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Wiesbaden, September 2021

Improving TVET Facilities and Equipment
A practitioner's guide

In theory, there is no difference between theory and practice.
In practice, there is.

Abstract
The idea to write a paper on this subject originated during many of my assignments around the world; seeing (in pain) so many inadequate and insufficient facilities, especially workshops and laboratories. As an old man, still very active, it is a pleasure to spread some of my experience gained.
The paper is outlining some generalised approaches, but is also introducing some practice-oriented techniques and examples for further discussions.

Background

Everyone will agree that in order to deliver high-quality, competency-based learning, it is essential to have adequate facility and equipment that enable students to gain the practice they need to develop skills required on the labour market.

Everyone? Well, I cast some doubts as long as Unevoc's TVETipedia Glossar is omitting terms like: Equipment, Infrastructure, Facility. Is it's just too ordinary for the esteemed academic circle?

If adequate physical resources are not available, the best curriculum / occupational profiles elaborated are of no use! Learning to swim without a pool?

Agreeable, best equipment is of no use without competent and adequately paid Teachers / Trainers.

The paper is focusing on all physical requirements necessary to build, or upgrade, and operate a TVET facility successfully. Hence, it is not digging in on the many other necessary issues, like Human Resources, Organisation and Institutional, etc.

Terminology

The term TVET (Technical and Vocational Education and Training) comprises all kind training programs, from short-term qualification courses, up to year-long vocational training for the private as well as the public sector.

The term **facilities** include necessary buildings comprising workshops / laboratory units, offices, classrooms, storage, toilets. including infrastructure (power supply, electric lighting, water supply, foundation, storage, sewage, etc.).

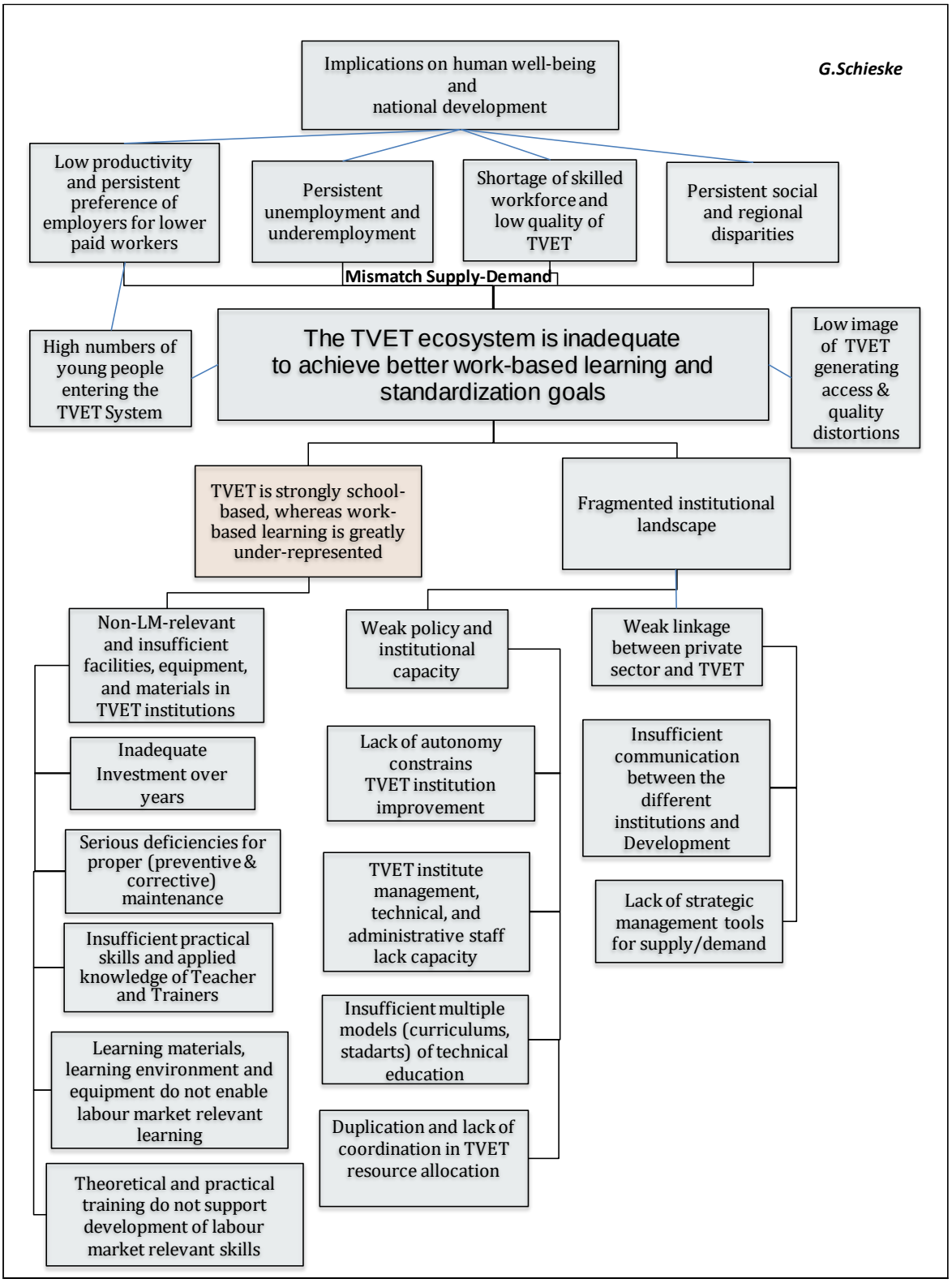
The term **equipment** includes training equipment and tools, didactic material as well as consumables/material suitable in quantitative and quality terms for the provision of relevant practice-oriented, hands-on skills and knowledge.

The Challenge

The constraint of financial realities is often one of the most serious of all. Science and Technology are not cheap and TVET is one of the most expensive components of any education system.

Frequently it has been found that internationally - funded projects with inputs and foreign technical assistance have been seriously reduced after the foreign input was withdrawn due to lack, or low level, of local budget support, which among other resulted into poor maintenance and repair of the expensive equipment.

For many developing countries (and not only there) an analysis might result in a problem tree as shown below:



The importance of a well-functioning facility and appropriate equipment must be realized!

If not, quality and effectiveness of the training to meet the objectives of knowledge and skills required by the labour market are insufficient.

In a situation where most equipment is missing, outdated or inadequate Teachers have inadequate practical abilities, and imparting theoretical knowledge (talk-and-chalk-teaching) rather than practical skills. Is

it so that TVET places too much emphasis on theory and certification rather than on skills acquisition and directly test competences students need in their future work life?

Planning Phase

Plans to develop or improve facilities for TVET will need to include systematic procedures for

- providing appropriate equipment and laboratory/workshop arrangements to support the specific knowledge and skills required by the curriculum
- maximising use of resources (avoiding under- utilisation of expensive equipment)
- training on Operation & Maintenance, Training of Trainers
- the care and maintenance of equipment.

Preferably such equipment and laboratory/workshop arrangements should be replicable for similar trades / educational sectors, ideally leading to or improving "Building and equipment standards".

Any planning should start with the elaboration or review of a **Utilization Concept.**
It must, for a new or upgraded TVET institution, consider the organizational set-up, competent teaching, training and management staff and sufficient financial means.
The elaboration of a utilization concept shall guide the design of required equipment and facilities, inter alia considering the following:

- Present and expected Number of students, teaching methodologies?
- Institution to be arranged for general vocational training, or for specialization, upgradation, continuous learning, etc.?
- Function and Layout of the rooms/ workshops / laboratories as basis for the unimpeded and effective operation?
- Learning place model (e.g., theory and practice are offered from a single source; blended learning)
- Strong focus on practical skill development as well as practical assessment (practice vs. theory around 80% to 20%)?
- Training to be based both on and off-the-job? (Alternative / Cooperative Training)?
- Offering of training for disadvantaged groups incl. people with disabilities / handicapped?

Moreover, Utilisation (cost saving / recovery) might be improved, considering the following:

- to pool some equipment among TVET institutions as well as leasing of usage time to the productive sector.
- to shift some workshop experience to employer premises as part of a work placement programme or "co-operative - system".
- to produce goods on a small scale, renting out premises for small production in cooperation with small local firms "generating additional income" (safeguard the exploitation of Trainees, as cheap workers; strengthen, not weaken, the local firms).
- to avoid underutilized facilities: Rental of spaces; Informal trading areas; Computer classes

Ideally, a (partly) self-sufficient facility in partnerships with the productive sector, and contributing to the strengthening of entrepreneurship; turning learning into earning and saving.

Overall, **Cost effectiveness** (cost benefit) is an important element of any planning and re-planning. Such analyses are a must for improving the utilisation of resources, the prioritisation of investments, etc.

Absorption capacity of institutes. Apart from staff capacities and/or organisational prerequisites, such a concept shall also consider the financial capacity of the selected institutes as regards the future operating cost of the investment (maintenance costs, costs for training materials/consumables, operational expenses such as electric power, etc.).

EQUIPMENT

Training content, module sequence and occupational profiles, ideally identified during a labour market demand and occupational profiles analysis, define the required equipment, which shall be recorded in a list. It is also worthwhile to assess the possibility of equipment relevant for income generation and any other cost saving measure, as outlined above.
Often industry relevant equipment is missing. But what is industry relevant, especially in a developing country? To my understanding TVET is imperative to develop / improve industry and commerce; truly

an interesting and complex topic. For example, considering new technologies for Renewable Energy (RE), which are much needed to change the ecosystem.

A very good source for further, detailed information is the free eBook:
Managing Technical Training Equipment, A practical guide to setting up or refurbishing a hands-on training center
The eBook provides for:
1. How to set up a technical training program
2. How to assess existing training equipment
3. How to search and find training equipment
4. How to evaluate and select training equipment
5. How to acquire and purchase training equipment
6. How to maintain and service a training center
7. How to use Edquip: find products and get quotations

A step-by-step process, including practical tips in each chapter. The eBook is available at https://edquip.co/

The definition of training equipment as part of a specific training concept does not stand alone, but requires appropriate room concepts mirroring required work flows, dimensions, accessibility, noise protection, technical installations, load bearing capacities, used media or material, room climate, etc.

Interrelation of equipment and facility planning: Teaching/training equipment requires to check on what exists and what is needed. The later depends what is required by the curriculum for respective occupational profiles. Those profiles must be assessed to satisfy marked demands to find a job at the job market. On the other hand, size and arrangement of facilities are determined by the required equipment, besides space and budget restrictions.

FACILITIES

Alignment of building construction measures and layouts ensure that the room designs / buildings designated to host new / upgraded workshops meet the requirements in regard to:

- Available surface area
- Room dimensions allowing for the intended equipment arrangements and storage
- Availability of supplementary infrastructure such as water, electricity, compressed air
- Environmental, health and safety guidelines shall be followed and respective risks and safeguards must be taken

Implementation Phase (Procurement Equipment)

Having agreed equipment lists at hand as stated above, including costing, and the estimated construction cost an Initial Procurement Plan can be prepared. The question of who pays for what needs to be discussed and agreed on before the plan is prepared.

The final list of equipment shall become subject of detailed cost estimates to work out clear boundaries for financial manoeuvre and flexibility by investigating market-based cost estimations (margin for deviation where possible 10-15%) for the equipment. It is good practice to provide links to manufactures, or distributers for necessary technical details. Such a list is for INTERNAL use only, as prices and manufacturers are given.

The development of the **Technical Specifications** based on the equipment list(s) will be done during the implementation phase. Procurement experts must assure that the technical specifications do not contain any prices or product names and are not directed towards a specific supplier[1].

[1] Further details on this issue provides the Practitioner's Guideline "Drafting Technical Specifications for TVET equipment", including useful template.

Procurement / Tender considerations

It happens (too often?) that Equipment from previous investments are left idle due to the expensive trading supplies (spare parts, consumables), no capacity to repair the imported equipment, and few knowing how to use it, not to say how to perform proper industrial related training.
Hence, in this respect to the sustainability of the investment, it is highly recommendable to explicitly specify:

- Operational & Maintenance (O&M) training
- User (train-the-trainer) training2 (basic training and technology-specific courses) to provide teachers with the necessary didactical knowledge and industrial know-how. Any training must include specific Teaching, Training and Learning Materials (TTLM) in the languages as required (All types of materials suitable or specifically designed and developed to support the occupational learning processes)
- Prolonged guarantee period of at least 5 years (especially for certain machines and costly equipment) and sufficient spare parts and materials.

Hence, not "only" Supply, but: "**Supply Contract for Delivery, Installation, Training and Maintenance of Training Equipment"** might be advisable.
Existing regulations, international safety, and environmental standards for the use of the technical equipment must be observed.

Understanding the **time required in any procurement activity** is possibly the single most important driver in the whole undertaking, and it is all too often underestimated. The overall period consists of the activities mentioned above, which depend on the size and complexity of the supply.
The following is an analysis of an "average" EU timetable from publications of project forecasts: "Clarification Opening session: 24/12/2020; Contract Notice: 19/02/2020; Tender Dossier published: 19/02/2020; Clarifications: 12/03/2020; Corrigendum: 10/02/2021: Award 14/07/2021; amounts to ~7 Months".
Add to your preparation time, the period for tendering plus delivery and commissioning to have a **realistic timetable**, if nothing goes wrong!

Sustainability

Preferably, any extensive investment should include necessary Accompanying Measures to establish an efficient system for planning, operating and maintaining school infrastructure. It is critical that schools are able to access maintenance funding through regular Government channels.

The Future

will effectively link between analog and digital learning methods for a variety of "high tech" disciplines, including Electrical and Mechanical Engineering, Mechatronics, Automation, Industry 4.0, Automotive Maintenance and New Energy Vehicles, CNC, Renewable Energy (RE) and many more. The approach called "Blended Learning" opens up opportunities for the transfer of learning content to target groups that are suitable for their situations and connects the theoretical and practical training of the workshops with exciting solutions from the field of Digital Learning. The function and servicing of machines and entire systems can then be practiced virtually without the real process having to be interrupted.
Not only for "high tech", but for many (all?) disciplines, such integrated teaching might be the ideal model. However, it necessitates the provision of suitable curricular and pedagogical strategies, instruction materials and appropriate facilities. One more important prerequisite are properly trained teachers; ideally the "theory-practice teacher". However, it can be expected that complexity and cost of equipment will increase.

Lastly, I would like to share some experiences I have acquired around the world. I chose privately kind of bottom-up approach: Often visited (especially in developing countries, sorry to say this) some training institutes without official encourage and compared the millions poured into the system and was has reached any of the training institutes. It made me sad to see so many times poor teacher payments and bad facilities.

[2] Practitioner's Guideline "Drafting terms of reference for training services", including useful samples.

Are we avoiding the term "Higher" Education, using instead "Academic"? Otherwise, how can we promote TVET, the lower ones?
TVET: The "Professional" Education!

I sincerely hope that my Practitioner's Guideline is helpful;
Please ***provide feedback:*** https://guenterschieske.wordpress.com/ *or email.*
New references and ideas are welcome!

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Other Papers and guidelines:

Practitioner's Guideline "Drafting Technical Specifications for TVET equipment"

Practitioner's Guideline "Drafting terms of reference for training services"

Financing TVET - A practitioner's view on costing and pricing issues

Specific organisational and financing arrangements of a Enterprise - Training- Partnerships (ETP) in the context of (inter) national PPP projects

Project Implementation Issue: A practitioner's perspective on Project Management Units

From White Collar Hype to Professional Hip

Communication Strategies for a TVET Program; General policy on international conferences, study visits and partnerships

Appraisal and Prioritisation of Equipment, Teaching Materials and Building Infrastructure Needs for Vocational Schools

Selection and Promotion of TVET Institutes based on Criteria

Training instructions on capacity assessment and development (based on ADB's Handbook for Capacity Building through Case Based Learning)

Manuals, Operational Procedures:

MEHRD: Procurement and Contract Administration Manual & Training Instructions (including Templates and Best Practices)

World Bank, Workforce Development Authority, **Ruanda**: "Program Operations Manual"

EU PHARE Project, Latvia: "Program Management Handbook"

EU TVET Reform Program, Egypt: "Manual of Procedures";

GTZ-DMS: "Guideline for Drafting a Manual of Procedures"; "Expert Guide"

Numerous specifications, including Environment and Occupational Health and Safety (EOHS) requirements for Equipment, Teaching Materials and Building Infrastructure for Educational Facilities (Schools and training centres); Many Terms of References for Expert Services; Various and complete Tender Dossiers for Supply- Service- or Works Contracts.

Author: Dipl.-Ing. Guenter Schieske, German national, born 1950, studied structural & cost engineering after the completion of an apprenticeship as metal worker. I have been working worldwide as Procurement / TVET / Finance Expert and Project Manager for International Consulting Firms and International Financing Institutes.