Introduction

Ever since the first days of railway operations, trains have been enabling passengers and goods to cross borders. It is in the interests of countries, consumers and railway companies to work together to develop means to enhance Inter-Operability.

By adopting a human factors approach, it is possible to anticipate and validate the future working situations of the various players involved in interoperability (drivers, shunters in marshalling yards, train and station staff, dispatchers and signallers). A standard approach must be adopted to assist the methodical preparation of interoperable services and thereby avoid starting from scratch for each operation.

It will therefore guarantee, as is the case in other risk industries, that the combination of a failure and an operational human error does not have any damaging effects on the operation of the system.

Setting up an interoperable service is rather like designing a product, it can be approached in several ways and different methods can be used. Whichever way this design phase is approached, human beings will be integral to future interoperable situations.

While this approach certainly integrates human aspects, it also embraces organisational aspects. Attention is indeed accorded to human beings but it is also acknowledged that their actions and their behaviour are a result of their interaction with the system or systems of which they are a part (the definition of work, the rules to be applied, the environment, the organisation, communications, other players involved, equipment, tools, normal/downgraded/transition situations, etc.).

All legislative aspects must also be taken into account, in Europe for example: directives and TSIs (Technical Specifications for Interoperability).

I. The Methodological Guide to integrating Human Factors

It proposes to include human factors in the railway interoperability design process in the following areas:

- Aid to project management
- Diagnosis of reference situations (or the existing situation).

“Aid to project management” presents recommendations to enable railway undertakings to carry through a project for an interoperable service, integrating organisational, human and social aspects (human factors).

Examples:

1. The study of a Franco-Italian railway link aimed to identify what aspects should be taken into account in conducting an interoperable project where human factors have a role to play.

   Juxtaposing different socio-technical systems implies the following:
   - New working teams will emerge
   - Competences will evolve
   - Players involved will be confronted with “unexpected” situations which have to be prepared for as much as possible.

Therefore the companies involved must be very careful regarding the conditions required for the success of interoperable operations. There has to be strong cooperation and collaboration in order to prepare different divisions for interoperable operations by creating new, or extending existing, reference documents, regulations etc. Meanwhile, it is vital for operational staff to take part in the drafting of these documents in order to harness the benefit of their hands-on experience. With regards to the implementation of such operations, daily feedback on events and experience should be provided to deal with and find solutions
for problems that may arise so as to give the parties involved optimum preparation for managing systems in both ordinary and down-graded situations.

2. An analysis based on field observation and interviews helps identify and link elements to be taken into account in steering a project. All managers tend to approach interoperability only from financial, technical and procedural points of view. Nevertheless, there is a tendency for executive and operational managers to raise different themes and diverge in opinion. The former are mainly focused on management tasks, company strategy and organisational aspects of work, which are a reflection of the environments they work in. The latter are more hands-on, closer to the practical demands and difficulties of work arising from daily border-crossing operations and closer to the progressive implementation of interoperability in the area, i.e. the contrasting semantic environments between countries in signalling and driver tasks.

However, at this level, the situation is generally organised around a set of rules and procedures. Although these aspects are necessary, they do not suffice in themselves. It is necessary to take into account the context of use, procedures need to be made operational, and the form of collective work necessary for their implementation needs to be calculated. Drivers interviewed were apparently scarcely aware of these projects and only had rather vague ideas of what went on over the border.

Thus, based on observations of the current situation in the field, we were able to reflect on the characteristics of probable future situations.

- Anticipating issues relating to the adaptation and approval of rolling stock to meet the criteria in each country calls for reflection on how these technical standards will impact driving tasks, work conditions and driver training. The project must cover the practical aspects of organising maintenance: frequency, responsibility, division of work between countries, training of equipment maintenance staff.
- The choice of freight tonnage for interoperable locomotives (1,150T) avoids the need for banking locomotives: this choice will have a positive impact on the balance of traffic. However, this should be accompanied by a new deployment schedule for banking drivers and a rapid recovery service, to cope with any system malfunction on banks and gradients.
- Interoperability of locomotives and personnel will not only have an impact on the work of drivers but also on the way stations and marshalling yards operate. Yet, those leading the project speak very little about the tasks carried out there and their relationships with the role of drivers and railway traffic control. (arrival/ departure of trains, composing of trains, ground staff duties). The communication networks that we identified in different stations in France and Italy signal the need to look into the consequences of increased interoperability in terms of tasks, workload, remits or even redeployment of marshalling staff.
- Safety is often viewed only from a technical perspective. Nevertheless safety should be considered in driving, communication and driver / ground staff interaction. Down-graded situations and their management modes also have to be considered, especially when occurring in a foreign country. Furthermore, it is essential to analyse and systematically gain feedback properly from any incident or accident in order to draw lessons for better prevention.
- Language and even technical training do not seem to be envisaged, and
- Working conditions are not mentioned (working hours, retirement, career prospects, etc.).

This list of examples illustrates the low level of attention devoted to human factors at this stage in the project.

3. Planning interoperability cannot be done without setting up cross-border work groups to prepare for interoperability. These should be comprised of experts and specialists from different fields as well as follow up groups to monitor progress in the field. Permanent special structures should also be set up to manage day to day coordination and collaboration. Besides, they also serve to identify other key topics for negotiation in such a project such as commercial strategies and interests for each country involved, train routing,
problems relating to setting and complying with timetables, managing delays and customer compensation.

The diagnostic aid for the organisation of interoperability presents three checklists to guide analyses on the ground:
- comparison of socio-technical systems
- analysis of the operation of a marshalling yard or station, and
- analysis of driving in another system

The aim of the diagnosis is to allow railway undertakings to identify risk situations and difficulties as well as the knowledge and competencies required for the preparation of the future situation in addition to and going beyond the Technical Specifications for Interoperability (TSI).

Example: The three checklists guide field based analysis in order to anticipate necessary human resources, equipment and training, that will be key to organisation and implementation of safe interoperable traffic. They are meant to be used by human factor specialists. The aim is to identify potential risk situations and difficulties as well as what knowledge and skills will be required by different staff in future situations. This can be achieved by comparing two socio-technical systems, e.g. analysis of the way a marshalling yard or station works and analysis of driving in other countries.

II. Languages: The Handbook to Assist in Assessment of Language Skills of Train Drivers & Other On Board Staff

Among those risk situations identified is the use of languages. Today all interoperability operations or similar have been developed adopting "the ground language", rather than a single common language as is practised by certain aviation companies.

There are several reasons for this:
- The railway is an open system: the driver may interact with a number of different people in each system for the purposes of his work and to ensure the safety of his load and this very often occurs in downgraded or accident situations. These different interlocutors, sometimes unexpected, (maintenance staff, level crossing operators, but also police officers, judges, rescue services, fire brigade, accident witnesses) speak the local language.
- Rail systems differ from one infrastructure to another and are based on concepts which are expressed in the language and culture in which they developed (multi-lingual countries may have succeeded, on account of their culture, in "translating" these concepts into their different languages, but this is also because the system referred to is the same). The choice of words is very important and using a third language would only widen the comprehension gap.
- Unlike international aviation which rapidly developed to enable global travel, railway interoperability is built on existing systems in which technology, procedures and communication are intrinsically linked to enable operations.
- It is difficult to imagine a system operating in the local language with native speakers and a single common language with those passing through.
- Implementation of a single railway language, even if it were limited to interoperability, raises the problem of the sheer numbers who would need to be trained (totally unrealistic), the enormous cost of initial and ongoing training, transition time, the uncertain quality of the result in the long term – including for safety-critical operations - given the number of people involved. In addition, working time rules, the need to organise the return legs of on-board staff journeys economically and transit to stations or yards, would place limits on how far staff travel from their home station, at least in conventional traffic.
- Moreover, language level cannot be maintained through daily driving, since in normal situations drivers are not required to speak (they simply obey information displayed in the cab or received via line side signals), yet they must be capable of delivering reliable messages in case of the slightest incident.
Finally, the implementation of a single language would create a definite advantage for the country where that language is spoken.

In order to better address the issue of languages, work has been undertaken with language specialists.

1. What language competences?

The railway experts working with language specialists identified:

- The need for general basic level of language competence defined as an A2/B1 proficiency level as defined by the Common European Framework of Reference for Languages (CEFRL). As the “oral” part is more important on the railways than the “written” one the following levels have been identified as requirements:
  - Listening – B1 (ILR 1+)
  - Spoken Interaction – B1 (ILR 1+)
  - Spoken Production – A2 (ILR 1)
  - Reading – A2 (ILR 1)
  - Writing – A2 (ILR 1)

- The knowledge of specific railway language was defined by the following 16 specific criteria:
  a. Criteria relating to general competency: Drivers must be able to:
     C1: formulate numbers and hours
     C2: spell words with the international alphabet (extended if necessary)
     C3: have the courage to speak in a language which is not their mother tongue, be able to initiate and take initiative in a communication, and overcome apprehension even when they know they are being recorded
     C4: pronounce sufficiently correctly and clearly as to be understood
     C5: adapt the speed of their speech to their interlocutor and the situation they are in
     C6: ask an interlocutor to speak slowly, to repeat or reformulate
     C7: reformulate (using other words or spelling out words or numbers).
  b. Specific criteria relating to safety and operation, in particular drivers must be able to:
     C8: use the specified vocabulary (glossary) and messages prescribed by the IM (Infrastructure Manager), formulate all messages positively
     C9: pronounce and recognise “name of stations on the line and key locations and their location” (OPE TSI § 4.2.1.2.2.1)
     C10: pay attention to words whose meaning can be confusing
     C11: recognise an emergency message even if it is badly pronounced or if there is interference
     C12: understand the description of a situation (ability to listen, ability to question)
     C13: explain a situation, even if it means paraphrasing
     C14: transform oral information into writing
     C15: read and understand a predefined written message
     C16: write a message, to fill in a form as dictated by another operator (predefined message or free message).

2. Linguistic Knowledge Proficiency Assessment–LiKPA

LiKPA is a three stage process which must be carried out in sequence: Stage 1 Certification prior to vocational training, Stage 2 Assessment at the completion of relevant training followed by Stage 3 Assessment which, if successful, allows the Railway Undertaking to issue a Score Report attesting the language competence required to satisfy the linguistic component of a train driver’s licence

1 Equivalent to the Interagency Language Roundtable (ILR) 1/1+
Stage One – General Language Competence, Pre-Training Assessment

This certification should be considered as the “foundation” on which further, railway specific competence can be built. Assessment of general language competency can be carried out by a specialised language entity, from within or outside the rail sector. The tests must be aligned to the CEFRL and assess all five areas: oral comprehension/listening, oral production/speaking, spoken interaction, reading and writing.

Assessment authorities should be members of a testing association, either EALTA, ALTE, or similar and adhere to their quality guidelines. The Assessment institution must provide for an evaluation of oral expression in interaction and oral production by testers who have documented evidence of having followed a calibration workshop and been tested and rated as reliable oral interviewers.

Stage Two – Railway Language – In-Training Assessment

Drivers must master:

- Normal railway words and phrases as specified in the “Manual of communication procedures” and the relevant “Book of Forms”, in the “Driver’s Rule Book”
- Normal railway words and phrases as specified by the Infrastructure Manager in the context of the envisaged route(s) (inc. place names) and the international system for communications.

Stage Two assessments should be considered as providing evidence that all the “building blocks” of language necessary for train drivers are in place. The tests are carried out by the training institute, during and at the end of training. They may consist of a wide variety of simple tests such as multiple choice, fill in the blanks, dictation for filling in forms, oral production etc. They will cover all language needed by drivers including standardised messages, place names on routes etc. Tests and test answers including video recordings of the test must be kept available for inspection.

Assessment authorities should be members of a testing association, either EALTA, ALTE or similar and adhere to their quality guidelines.

Stage Three – Language In Use – Post-Training Assessment

Drivers must master safety-related and operational communications so they do not render situations more dangerous.

This means that the Stage Three test must provide evidence that the candidate not only knows the language but “knows how to use the language”. Specific language skills must be assessed in work situations, in the same way as professional competency, the assessment must therefore take place after vocational training (training in the driving rules of the network in question) in the system corresponding to the language tested. Assessment will be carried out in as realistic a situation as possible within the framework of Scenarios.

The testers should be selected, trained and certified according to specific instructions. They must not be trainers known to the candidates. The candidates will receive their results from the following five descriptors:

<table>
<thead>
<tr>
<th>PASS</th>
<th>FAIL</th>
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<tr>
<td>Level 5—“Superior Competence”</td>
<td>Level 2—“Nearly Competent”</td>
</tr>
<tr>
<td>Level 4—“Clearly Competent”</td>
<td>Level 1—“Not Competent”</td>
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<tr>
<td>(Target level for Drivers)</td>
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<tr>
<td>Level 3—“Capable”</td>
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3. Duration and Expiry of LiKPA

Railway Undertakings and Infrastructure Managers are required to establish recruitment and competence management system to ensure that the individual competency of their staff
involved is assessed and maintained. Additionally, training must be provided, as necessary, to ensure that knowledge and skills are kept current, especially in relation to weaknesses or deficiencies in system or individual performance.

Over the course of an individual’s working life language competency as well as professional competency must be checked via periodical tests or examinations and at all other opportunities such as management checks, audits, incident evaluation, feedback of experience, etc. which form part of Railway Undertakings’ quality and safety management systems.

Train crew have little opportunity to use their linguistic competence and tend to lose through time their capacity to act efficiently under degraded or emergency conditions.

In view of their obligation to ensure safe operations, experience suggests that Railway Undertakings would be advised to adopt as a minimum the following guidelines.

For drivers certified:

1. "Capable" further training and reassessment within the year
2. "Clearly Competent" reassessment within two years
3. "Superior Competence" reassessment within three years.

Railways Undertakings’ & Infrastructure Managers must provide ongoing and remedial language training which should address the need to maintain or improve. Vocational training is normally carried out in the target language, to simplify the acquisition of vocational and language skills and the ability to handle communication situations.

4. Other Ways of Improving Communications

Whilst the principal objective of the Handbook is to provide Railway Undertakings and Infrastructure Managers guidelines for putting into practice LiKPA Assessment, all Railway sector stakeholders should envisage additional measures which will contribute to safe communications.

It should be noted that, even though the capacity of ground personnel to communicate in their own language is not currently the subject of a TSI, improvements in their practice will also enhance safety. Basic training for ground personnel on how to interact with Speakers of Other Languages should therefore be considered by Infrastructure Managers. Similarly the assembly and provision of bilingual glossaries, which must be carried in drivers’ cabs for consultation as required, will facilitate safe use of language.

5. Example of a LiKPA Scenario

Freight train in France

Background

Freight train 146127 consisting of 22 wagons, 728 tonnes, 365 m. long, with all axles braked.

1. The driver is alone in the cab.
2. The train is running on the second track on the left on a track bed with four tracks (two other tracks to the right of the train).
3. Lines electrified to 25 kV AC; automatic colour-light block signalling system (BAL) with fixed equipment for occasional wrong track working (IPCS) on the four tracks.
4. The train is called over the radio system: "Driver of train 146127, emergency! Stop the train. There are sparks emitted from your train, on the right, 2/3rds down the train".
5. A text will be given to the driver when he "goes to inspect his train" to provide him with the elements describing the situation – in his language.
Criteria that can be tested:

- Recognition of an emergency message (C11)
- Ability to understand the description of a situation (C12)
- Ability to ask one’s interlocutor to speak more slowly (C6), if necessary
- Ability to explain a situation (C13): ask for protection to go and inspect the train followed by explanation of the findings
- Ability to use the specified vocabulary (C8)
- Ability to write a simple message dictated by the sender (C16)
- Ability to overcome any reluctance to speak, take the initiative, to communicate with someone (C3)
- Ability to pronounce words correctly and clearly (C4)

Critical Points:

- Recognition of the emergency message which can be under poor reception conditions due to interference over the radio system
- Reformulation of the information received regarding the problem detected on his train
- Criteria C3 - Ability to overcome any reluctance to speak

Critical Points are identified as any linguistic function critical to safety. Typical Critical Points will include, but are not limited to, the above criteria. Testers must fail candidates who do not respond appropriately to these points. They should not notify the candidate at the time of the breakdown but continue to administer the full range of criteria. Notification of the specific breakdown should be included on the Score Report given to the candidate on completion of the rating procedures.
References:


Technical Specifications of Interoperability relating to the subsystem ‘Traffic Operation and Management’ of the trans-European conventional rail system (OPE TSI)


