identification of changing work requirements in future occupational fields and activities (also known as *Generic Occupational Fields of Action in Industry 4.0*).

After Spöttl (2016), a generic field of action in Industry 4.0 is a field of tasks for skilled workers extended by “Industry 4.0” which has been identified with the help of empirical studies in companies. After the implementation of Industry 4.0, companies have partly already reached an advanced stage. A generic field of action describes new requirements and tasks within a field of tasks (e.g. plant monitoring) typical for an Industry 4.0 environment.

According to Spöttl (2016), nine generic occupational fields of action relevant for Industry 4.0 were generated from the empirical fields of action in companies dealing with Industry 4.0. These “generic” occupational fields of action emphasise “the new” relevant contents for metal and electrical occupations including their target expectations as follows:

- ***Plant Engineering*** - Target expectation: Simulation of plants.
- ***Plant Installation*** - Target expectation: Plant networking.
- ***Set-up of a Plant and Putting it into Operation*** - Target perspective: Ensuring the data availability from sensors, actuators and process data in production systems.
- ***Plant Monitoring*** - Target expectation: Monitoring, analysis, and evaluation of real-time data.
- ***Process Management*** (Visualisation/ Monitoring/ Coordination/ Organisation) - Target expectation: Guarantee of process safety by process monitoring and repair.
- ***Data Management*** - Target expectation: Programming, safeguarding of machine data for plant quality operation, analysis of operational data and optimisation of processes.
- ***Maintenance*** - Target expectation: Preventative and predictive maintenance, multi-functional machines, assessment and use of different data and data formats.
- ***Repair*** - Target expectation: Consideration of repair interdependencies due to networking and IT-integration of machines and plants; software updates.
- ***Troubleshooting and Repair*** - Target expectation: Diagnosis; troubleshooting in networked plants.

The hereby-presented description of the changes in the form of generic occupational fields of action resulting from a survey of German companies in the Metal and Electrical Industry and referring so far to the German situation (ibid.) But in a globalized context of Industry 4.0 similar reflections shall be relevant for the adaptation of new training contents with regard to the same industrial sectors in Thailand and other ASEAN countries.

Summary:

- Based on the above generic occupational fields, complementary or new training content should be effected by expert groups from the business and training sectors as soon as possible;
- Respective standards and curricula (for example for mechatronic, electronics etc.) should be analysed and revised by expert groups;

- From the current perspective there is no need to create new professions like the “Meta-Mechatronic” (this diagnosis refers to the German situation);
- Teachers should be upgraded in these generic occupational fields. Respective teacher training programs must be developed.
- The focus should not be solely on high-tech competencies in Industry 4.0, but high social competencies of TVET graduates should also be recognised. Participants in the program should be capable of effective communication and teamwork in connected work processes. (Man is, after all, a social being.)

4 Conclusions and recommendations

The globalised economy “Industry 4.0” makes no distinction between countries and cultures. The complexity of work situations in the industry is steeply increasing and is consequently leading to higher demands in the quality of workforces with special competencies to meet companies’ needs. A general statement on companies’ readiness regarding Industry 4.0 across all branches is not yet possible, but the previously mentioned survey shows changes related to the implementation of Industry 4.0 and states clearly that there will be a change in paradigm for skilled workers and technicians in production (cf. Spöttl 2016)

“Thailand 4.0 is an ambitious growth strategy that lacks a bottom-up vision to cope with the fluctuating global economy. Thailand needs to move away from cosmetic and superficial policy announcements in favour of a blanket acknowledgement of our structural shortcomings and a broad-based drive to enact institutional and policy reforms that can underpin innovation and value creation” (cf. Pananond 2017).

The same statement is true for the education and training sectors- and this is not limited to Thailand. Fulfilment of the as yet theoretical policy direction should be approached with urgency. Considering the current situation of steadily changing technological requirements, vocational training and vocational teacher education must be fundamentally upgraded in order to narrow the gap between the high expectations of the industries and the current performance of education and training.

Therefore additional work has to be done without delay, including but not limited to:

- Analysing work processes and occupational standards regarding Industry 4.0 and upgrading respective training documents (occupational standards and curricula);
- Bridging the gap between the world of work and the world of education by promoting DVET and various other types of experienced vocational learning systems (such as WIL, etc.);
- Delivering relevant solutions for labour market oriented VET and establishing a policy for accompanying supportive infrastructure e.g. financing and network mechanisms, etc.;

- Making DVET more attractive to stakeholders; establishing a career guidance system for graduates of secondary schools and their parents in order to convince them of in-demand qualifications which can lead to gainful employment with acceptable income.

Recommendations:

1. The mentioned efforts of the Thai Government concerning Thailand 4.0, and consequently the full trust of foreign investment and Industry 4.0, must be complemented by relevant supporting measures in labour force and vocational education development (accompanying measures for technical schools, colleges and universities etc.).
2. New investments in the business sector also need new investments in vocational education and the labour market sector focussed on Industry 4.0. Institutions must be modernised and vocational personnel need technical and pedagogical improvements.
3. On the question of how to cope with the challenges of Industry 4.0, there is an important message arising out of the studied German experience: The proper functioning of workplace-based vocational education or the so-called dual vocational education and training (DVET) is essential for mastering the challenges of Industry 4.0. It follows that DVET in Thailand should be kept in high regard and should become a priority of TVET development and implementation.
4. Therefore, the involvement of employers represented by chambers and federations is indispensable. Respective incentives should be offered to employers and schools to encourage the practice of cooperative vocational training.
5. Any kind of public or private cooperation in vocational education should be supported by both government and private entities in order to advance the dual vocational training scheme (DVTE) with focus on, but not limited to, the so-called high-tech professions.
6. The quality of Vocational Teacher Education should be significantly improved and changed in terms of contents and methodologies. Related study programs have to be adapted to incorporate new requirements of digitised work processes.
7. Government institutions (MoE /OVEC /OHEC) should collaborate with leading companies and universities, including the Regional Association of Vocational Teacher Education (RAVTE), in order to better respond to the needs of Industry 4.0 by establishing a well performing “*Vocational Education and Training Policy & Strategy - Industry 4.0*”.
8. Consequently a well adapted “*Vocational Teacher Education Concept 4.0*” is needed to improve quality and efficiency of vocational teacher education in order to ensure future targets.

9. Government (MoE including OVEC and OHEC) should take the momentum and create a *TVET Reform Committee 4.0* (senior expert group) in order to rank TVET within the context of government efforts regarding Thailand 4.0, to design target specifications, and to implement result based monitoring and sustainability of above mentioned policy papers and respective rules and regulations.

These recommendations are essential in order to successfully implement the proclaimed foreign investment policy as a major engine to transform Thailand 4.0. Industry 4.0 should be seen by all– governments, companies and training providers – as chance to further enhance and implement workplace based vocational training at all qualification levels and to provide vocational learners and workers with the respective soft skills and professional competencies necessary for their future.

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