DT2.1.4 SHARED TECHNOLOGY RATING METHODOLOGY (TRM) TO CHECK OUT READINESS OF NEW TECHS AND PROCESSES

DT2.1.4

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1. Introduction

The aim of the present document was introducing the new conceptual methodology for rating the selected technology or managerial solution (or new business model). The Technology Rating Methodology (TRM) was developed to provide researchers/engineers/investors/owners the possibility to execute a self-test of their projects idea. After the Material-Flow-Analysis (MFA) every project partner had to find different potential solutions which help to handle their waste problems in the pilot area.

Every partner (from pilot countries) has already selected max. 3 waste flows with MFA method and now they should match them to the best business or technology model. The partners should have to search different technological or business solutions (min 2/pilot area) for each waste flow.

With helping of TRM index, we can suggest to select the „best" technology or business model from technical point of view.

The colleagues of BZN investigated different methodology which is similar to this purpose, but we have not found an available methodology for technology rating, especially for circular economy. Therefore we had to develop a new methodology for ranking different technologies.

2. Elements of the TRM Index

The TRM index will be a single number, but to determine this number we have to consider different aspects. In this table we summarised these aspects.

Best technology to recovery (TRM INDEX)
Technology readiness level (TRM 1)
Market references (TRM 2)
Reliability (TRM 3)
Circularity level (TRM 4)
Operational experience (TRM 5)
Technical limits (TRM 6)
Other aspects (TRM 7)

Different aspects of TRM

In the next subchapter will be explained each of the aspects.

2.1. Technology readiness level (TRM 1)

The first aspect is the readiness level of technology, where we would use the well-known method of TRL. The technology readiness levels (TRL) are a method of estimating technology maturity during an acquisition process. TRL are based on a scale from 1 to 9 with 9 being the most mature technology. The use of TRLs enables consistent, uniform discussions of technical maturity across different types of technology. TRL has been in widespread use at NASA since the 1980s where it was originally invented. The European Commission advised EU-funded research and innovation projects to adopt the scale in 2010 which they did from 2014 in its Horizon 2020 program.

According to Horizon 2020 program, the following maturity degree is applied to determine the TRL. (https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf):

- TRL 1 – basic principles observed,
- TRL 2 - technology concept formulated,
- TRL 3 – experimental proof of concept,
- TRL4 – technology validated in lab,
- TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies),
- TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies),
- TRL 7 – system prototype demonstration in operational environment,
- TRL 8 – system complete and qualified,
- TRL 9 – actual system proven in operational environment.

According the above TRL categories we would suggest defining the TRM 1 as follows:

1 point:	TRL 1 – basic principles observed,
	TRL 2 – technology concept formulated,
2 points	TRL 3 – experimental proof of concept,
	TRL 4 - technology validated in lab,
3 points	TRL 5 – technology validated in relevant environment,
	TRL 6 – technology demonstrated in relevant environment,
4 points	**TRL 7 – system prototype demonstration in operational environ**,
	TRL 8 – system complete and qualified,
5 points	**TRL 9 - actual system proven in operational environment**.

We think that the most promising technologies for the partners have already reached min. the TRL6. Please, investigate your selected technologies and estimate their maturity level from the above TRL, then mark the right points for TRM 1.

2.2. Market references (TRM 2)

Nowadays, it is not enough if we have an innovative technical solution. In the business life it is very important if we have an operating technology, where the investors can investigate and make sure of the real operation. Therefore the market attendance can be convinced for those who would like to interest some new technologies. From European point of you would be challenging if this solution is situating in closer to Europe. Matter of course if we have more reference point in the market, it would more promising for investors.

So, for TRM 2 we suggest to classify your selected technologies from the bellow points according to market references. Of course, due to the project time frame and budget limitation it is very difficult to solve traveling and see all reference sites, so we would suggest to investigate it by the available information from the internet or any other resources.

1 point: no reference,

2 points: one reference site, but not in Europe (it is difficult to check it),

3 points: one reference site in Europe (it is easy to check it),

4 points: two or more reference sites, but not in Europe,

5 points: two or more reference sites in Europe,

Please, choose the right one and mark it for TRM 2.

2.3. Reliability of the technology provider (TRM 3)

Besides the market attendance, if we want to choose the best available technology from the market it is advisable to consider the financial background of the provider. Nowadays the confidence is one of the most valuable things in the business life. Therefore it needs to investigate and estimate the reliability of our technology or service provider. Why we need to consider it? Since the market changes dynamically nowadays, one startup company can arise quickly and one can go to ruin easily. We need a reliable company who can ensure spare parts and the service for reparation within a short period. It goes without saying that the most reliable companies are the well-known firms with good financial and technical background.

So, for TRM 3 we suggest to classify your selected technologies from the bellow points according to reliability of technology provider. Of course, due to the project time frame and budget limitation it is very difficult to solve traveling and see all reference sites, so we would suggest investigating it by the available information from the internet or any other resources.

1 point: no information about the company,

2 points: Start-up Company (unknown background),

3 points: Start-up Company (well-known background),

4 points: well-known, reliable SME company,

5 points: well-known, reliable company (not SME),

Please, choose the right one and mark it for TRM 3.

2.4. Circularity level (TRM 4)

Although, the TRM basically is focusing the technological point of you, we would like to consider here the circularity level too, since this methodology was developed primarily for circular economy's solutions. Based on the worked out method of MFA, we would suggest using the same definition for the different stage of circularity.

So, for TRM 4 we suggest to classify your selected technologies from the bellow points according to circularity level of the selected technology. Of course, due to the project time frame and budget limitation it is very difficult to solve traveling and see all reference sites, so we would suggest investigating it by the available information from the internet or any other resources.

1 point: no circularity (the waste goes to disposal),

2 points: weak circularity (waste to energy recovery),

3 points: good circularity (waste to material recycling)),

4 points: very good circularity, (preparing to reuse, repair, remanufacturing),

5 points: strong circularity (waste prevention and product prolongation).

Please, choose the right one and mark it for TRM 4.

2.5. Operational experiences (TRM 5)

Based on the earlier aspect (TRM 2: market reference) the next element is depending from the operational background. When a technology has already installed and we collected much information during the test phase, we have more experiences about our technologies, such as the stable and reliable operation, cycle period of the changeable spare parts and lubricants. After the test period, especially one year operation period we can know not only the technical problems but the economic data also. A reliable technology or service provider collects this information and during the negotiation phase they can provide us in strict confidence. Most of this information – in generally – it is not available in the internet. So without site visit, it is very difficult to estimate the operational experiences – excepting if we find any publication/blog about the experiences. So, if we have not got any possibility to the site visit (due to the budget or time) we have to try the TRM 5 definition by the available resources what we found.

So, for TRM 5 we suggest to classify your selected technologies from the bellow points according to operational experiences of the investigated technology.

1 point: no information about the operation

2 points: week operation (instable and not reliable operation)

3 points: average operation (semi-reliable, need more maintenance)

4 points: good operation (stable and reliable operation – may be not cheap)

5 points: very good operation (stable, cheap and reliable operation),

Please, choose the right one and mark it for TRM 5.

2.6. Technical limits (TRM 6)

Based on the state of the current science there in not any universal solutions for the technical problems. Therefore before decision of the investment all investors must analyse the technical limitations of the selected technologies. Most of this information – in generally – it is not available in the internet. So without site visit, it is very difficult to estimate the technical limits – excepting if we find any publication/blog about the limitations. So, if we have not got any possibility to the site visit (due to the budget or time) we have to try the TRM 6 definition by the available resources what we found.

So, for TRM 6 we suggest to classify your selected technologies from the bellow points according to technical limits of technology.

1 point: very strict limitation (it can be used only in homogeneous, pure waste fraction),

2 points: strict limitation (it can be used only homogeneous waste fraction),

3 points: average limitation (it can be used for average, mixed waste),

4 points: few limitation (one or two substance is restricted),

5 points: no limitation/restriction in the technology,

Please, choose the right one and mark it for TRM 6.

2.7. Other aspesct (TRM 7)

Due to the flexibility we suggest to set up an own aspect for the investors (and for the project partners) where they can determine any other aspects what they think to be important for them.

3. Calculation of TRM Index

When we finished determining of the TRM elements, we can easily calculate the overall TRM index for each selected technology. Before the calculation we have to set a weighting factor for each TRM aspects. The weighting factor is determined by the investors (or the project partners), depending of the importance of each aspect. So, the set of the weighting factor is subjective by the users.

In the following definition can be seen the calculation of the TRM, where TRM_i is i^{th} specific TRM aspect and W_i is the i^{th} specific weighting factor.

$$TRM = \sum_{i=0}^{n} TRMi * Wi$$

If we have more technologies we can calculate the TRM index for each of them and after that it is easily to compare two or more technologies by the technical point of you.

4. Excel sheet for TRM Index

The BZN has developed an excel sheet to help for TRM calculation for the partners. This table calculates automatilcally the TRM index, if the user gives the weighting factors of the different aspect and gives the pointing of the technology according to the TRM elements.
The excel sheet availble from this website:
https://docs.google.com/spreadsheets/d/1WLAkFDlKH5ZCliLtK8DFaGdPW0UrFeNBk4bo7a1gpTU/edit#gid=0