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Accepted Manuscript






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*Perspectives Article*

# ECETOC TRA version 3 : Capturing and Consolidating the Experiences of REACH

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**Word count** : abstract : 187 contents : 4256 reference # : 18

**Key words**: REACH, exposure assessment, exposure prediction, modelling, TRA

**Abstract**

The ECETOC Targeted Risk Assessment (TRA) model is intended to evaluate the nature of human and environmental exposures and risks arising from the manufacture and use of chemicals and version2 has been extensively applied to develop Chemical Safety Assessments for substances registered under Phase 1 of REACH. In order to maintain the model, ECETOC solicited suggestions from TRA users arising from their experiences gained from its use in the 2009-2011 period. TRA users identified 16 different ways in which the worker exposure predictions of the TRA might be further improved at the technical level. The suggestions can be divided into those that are capable of being incorporated into the model and those which cannot which, in turn, appear to be reflective of the wide range of technical understandings of users of Tier 1 REACH models such as the TRA. The consequence of such user heterogeneity presents challenges for model developers, particularly those models intended for inclusion in regulatory processes. Those considerations that are relevant for the revision to the worker portion of the TRA (version3) are described, together with their potential relevance for other REACH exposure models.

## Background

The European REACH regulation [1] requires the documentation of safe conditions of use for classified chemical substances during their entire life-cycle, from manufacture, via distribution and formulation, to a series of end uses which can be extensive for commodity substances such as solvents. The regulation introduced the concept of the 'Exposure Scenario' (ES) for each use in the life-cycle where the ES refers to the Risk Management Measures (RMMs) required to be applied to ensure safe use under defined Operational Conditions (OCs) of the use. 'Safe use' implies that exposure levels (inhalation and dermal in the case of workers) are below specified reference values. Within each use there are likely to be distinctly different activities (tasks) requiring specific RMMs, resulting in a multitude of Chemical Safety Assessments (CSA) that are required to build up a REACH registration dossier for a substance.

The ECETOC Targeted Risk Assessment (TRA) model is intended to evaluate the nature of human and environmental exposures and risks arising from the manufacture and use of chemicals and was launched in 2003 [2]. For human health, the TRA model can estimate both worker and consumer exposures, together with the ability to incorporate defined reference values (such as OELs) in order to gauge the nature of risk. The original aim of the TRA was, in the discussions leading up to what eventually became the EU REACH Regulation, to demonstrate the utility of tiered and targeted approaches for the risk assessment of chemicals i.e. the application of a series of models (Tiers) that together serve as a suitably conservative screen for identifying where ('targeting') the application of more detailed (higher Tier) approaches is appropriate [3]. Such tiered approaches to the use of exposure estimates in the evaluation of workplace risks build from established occupational hygiene practice and hence are equally applicable to assessments under worker health protection regulations as well as under REACH. In this respect, the original TRA (version1) used the concept of the 'exposure scenario' to help users differentiate and focus on those workplace use conditions that are likely to represent those of most concern.

The concepts of tiering and targeting, together with that of the 'exposure scenario', subsequently became enshrined within the REACH Regulation, as well as its supporting Technical Guidance. For example, the origin of the Use Descriptors (such as Process Categories, PROCs, and Product Categories, PCs) that now form the basis of how uses are described and communicated within REACH [4] can be directly traced to the terms used to describe worker and consumer exposure in TRA v1. However, as the discussions on the form and content of REACH developed during 2003-2005, it also became apparent that certain elements of TRA v1 were either insufficient to meet some of the demands of REACH or had become redundant altogether [5]. Specifically, in order to accommodate potential data gaps in the understanding of a substance's hazardous properties, parts of the TRA v1 reflected 'hazard and risk banding' concepts such as those contained in the UK HSE's COSHH Essentials tool [6] whereas REACH is clear in its requirement that substance risk assessments must be based on the specific hazards of the chemical and not any generic assumptions. Furthermore, it also became apparent that version 1 was insufficient to address the necessary scope and level of detail expected of worker risk assessments under REACH [7]. As a consequence, ECETOC significantly revised v1 and released version 2 in 2009. This meant that version 2 better reflected the requirements of REACH as described in the legal text and its

supporting Technical Guidance, particularly its ability to predict inhalation and dermal exposures for relevant conditions of use (and described using Process Categories (or PROCs)). At the same time, the tool's layout was also developed to allow ready access by the range of user skill types implied by its use in REACH Chemical Safety Assessments i.e. ranging from manufacturers and formulators to downstream users of chemicals. Version 2 has been available for free download from the ECETOC website, together with supporting materials that enable users to correctly install the tool and understand its limitations [8]. The current REACH technical Guidance identifies the TRA as the "preferred Tier 1" tool for worker exposure estimation [9]. Over 14,000 downloads of the TRA v2 tool have been made from the TRA website since May 2009 and the TRAv2 has been used as the basis for estimating worker exposures in the significant majority (greater than 80%) of those Phase 1 (2010) REACH Registrations that were required to be supported by a Chemical Safety Assessment [10].

Following the completion of Phase 1 of REACH in December 2010 (substances in commerce at >1000 tpa), ECETOC approached users of the TRA to seek their ideas for how the TRA might be further improved. The aim of this exercise was to ensure that key learnings arising from the use of the TRA in 2009/10 could be captured, evaluated and incorporated into an updated version that would be intended to be available for use in Phase 2 of REACH (registration of substances in the tonnage range 100-1000 tpa by 1st June 2013). The intention was to characterize the nature of any shortcomings in TRA v2 in order to identify the extent to which the TRA needed to be further improved. At around the same time, the European Chemicals Agency (ECHA) also announced its intention to release a revised version of its Chesar CSA tool by Summer 2012, in order that Chesar was able to incorporate many of the solutions to the challenge of CSA/ES development and communication that had become available subsequent to the initial release of Chesar (for example the substance use maps and generic exposure scenarios developed within the key chemical supply chains [11]). For human health scenarios, Chesar v1 applied the TRA v2 exposure estimates. ECHA therefore asked ECETOC to ensure that any developments to the TRA were also undertaken on a timescale that was consistent with ECHA's desire to have available a revised version of Chesar before the summer of 2012.

## Methods

Free download of the TRA is possible after potential users have registered some basic details on the ECETOC website (http://www.ecetoc.org/tra). This step enables ECETOC to maintain a listing of TRA users in order to make them aware of TRA-related developments, but no information is captured on the demographics of the user or the reasons why they are seeking access to the TRA. In the case of TRA v1 (which was a web-based application), ECETOC's vision was that this 'community' might be stimulated to become proactive in collaboratively solving questions on the use of the TRA, as well as proposing ideas on its further development. But this level of ambition exceeded reality, so this functionality was withdrawn in TRA v2.

In order to ascertain the extent to which further development of the TRAv2 was appropriate, ECETOC contacted all registered TRA users in late 2010, explaining its reasons for wanting to review the TRA v2

and soliciting their experiences of its use and suggestions for how it might be further improved. Around 120 responses were received. These were mostly from larger European companies, but also included regulatory agencies and smaller consulting organisations. ECETOC then compiled an inventory of the various experiences and suggestions it had received and used this as a major input to a one day workshop that was held in March 2011 at which the proposals was discussed in order to identify those suggestions that had the potential to be taken forward for incorporation into version3 of the TRA. Moreover, as ECHA's vision for Chesar v2 (http://chesar.echa.europa.eu/home) evolved, especially regarding its planned functionality and data dependencies, discussions also took place with ECHA, in order to ensure TRA-related enhancements could also be accommodated within Chesar (and vice versa).

## Nature and Rationale for Model Improvements

In REACH terminology, the TRA is a Tier 1 tool [12], i.e. it is intended to provide simple, yet conservative estimates of (inhalation and dermal) exposure sufficient for an user to determine whether a more detailed (Tier 2) exposure assessment may be required or not. For worker exposures, the structure of the TRA has been developed along the lines of a source receptor model, such that account can be taken, as required under REACH, of how different workplace conditions (OCs) and forms of exposure control (RMMs) affect exposure. Figure 1 illustrates this basic form for inhalation exposure predictions.

A broad summary of the suggestions that were provided by TRA v2 users for improvement to the worker element of the TRA is listed in Table 1, together with those suggestions that were taken forward for incorporation in TRA v3. They are categorized according to their relationship to the element of the source receptor chain that they are most closely related to. The user suggestions represent a variety of aspirations, ranging from practical suggestions for improving the inherent sensitivity and specificity, to extending the TRA v2 beyond its stated domain of application. Apart from the technical suggestions for improvement listed in Table 1, users expressed their overwhelming support for how the TRA v2 was positioned and structured i.e. as a single tool that is capable of delivering estimates of exposure as required by REACH (i.e. the capability to account for any differences in inhalation and dermal estimates that result from different industrial and professional uses). This indicated that a prime consideration that ECETOC needed to account for in any revision was to identify if the model's accuracy and flexibility should be further improved, without radically overhauling its basic structure.

The TRA v2 has a boundary of reliable application that has been previously described [8]. But the paradox of 'user friendly' tools is that they are used by a wide range of ability levels that, in turn, have a range of (sometimes competing and contradictory) expectations for the tool. Indeed, where a tool's boundaries are more restricted than the user's expectations, then this does not always seem to serve as a constraint to users seeking to apply the tool outside the stated domain. Some of the suggestions in Table 1 are possibly a reflection of this fact. So while some represent straightforward suggestions that aim to improve the technical basis of the tool, others seek to extend its boundaries in ways that are inconsistent with its underpinning principles (viz founded on proven scientific principles; broadly

applicable across a range of substance types/properties; directly REACH relevant; conservative in its outputs; and simple to access and apply).

In order to determine which improvements could be accounted for, ECETOC therefore considered each of the suggestions within the context of these principles. Table 1 also identifies those that were chosen to be incorporated in TRAv3 and those that were not, together with a brief explanation of why those suggestions not taken forward were rejected. In the main, those discarded fell into 3 categories: 1) that the proposals were not broadly applicable across the uses (REACH process categories, PROCs) covered by the TRA; 2) that the measures were technically valid but were associated with sophisticated engineering or management strategies, which are inconsistent with the expectations of a Tier 1 model under REACH; and 3) that the scientific rationale supporting the proposed solution was considered insufficient for inclusion within the model (i.e. the associated uncertainties were too high to be included in a Tier 1 tool). A further consideration was the need, identified by several key users, for the TRA to align as far as possible with the broader 'scope expectations' of the relevant REACH Technical Guidance. In this respect, changes were also introduced that enable short-term inhalation exposure values to be calculated from the shift average estimates according to the methodology contained within the TGD, in order that these can then be compared to available short-term DNELs. In the case of dermal exposures, more extensive revisions were introduced (Fig.2) which were driven by the significant gap between the ability of the inhalation and dermal modules in version2 of the TRA to account for REACH OCs and RMMs. The result is that in version3, the two modules are now more closely aligned, albeit that there remains less flexibility in the assessment of dermal exposures, i.e. ECETOC considered that the available science is not sufficient to reliably support the ranges of OCs and RMMs linked to inhalation exposures (Fig. 1) or to predict short term exposures.

**Discussion**

The ECETOC TRA is not a sophisticated model in terms of the means it employs to predict exposure. In essence, it is a source receptor model that has been modified and optimised to accommodate the broader requirements of REACH [13]. Because it is specifically targeted towards REACH, the TRA has acquired a diverse user community, ranging from experts in large established organisations to users in small and medium sized enterprises. Indeed, the fact that the TRA has been specifically targeted for REACH may go some way towards explaining the fact that TRA has been used in so many REACH Registrations. However, despite its intended attributes, it does not address every eventuality. In this context, the applicability domain of the TRA has been described and, in addition, the tool incorporates integral information (in the form of pop-ups) that is intended to further help users correctly use the tool. Experience, however, suggests that despite such accompanying warning advice, some users will try to adapt it (either intentionally or in ignorance) to situations that lie outside the domain of the tool.

In this sense every exposure model has its strengths and weaknesses. More sophisticated models (often termed Tier 2 models) invariably have greater accuracy and more developed outputs such as confidence intervals around point estimates, but are invariably less accessible to non-expert users (such as those downstream groups that are often associated with REACH) and, perhaps as a consequence, can be associated with greater between user variability [14]. Furthermore, since these models are often only

applicable to defined use types or exposure routes, they often are linked to a more restricted domain than Tier 1 models. These factors perhaps explain the reason why REACH advises registrants to apply available models in a tiered and targeted manner, accounting for the limitations of each model.

Table 1 indicates that two types of suggestions proposed by users were: 1. revisions (mostly downwards) to the TRA's base exposure predictions (and particularly those for dermal exposures), and 2. suggestions for expanding the tool by extending the range of exposure determinants (termed operational conditions (OC) and risk management measures (RMM) by REACH) that the TRA incorporates. Concerning the first suggestion, even though the process of developing the TRA v2 introduced significant revisions to the TRA v1 exposure estimates, there has been no comprehensive independent validation of the TRA v2 predictions. Limited evaluation of parts of the tool [15,16,17], coupled with the anecdotal experiences of 2010 Registrants, suggest that the inhalation estimates for volatile liquids are, in the main, conservative reflections of reality. In the case of dermal exposures, there is a paucity of reliable and representative measured data against which models can be compared. For this reason, ECETOC decided that it would not substantially revise the base TRA v2 exposure predictions in v3 but await the findings of the larger BAuA funded E-Team project that is intended to validate the range of available REACH worker exposure models (http://www.eteam-project.eu/). However, concerning the second type of suggestion, ECETOC determined that it would expand the TRA to incorporate new exposure modifiers (OCs and RMMs) provided that they remained in line with the screening nature of the tool and followed the same principles as those applied for inhalation exposure estimation, i.e. that they were capable of application across the range of use scenarios (PROCs) covered by the TRA, were straightforward to apply and that there was a convincing underpinning scientific rationale. It was also agreed that ECETOC would correct anomalies regarding how the exposure predictions for certain PROCs were identified. The implemented changes (for inhalation and dermal exposures respectively) are summarized in Figures 1 and 2.

Previous research on how target audiences respond to health and safety communications has shown that the responses and expectations of these groups are shaped not only by their understanding (or lack of understanding) of the technical basis of the information itself (in this case the TRA model), but also by other factors that relate to their 'needs' [18]. For this reason, it is perhaps unsurprising that Table 1 includes suggestions that may at face value appear misplaced: the suggestions simply reflect the expectations that these groups would like any REACH model to deliver. For example, while some suggestions represent incremental improvements to the TRA within its existing domain, others have limited application or are at odds with the expectations of REACH (and in particular those laid out in the relevant Technical Guidance Documents). In the former case, ECETOC was receptive to the inclusion of such ideas, but ECETOC did not accommodate any suggestions that would be seen to be at variance with REACH. This is not to say though that not all the 'in scope' improvements were implemented. For example, where a valid exposure control was only applicable to a sector specific use or type of substance e.g. a vapour recovery system during tanker loading, then this was not included. Similarly, if the available science for the suggestion was considered weak (even though the basic thesis may be attractive), then this was rejected too e.g. the suggestion that the dustiness of a substance is a legitimate predictor of dermal exposure.

The changes implemented in TRA v3 should result in it being an improved model compared to v2. Because the tool has been applied in REACH registrations, it is important to gauge whether these changes undermine in any way the integrity of registrations that have been based upon the TRA v2. The fact that the improvements are essentially enhancements to the tool's utility (the addition of OCs and RMMs) and not material differences in its core exposure prediction framework means that v2-based CSRs remain valid i.e. v2 was not deficient in any material way, rather it was capable of further refinement, especially in the flexibility it offered users. Indeed, within the context of REACH, there is probably no 'best' model. Users normally need to have access to a range of models to address the breadth of expectations demanded by REACH. The TRA is aimed as a Tier 1 (screening) model, i.e. its prime purpose is to identify situations (Exposure Scenarios) of 'no concern' and target those where higher tier approaches to evaluation should be applied. As a consequence, the TRA is unlikely to deliver the most accurate exposure estimates among available REACH models: by definition they are intended to be inherently conservative. The TRA v3 has retained the v2 structure that enabled the inputs to and outputs from the tool to be readily processed into REACH CSAs and Exposure Scenarios something that allows for work flow efficiencies to be derived from the process of chemical safety assessment, ES writing for registration dossiers and ultimately ESs for extended Safety Data Sheets.

One of the dilemmas of exposure tools could be said to be that enhancing their accessibility invariably demands simplicity in the associated user interfaces. In turn, this militates against model complexity. But, often, complexity is associated with increasing sensitivity. To compensate for this conundrum, REACH encourages a range of exposure tools to be applied in the development of CSRs. But, it is apparent that despite the comparatively straightforward domain statements in the TRA, a wide number of users either misunderstand or ignore them. Several of the suggested improvements specifically deal with topics outside the stated domain of the TRA (e.g. liquid aerosols and metal fumes). Therefore, version 3 not only includes a clearer written domain statement but has also been structured to incorporate a series of active features (e.g. 'pop ups') that serve to warn or remind users of the TRA's limitations when they try to enter counter-intuitive information, e.g. higher efficiency ventilation or respiratory protection is not permitted for professional uses; LEV cannot be applied outdoors. Table 2 describes the domain of version3 and will hopefully not only serve to constrain the creativity exhibited by some version2 users, but also to further reduce intra- and inter-user variability.

At the basic level, any model should be regularly reviewed to identify if it is capable of offering improved accuracy and/or flexibility. But as changes to the models used in regulatory settings can also initiate the need to re-work regulatory submissions that rely on the model, then improvement for the sake of it should clearly be avoided. When a revision to a model results in its ability to identify new or better describe existing risks, then such a change is clearly warranted. However, it is difficult to prospectively determine the potential impact of possible improvements. Those that result in no material change to the risk assessment outcome must clearly be considered to be of questionable value. In this respect it would appear appropriate for models having regulatory application (such as those referred to within REACH) to be reviewed and maintained. What might represent an appropriate frequency for such reviews is unclear, but it perhaps might align with the frequency of the parent legislation (i.e. 5 years in the case of REACH). As the TRA revision exercise perhaps illustrates, it is comparatively straightforward

to propose new models, but is much more challenging to sustain them over the associated regulatory timescales.

## Conclusions

The scientific basis of exposure models varies according to the intentions and characteristics of the model. At face value, those models that are built on established scientific foundations may not require regular review and revision. However, exposure models seldom operate in isolation. Indeed, some models (such as the TRA) have been primarily developed to support particular regulatory frameworks and needs. But as chemicals regulation is invariably dynamic, then it is important that the review period for those models that are intended to be used in regulatory arenas, is more frequent as one of the express aims should be to ensure that the model remains optimised for the regulatory space which it is intended to operate.

Following the release of the TRA v2 in 2009, ECETOC has completed an assessment of those elements of the TRA that require update in order that the tools remains suitable for use under REACH, the exception being the accuracy (or not) of its inhalation and dermal exposure estimates that are being addressed by the wider E-Team project. The potential improvements to the TRA suggested by its users indicate that lower tier models not only need to be based on established scientific principles but also need to be robustly structured in order to address the likelihood that users will try to apply such models outside their domain of reliability. Indeed, in such cases, it would appear that simple 'boundary statements' may be insufficient in themselves and that more active approaches to limit such tendencies may be advisable. The ECETOC experience also highlights the fact that the process for model update is not simply one of accommodating scientific and technical advances; in conjunction with any intention to implement a change, model developers must also understand the implications of further model updates on the regulatory environment in which the model operates. For example, will the revised version bring new responsibilities for users or serve to potentially undermine the integrity of prior decisions arrived at using previous versions of the model? Conversely, when new or existing models are intended to be introduced into existing regulatory frameworks then it would appear sensible for such 'regulatory impact analyses' to be available to accompany the model and suitably inform prospective users of potential pitfalls and responsibilities that they should be aware of. In this respect, it is advisable that the process for revising model of this type is sufficiently transparent and comprehensive to document such considerations, as the benefits of communicating the rationale for and consequences of any changes as part of the roll out of any revised version of the model are self-evident. There would also appear to be a benefit in ensuring that the processes adopted by developers when revising models (and particularly those targeted at common or similar regulatory needs) are harmonised in order that the users are able to obtain consistent 'impact assessments'. Clearly, change for the sake of change should be avoided.

Users of models are also not without responsibilities. The suggestions put forward by TRA users appear to indicate that most are well aware of their obligations when deploying the TRA within REACH. But some appear less well-informed. In this respect model developers would appear to have ongoing

responsibilities to sustain their models, both through regular technical review but also via activities aimed at describing the nature of user experiences. The integrity of models applied in regulatory settings is not solely a function of the inherent capabilities of the model, but also how the model is routinely applied. Historically, significant attention has been paid to the former, but the latter area is equally important if any outputs are to be both reliable and consistent. Success is not just therefore a function of the model *per se*, but is also shaped by the nature of how it can be understood and applied.

315 **Titles of Figures and Tables**



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321 Table 1: Summary of suggested and adopted improvements to the TRA version2

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| Affected Element of TRA | Suggested Area for Improvement | Within Scope of TRAv2 | Nature of Changes in TRAv3 |
|---|---|---|---|
| **Core Model Determinants** | • Ensure that any differences between the exposure estimates for industrial and professional users are suitably differentiated | Yes | • Identified anomalies now corrected |
| | • When relevant, ensure that same ventilation effectiveness applies to both inhalation and dermal estimates | Yes | • Identical values apply to both forms of estimate |
| | • Suggestions that several core estimates are too conservative (e.g. PROCs 7 and 11) and require downward revision | Yes | • Not implemented. Awaiting outcome of E-Team validation project. |
| | • Introduce consideration of the potential impact of volatility/dustiness on dermal exposure estimates | No | • Not implemented. Current scientific basis considered insufficient to justify inclusion |
| | • Introduce ability to characterize exposures from UVCBs (substances of unknown and variable composition ) | No | • Not implemented. Current scientific basis considered insufficient to justify inclusion |
| | • Extend the TRA to include an ability to predict aerosol (mist) exposures and process fumes | No | • Not implemented. Current scientific basis considered insufficient to justify inclusion. Warning message now included in tool. |
| | • Introduce further discrimination in the TRA to better predict the nature of exposures to liquids having very low vapour pressures | No | • New functionality incorporated for certain substances with vapour pressure of < 0.01 Pa |
| | • Exposure estimates should apply to all industry sectors (REACH PROCs) | No | • Not implemented. Available exposure data for affected PROCs not considered sufficient to develop reliable exposure estimates |
| **Operating Conditions** | • Introduce ability to predict exposures at different operating temperatures (i.e. beyond ambient) | No | • Implemented via input of VP at elevated temperature |
| | | No | • Implemented with four duration and concentration |

| | | | |
|---|---|---|---|
| | • Introduce consideration of the potential impact of task duration and concentration of substance in product/preparation when applied to dermal exposure estimates | | bands (same as for inhalation) |
| **Risk Management Measures** | • Include the capability to account for the effectiveness of general ventilation on inhalation exposure estimate<br>• Include the capability to account for LEV use outdoors on inhalation estimates<br>• Incorporate the ability to address the effectiveness of dermal protection (gloves)<br>• Incorporate the ability to address the impact of specific working training on inhalation/dermal estimates<br>• Include a function to address the impact of specific work equipment and procedures e.g. film isolators, drum pumps, remote handling, etc.<br>• Provide the ability to factor in 'enhanced' exposure controls i.e. RPE and extraction ventilation beyond TRAv2 upper bounds (typically 90%) | Partly<br>No<br>No<br>No<br>No<br>No | • TRAv3 includes ability to account for two different forms of general ventilation<br>• Not implemented as the use of LEV outdoors is not an appropriate Tier 1 consideration<br>• TRAv3 now incorporates this feature<br>• Not implemented. Proposed solutions considered too scenario specific for incorporation into a general exposure model<br>• Not implemented. Proposed solutions considered too scenario specific for use in a general exposure model<br>• Not implemented. TRA is a Tier1 model and does not consider effectiveness >95%. |

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325 Table 2: Domain of reliable application of the ECETOC TRA version3

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| Domain Boundary | Comments |
|---|---|
| **Gases** | The TRA does not predict exposure to gases. However the TRA does allow exposures to very volatile liquids (with no upper bound set on vapour pressure) to be estimated. As these very volatile liquids might be assumed to be the equivalents of gases for many circumstances of use (PROCs), then provided users are able to assure themselves of such equivalencies, then it is reasonable to assume that the high volatility exposure prediction can also be used to predict exposures to gases in certain scenarios. |
| **Aerosol mists** | Although exposures aerosol mists might be expected to be associated with certain uses which are open and associated with the release of significant amounts of energy (e.g. spraying, machining, etc), the TRA does not address such exposures. However, in circumstances where users have available representative measured exposure data on mists, then these may be able to be used to 'calibrate' and read across to relevant PROCs. |
| **Process fumes** | Although exposures to process fumes might be expected to be associated with certain uses which are undertaken at elevated temperatures (e.g. handling hot materials when their melting point lies at or above ambient temperatures), the TRA does not address such exposures. |
| **Fibrous materials** | The TRA does not predict exposure to fibrous solids. |
| **Exposures above ambient temperature** | The TRA predicts exposure at 20$^{o}$C. Where a liquid substance is handled at temperatures significantly in excess of this, then users should apply the vapour pressure calculated at the operating temperature. The exception to this 'rule' is PROC6 (calendaring) where the TRA predictions already account for the elevated temperatures applied in this activity (see also 'process fumes' above when solid substances are handled). |
| **Solids in liquids** | The TRA cannot predict exposures to solids suspended or dissolved in liquids. If such exposures are considered relevant, then in circumstances where users have available representative measured exposure data, then these may be able to be used to 'calibrate' and read across to relevant PROCs, or alternatively users are referred to other tools capable of estimating such exposures. |
| **CMRs and 'very high hazard' substances e.g. respiratory sensitisers** | Although the TRA is a Tier 1 model and hence is conservative in the nature of its predictions, it requires judicious application to CMRs and other high hazard substances. However, for 'simple' mono-constituent substances such as readily volatile liquids (e.g. toluene, benzene, n-hexane), then provided users can assure themselves that the exposures lie within the domain boundaries, the TRA will be capable of offering valid predictions. |
| **UVCBs** | The TRA estimates have been developed for mono-constituent substances. Where UVCB substances are being assessed using the TRA (in particular those substances having a range of volatilities) then users should apply the nominal VP for the substance (or the VP of most volatile component present at >1% when this is known |
| **Mixtures** | The concentration modifier enables the TRA to predict exposures to a single substance within a (simple) mixture. However, the TRA is not intended to be applied to calculate combined exposures to different substances in a mixture beyond the 'concentration banding' that already exists. |
| **Fractions of airborne solids** | The TRA exposure predictions for solids do not differentiate between total inhalable exposure (respirable and non-respirable) and respirable exposures fractions. Users should therefore assume that any output for solids describes the inhalable fraction. |
| **Out of scope uses** | The TRA does not cover certain REACH uses (PROCs), specifically PROC 25 (handling of solid inorganic substances at ambient temperature); PROC 26 (Handling of solid inorganic substances at ambient temperature), PROC 27a (production of metal powders using hot processes) and PROC 27b (production of metal powders using wet processes). If these PROCs are considered relevant, then users are referred to other tools capable of estimating exposure in these circumstances (e.g. MEASE). |

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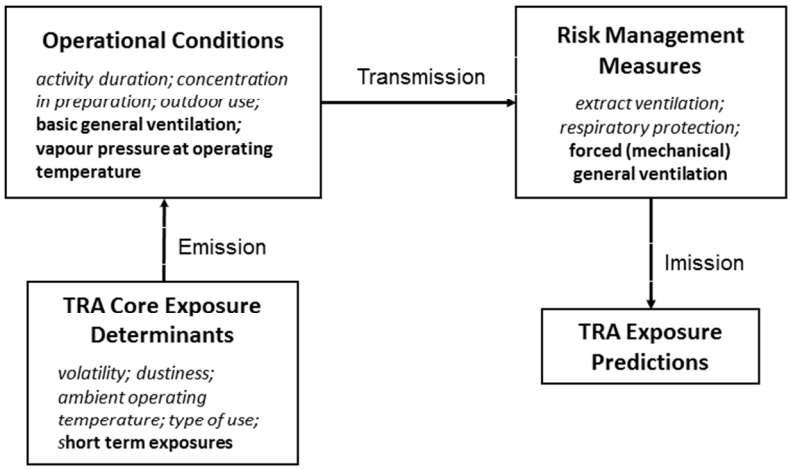
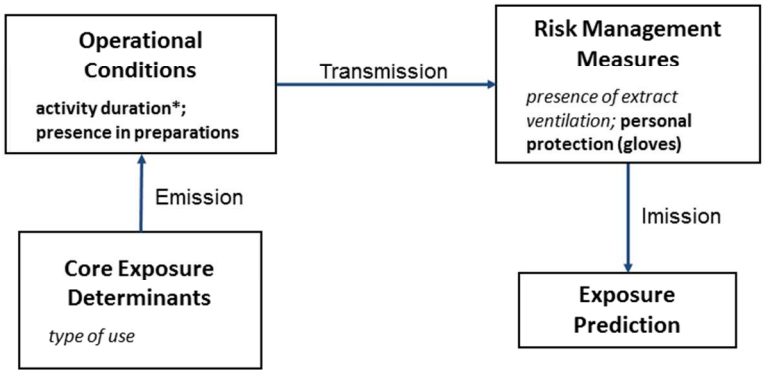



Italicised text represents TRA v2 functionality. Bold text indicates TRAv3 enhancement

Figure 1 : Structure of the ECETOC TRA model (inhalation exposures)
254x190mm (96 x 96 DPI)




Italicised text represents TRA v2 functionality. Bold text indicates TRAv3 enhancement

* applies to all PROCs for high and moderate volatility liquids and non-dusty solid substances

Figure 2 : Structure of the ECETOC TRA model (dermal exposures)
254x190mm (96 x 96 DPI)

**ECETOC TRA version 3 : Capturing and Consolidating the Experiences of REACH**

Environmental Impact Statement

Version 2 of the ECETOC targeted risk assessment (TRA) exposure model was released in 2007 and over 10,000 users have subsequently downloaded the model. The TRA v2 has subsequently been applied to assess worker, consumer and the environmental risks in over 80% of the REACH registrations in the EU. But like all models, it is capable of further improvement. This work describes the experiences resulting from the development of the TRAv3 and particularly those considerations that are relevant for those exposure models aimed at 'non-expert' groups, in order that such models can be reliably and consistently applied.

**ECETOC TRA version 3 : Capturing and Consolidating the Experiences of REACH**

Chris Money, Frank Schnoeder Dook Noij, Hsieng-Ye Chang, and Jan Urbanus

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This article outlines the pertinent considerations when developing and sustaining exposure models that are intended for use in regulatory processes.