**Answers to this questionnaire should be submitted via the online EU survey tool. You can use this template to work in draft and copy-paste the answers in the online tool via:**

[**https://ec.europa.eu/eusurvey/runner/Diversification\_qualitative\_questions\_phase\_2**](https://ec.europa.eu/eusurvey/runner/Diversification_qualitative_questions_phase_2)

# Qualitative questionnaire

*This qualitative questionnaire serves to accompany the phase 2 quantitative Excel template and to gain insight in the wider context of diversification in internal models. This insight does not only help to meet the objectives of the diversification study, but also feeds into improving future EIOPA studies.*

*You can fill in one qualitative questionnaire for multiple undertakings in case the answers are the same.*

*Due to the similarities of this questionnaire with the one for the first data request, a reference to your previous answers might be helpful.*

*Diversification relates to terms as modelling dependencies, aggregation and resulting diversification effects. In the annex we have therefore provided a definition of these terms to enhance the understanding of this questionnaire.*

*Your responses can be succinct, but should be sufficiently understandable and comprehensive.*

# Participant information

*To provide in the EU survey tool*

# General approach

1. In general, it is expected that modelling dependencies and correlations are partly subject to expert judgement settings. Please elaborate how the process of setting expert judgements is embedded in the organisation and on the main challenges with regard to the expert judgement settings for lower level risks and inter-risk/intra-risk correlations.

When and how are the experts involved in the definition of correlations/dependencies between subrisks of different modules?

# Dependencies, aggregation, and risk modelling

*Within the Solvency 2 framework, undertakings have the freedom to set-up the model structure, as long as it is in line with the tests and standards as defined in the Directive. Therefore, different approaches are expected.*

*The following aggregation approaches could be applicable at both top and lower level risks.*

*Bottom-up integration:*

*The dependence structure is based on the simultaneous aggregation of all different risk-factors. Afterwards a stressed P&L is determined for each set of combined risk-factors. Non linear effects, or cross terms, are directly captured in a natural manner.*

*Modular approach:*

*The dependence structure is based on aggregation of SCRs or P&Ls of the different risks, similar to the standard-formula. The possible non-linear effects or cross-effects between risks are not directly captured since the model assumes “walls” exists between the different risks.*

*Sideways integration:*

*The dependence structure is based on the aggregation of different risk-factors and P&Ls based on multiple partial dependencies. Similar to bottom-up integration, possible non-linear effects or cross-effects between risks are often directly captured.*

1. Please describe the aggregation approach(es) applied at the **lower level risks** in the internal model. For instance if the dependencies on these lower levels are based on bottom up, modular or sideways aggregation approaches or a mixture of these on e.g. equity, interest, longevity risks etc.

*The following different methods to model dependencies can be applicable, which come forward at different levels or branches of the aggregation tree:*

*Var-Covar approach:*

*A correlation matrix is used to aggregate SCRs as in the Standard Formula. Per pair of risks a single parameter will therefore define the dependence in the tail and the body of the distribution for positive and negative P&L movements.*

*Copula:*

*This is a structure, which will distinguish between the different aspects of dependence. In essence, the appropriate copula can be chosen to specifically calibrate the different levels of dependence in the tail and in the body of the distribution and for positive and negative P&L movements. A lot more freedom exists to customize the dependence structure, but this is accompanied by mathematical complexity.*

*Common risk-drivers:*

*Common risk drivers can impact different risks. Underlying risks are identified and their interactions modelled. For instance if inflation is supposed to impact two lines of business, this will create a dependence between both.*

*Sum:*

*One could also simply sum the SCRs of single risks.*

1. Please select and describe the method(s) applied to model dependencies, at the lower level risks of your internal model. If possible, please also specify the parameters of the dependency method, e.g. ‘degrees of freedom’ in case of a copula approach.

Dependency method Choose an item.

1. The body and tail of the distribution can be both relevant in the dependency settings, for instance the correlation settings in the tail could typically differ from the correlation settings in the body of the distribution. Please explain whether you determined the dependency settings in the body and tail of the distributions differently, and how.

# Model Changes and impact COVID-19

1. Did you apply model changes in the dependency, aggregation and correlation settings since the first phase of this study? If yes, can you elaborate what initiated these changes? It suffices to describe the most material changes. Regular updates e.g. of calibration are not

needed.

1. With more than one year of the COVID-19 pandemic, can you elaborate on how COVID-19 impacted the assumption settings in the dependency, aggregation and correlation settings? Are model changes expected in light of COVID-19?
2. Which tests, in the scope of diversification, did you perform to assess the ongoing compliance explicitly in light of COVID-19, and which conclusions did you draw from these tests? Please also elaborate in case validation tests are foreseen in the future with regard to aggregation concerning COVID-19 effects.

# Complementary information to the quantitative data request

1. In case the reported regulatory SCR does not reconcile with the SCR derived from the simulation data (cell D17, scenario request), was that caused by simulation noise? For instance, by re-simulating the scenarios entered in the sheet “Scenario request”, or did you use simulations from your own aggregation runs?

1. In case the lower-level risks in the standardized reporting are not in line with the lower-level risk taxonomy in your internal model: Are the differences sufficiently covered in the template? If not, please elaborate.
2. Did you make approximations and/or assumptions to generate the data as provided in the standardized model reporting? If yes, please elaborate.
3. What other challenges did you encounter when producing the data for the data request?

# Terminology as used in this questionnaire

|  |  |
| --- | --- |
| Term | Definition |
| aggregation | Action of determining the size or value of a cluster of several components. In this case, this would be the process of considering different risks jointly in order to obtain an integrated risk profile (e.g. calculating the SCR of a company based on its life, non life, market and operational standalone SCRs) |
| aggregation tree | Representation showing how sub-risks aggregate to a total risk (e.g. equity risk and interest rates risk aggregate to market risk, premium risk and reserve risk aggregate to non life risk, market risk, non life risk and operational risk aggregate to the total risk). The aggregation tree also shows the order of aggregation operations (from bottom to top), as well of the method used. |
| allocation | Action of sharing something in several contributions. In this case, this would be the action of sharing or splitting the amount of risk dependent on the contribution of the single components to the total risk, the sum of the contributions being equal to the amount of the risk (e.g. dividing the total SCR of a company onto the risk categories life, non life, market and operational risks according to their contribution) |
| copula | A copula is a multivariate joint distribution function establishing a connection between the marginal distributions of two or more random variables and their joint distribution. The marginal distributions of the copula itself are uniform distributions. Combining the copula function with the margins of the modelled random variables yields their joint distribution. The usage of this approach allows to model the marginal distributions and the dependence in separate steps. |
| correlation | Mathematical description of dependence, i.e. the relationship between two or more random variables, most commonly pairwise linear dependence. Can be measured by correlation coefficients that vary in definition and features (“Correlation does not imply causation.”).  If measured on a joint distribution obtained from marginal distributions and a copula, certain correlation coefficients depend not only on the copula but also on the marginal distributions (ex: Pearson correlation coefficient) |
| cross effect | Describes functional dependencies as opposed to stochastic dependencies between two or more risk categories, e.g. longevity and interest rate. Stochastic dependencies arise due to correlation, i.e. the probability that events occur simultaneously, whereas functional dependencies determine the impact if events occur simultaneously. Both impact the diversification effect. The multiple usage of buffers is an example of a cross effect. In a modular model, these are often considered by an additional modelling step, which can lead to a (positive as well as negative) correction of the risk capital calculated so far. |
| dependence | The association between two or more random variables, where information on one variable provides information on the other variables. |
| diversification | The concept of allocating exposure across a range of risks which are not fully correlated, with the purpose of reducing the overall risk exposure using the fact that the adverse outcome from one risk can be offset by a more favourable outcome from another risk.  Diversification is a core principle of insurance, e.g. pooling of risks in a portfolio of policies and thereby sharing the overall risk. |
| diversification effect | The reduction in the risk exposure of insurance and reinsurance undertakings and groups related to the diversification of their business. The diversification effect is everything that arises from diversification concerning the risk exposure. It can for instance be quantified through risk measures such as the SCR. |
| marginal distribution | A distribution is a mathematical function that assigns to an exhaustive set of mutually exclusive future events a probability of realisation.  A marginal distribution is the distribution of a random variable contained in a subset of random variables (e.g. a vector of risk factor changes), without any reference to the value of the other random variables of the subset. So a marginal distribution is obtained from the joint distribution by integrating out dependence to other variables. In practice however in internal models, it works the other way around: risk distributions are coupled together to form a joint distribution. |
| non-linear dependence | A set of vectors is linearly dependent if one of the vectors is a linear combination of the others.  Non-linear dependence is dependence that cannot be expressed by a linear function or captured by a linear correlation coefficient.  In internal models, non-linear dependence typically arises as tail dependence or association of higher order terms of risk factors. |
| risk factor | External realisations of risk drivers that enter the economic valuation in the IM. The distribution of the risk factors leads to a distribution of profits and losses. Examples for risk factors are specific interest rates or longevity. The terms risk driver and risk factor are often similarly used. |
| risk profile | Set of sub-risks, risk factors and sensitivities which express an undertaking’s exposition to risks reflecting its specific business model. |
| tail dependence | Tail dependence describes the dependence between variables above a certain quantile of the joint distribution. Typically, it can be expected that tail dependence differs from (and often be stronger than) the dependence in the body of the joint distribution. |
| variance-covariance approach | Sometimes called *parametric VaR*, the approach assumes the risk factor (changes) follows an elliptical distribution, e.g. multivariate normal. Therefore, from an estimation of the mean vector and covariance matrix, the VaR result can be obtained directly.  This approach is assumed for the aggregation via standard formula in the Solvency II regime. |