# Tomorrow's Cities Decision Support Environment (TCDSE)

## WORK PACKAGE 1: FUTURE VISIONING

### Background

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Tomorrow's Cities Decision Support Environment (TCDSE)

the voice and capacity of the urban poor in tomorrow's cities through the Tomorrow's Cities Decision Support Environment (TCDSE).

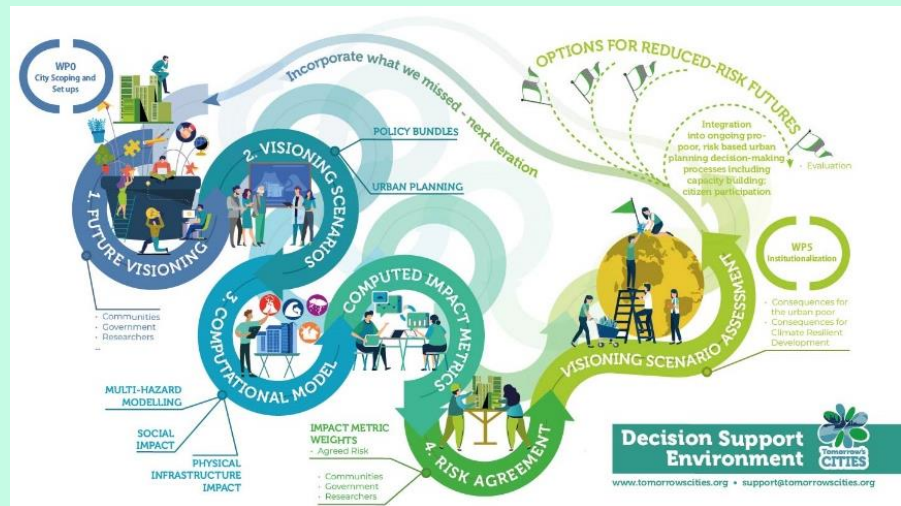TCDSE has following main components or stages, which research-wise are framed as Work Packages (WP):

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### WP1: Future visioning

Future Visioning is the official start of the framework. It is a people-centered stage in which powerful and marginalized urban voices gather to imagine better futures that reduce disaster risk for the poor, and to think about the possible pathways and constraints to reach such futures. In the TCDSE, Future Visioning is a trajectory rather than a one-off exercise. It aims to create synergies between stakeholders, to legitimize collective positions, and to produce outputs (data, notions, expectations) that will feed other TCDSE components.

Future Visioning, as the name suggests, is a process that supports informed decision making rather than making or enforcing decisions.

Future Visioning is not only about imagining a good future city, but also about building relationships and questioning the injustices that shape risk. Whilst not all groups and voices could be represented in the TCDSE, having those who represent (and are able to communicate) power imbalances is a good starting point for a more democratic Decision Support Environment.

### Rationales for Thinking about the Future

Before delving into Future Visioning, it is important to highlight 3 rationales for thinking about the future.

- The first rationale asks how the future should be or what it should look like. This is called a **normative rationale** and is usually associated with qualitative methods and utopian thinking.

- The second rationale asks how the future will probably be or look like given past data and current trends. This is called a **predictive rationale** and is usually associated with quantitative methods and forecasting techniques.

- The third rationale is about asking how the future could be or look like under certain premises or conditions. This is called an **exploratory rationale** and could be an adaptation of forecasting or a qualitative assessment of diverse perceptions or expectations about the future.

### Future Visioning in the TCDSE

Future Visioning in the TCDSE asks how cities should be, whilst also prompting reflections about possible futures and injecting data and information about possibilities and probabilities. The objective is to reach a pallet of options which are both desirable and plausible/possible. Moreover, in Tomorrow's Cities, participants are prompted to reflect not only about

end-states in the future, but on the pathways that lead to such a range of aspired futures. Following figure suggests that process.
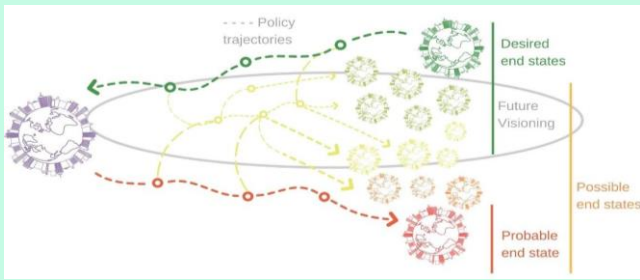


The concept of Future Visioning in Tomorrow's Cities
Source: Future Visioning Toolbox (image inspired by IPCC reports)

## The Wheel of Urban Assets

A key device – used both during Future Visioning and in other TCDSE stages – is the 'Wheel of urban assets'.
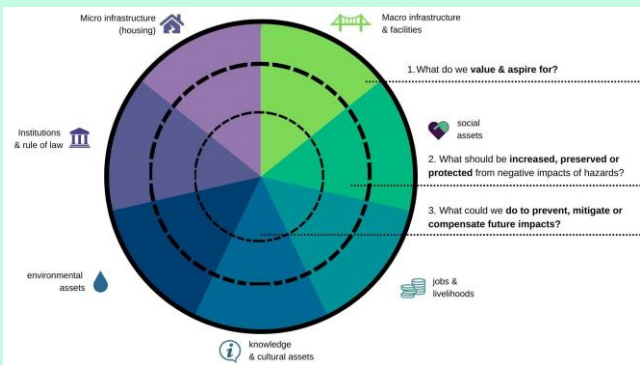


**The wheel of urban assets. Source: Future Visioning Toolbox**

The wheel helps think about urban complexity by highlighting 7 dimensions, each representing one class of assets: *macro infrastructure and facilities*, *social assets*, *jobs and livelihoods*, *knowledge and cultural assets*, *environmental assets*, *institutions and rule of law*, and *micro infrastructure/housing*. Cities are welcome to change terminologies (the labels of each section), so the final version of the wheel is easily digestible by participants.

In Future Visioning, 3 overarching questions are asked, represented by the 3 rings of the wheel.

- What do we value and aspire to?
- What should be boosted, preserved, or protected from the negative impacts of (future) hazards?
- What could we do to prevent, mitigate or compensate for the impacts of future hazards?

## The Trajectory of Future Visioning

The 3 overarching questions shown in the wheel of urban assets are further unpacked as a methodological trajectory in which each question represents a milestone with preparatory and concluding stages.



The methodological trajectory of Future Visioning within the TCDSE Source: Future Visioning Toolbox





**Future visioning in Nairobi, Kenya**

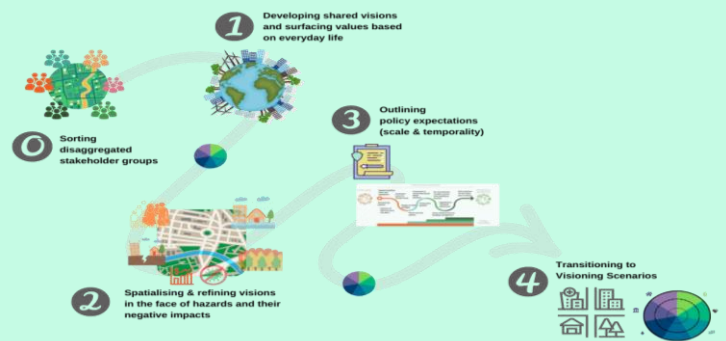For further information:



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# Tomorrow's Cities Decision Support Environment (TCDSE)

## WORK PACKAGE 2: VISIONING SCENARIOS

### Background

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Tomorrow's Cities Decision Support Environment (TCDSE)

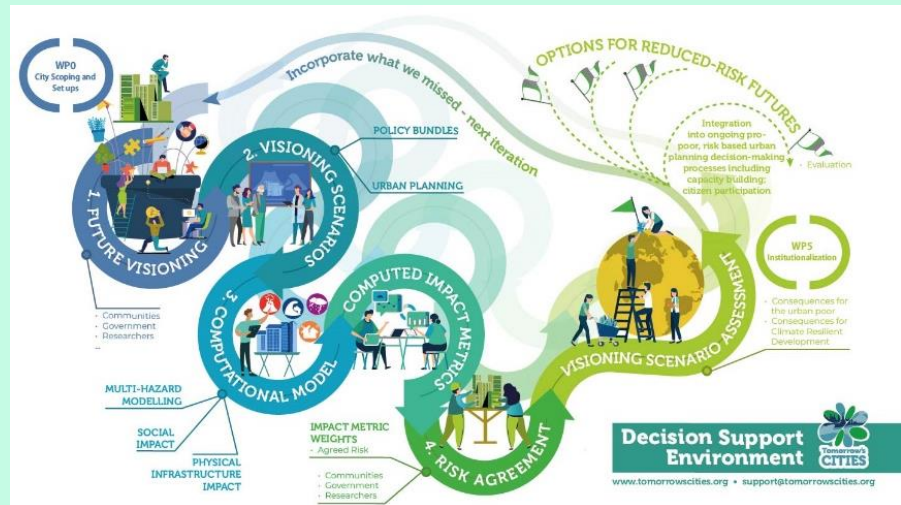TCDSE has following main components or stages, which research-wise are framed as Work Packages (WP):

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### WP2: Visioning Scenarios

The **Future Visioning** module highlights conceptual physical and social limitations of the future urban context of interest, including appropriate policies for reducing future urban risk. A vision is defined as a "desirable state in the future" (Cremen et al., 2022); which imply differently for different stakeholders. Therefore, it is critical for different groups to be able to participate and speak up for their future within the given urban context.

The outputs of this process are used to guide the components of the **Visioning Scenario Development (VSD)**, which includes the representation of the physical (natural and built) and social environment of the future the urban area of interest and policies that accompany these spatial items.

The **Visioning Scenario** is the fundamental input to the Computational Model, which computes the potential impacts that may occur due to the exposure to the multi-hazards within the area of interest. Within this computation, the underlying physical and social vulnerabilities are considered in addition to policies that may reduce the intensity of the impacts.

After the impacts are calculated for each impact metric, they are synthesised into a measure of agreed risk that incorporates different visions, priorities, and aspirations of different stakeholders (as weights to impacts) within the Risk Agreement module. Based on the comparison of risk scores of different scenarios that are generated by each stakeholder group; an agreement procedure takes place where the pros and cons of each scenario are assessed. The process between **Future Visioning** and **Risk Agreement** is iterated until a **Visioning Scenario** is agreed upon.

### Visioning Scenario Development (VSD) process

Methodologically, VSD relies on an exploratory rationale and strategies for scenario development. A combination of future visioning and scenario development (representing and visualising future visions) is a novel and emerging technique used in the last decade for an effective communication of co-produced futures (Avin and Goodspeed, 2020).

The stage of Visioning Scenario Development draws on the outputs of Future Visioning and information on political context, hazards, urban planning norms and socio-economic trends. With this respect, there are two main tiers in VSD that are policy development and urban planning. Policy development is the process of generating tangible policy options based on the solutions and aspirations gathered in future visioning. The urban planning tier includes two sub-sections as land use planning and data generation.

## The transition from Future Visions to Visioning Scenarios

The transition from Future Visioning to Visioning Scenarios ideally happens in a participatory workshop where participants and experts gather and work collectively to assess and refine spatial and policy expectations.
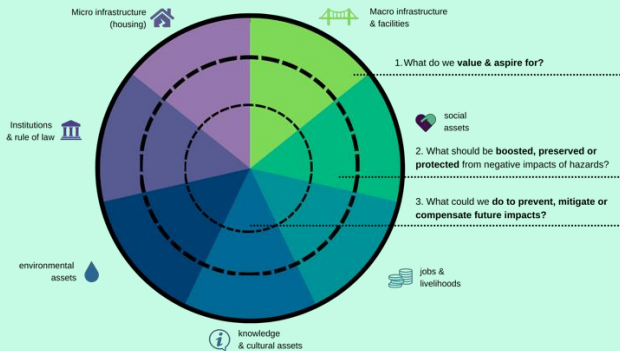


Visioning Scenarios are detailed exploratory options for the future of cities; they are more structured than future visions and have a stronger quantitative and spatial foundation. Still, it is important that stakeholders can still understand how their conceptual visions were translated. Transitioning workshops support this process and the wheel of urban assets is an essential device in that regard.

### Policy Development

The **policy development** component is the process of selecting, adopting or generating various policies that are sourced to the aspirations that emerge in the **Future Visioning** process.

Based on expert evaluation and elicitation, policies are either selected or adopted from existing policies or generated from scratch to take part in the visioning scenario.

The scope of the policies is outlined by two main aspects: Being future-oriented, and Focusing on disaster risk reduction.

### Urban Planning

Unlike conventional urban planning processes, urban planning within VSD generates a detailed representation of the future urban context comprising both physical and social attributes rather than an aggregated land use plan. This process is grouped in two sections as land use planning and generating detailed exposure data that is associated with the plan.

As in policy development, the aspirations of the stakeholders establish the social foundation of the land use plan by providing insights on what kind of future urban context they desire. In land use planning, once the spatial expectations are identified, they are rectified to fit the external factors through expert intervention.

After the land use plans are designed, detailed future exposure data is generated based on future projections and assumptions on urban context. The future exposure dataset includes building layouts, households and individuals that are via a GIS-based computation process including synthetic data generation where necessary.

### Visioning Scenario

Once the policies and future urban context are created; they are combined with each other to generate the visioning scenarios. As a whole, a visioning scenario feeds into computational modelling process within TCDSE to evaluate the potential impacts that occur due to related hazards.

As a result, for each focus group taking place in the future visioning process, a visioning scenario is developed that includes urban plans and policies that are preferred by them. Then these scenarios are subjected to hazards and vulnerability assessments in the computational modelling stage.
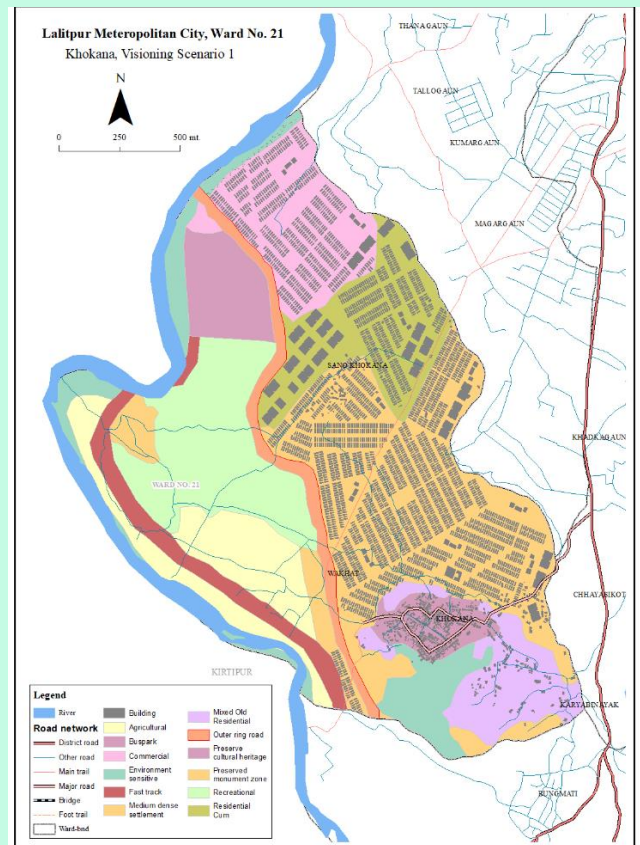


**Visioning Scenario Map of Khokana, Nepal**

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# TOMORROW'S CITIES DECISION SUPPORT ENVIRONMENT (TCDSE)

## WORK PACKAGE 3: MULTI HAZARD PHYSICAL AND SOCIAL IMPACT ASSESSMENT

### Background

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### WP3: Multi Hazard Physical and Social Impact Assessment

Multi-hazard Social and Physical Impact Assessment is located within a broader framework for risk-informed urban development planning; the Tomorrow's Cities Decision Support Environment (TCDSE). The framework of TCDSE starts with Future Visioning. Once Future Visions are elaborated by groups, spatial and policy expectations expressed in those visions are turned into Visioning Scenarios. Then, Visioning Scenarios are exposed to multi-hazard modelling, which are simulations of hazards. Such simulations are based on
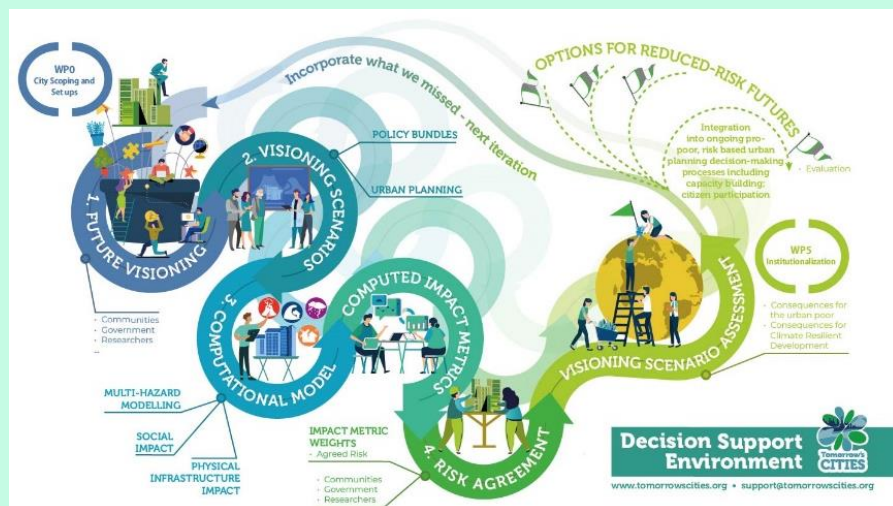


Tomorrow's Cities Decision Support Environment (TCDSE)

probabilistic hazard data and produce a series of objective impacts on physical and social aspects of the city to be assessed by stakeholders.

The **Computational Model** within the TCDSE consists of three modules:

### Multi-hazard modelling

The natural hazards that are identified in Stage 0 and 1 are taken for selecting multi-hazard scenarios. Various data are collected on site and from various secondary sources for hazard study. The hazards are then simulated for the future urban setting of the city and distributed spatially and temporally based on their relevant intensity measures.

### Physical infrastructure impact

In the physical infrastructure impact module, the attributes of buildings and infrastructures are
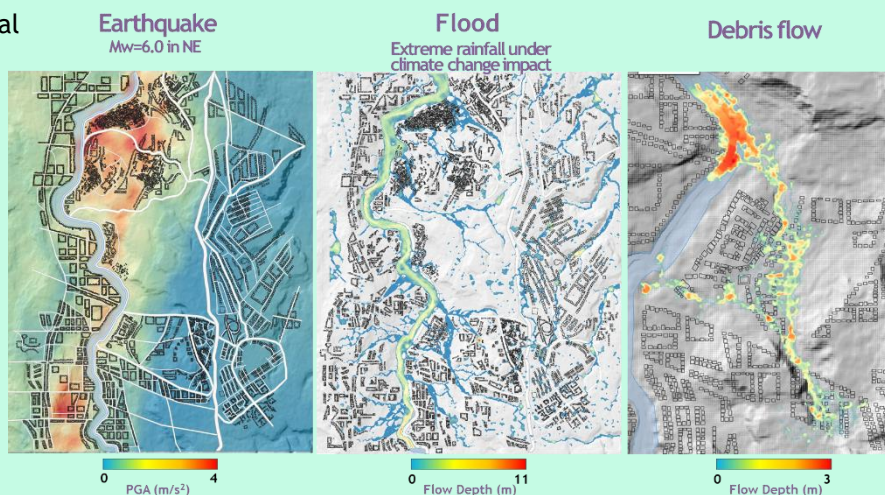


Scenarios for different hazards in Tomorrowville, Source: Tomorrow's Cities

identified first for future-built environment as developed in Visioning Scenario Development Module and then the associated fragility or vulnerability models are gathered. Fragility models relate probability of exceeding certain sets of damage level with relevant hazard intensity measures whereas vulnerability model relate loss with relevant hazard intensity measures. Earthquake fragility models developed for some building systems prevalent in Nepal is shown in figure below.
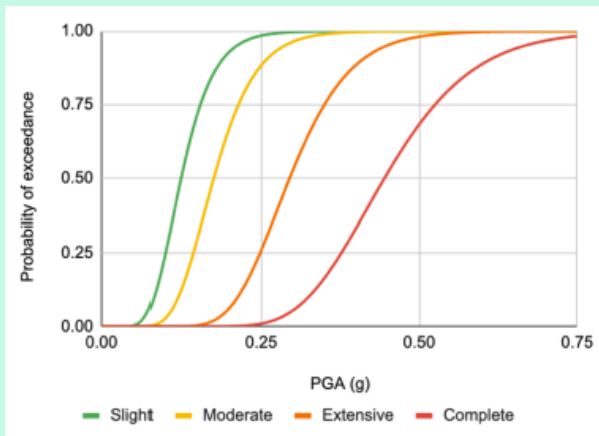


**Fragility Curves for Brick in cement mortar with rigid floor**

Development of earthquake fragility curves for various building system in Nepal, Source: Guragain (2015). Development of seismic risk assessment system for Nepal. PhD dissertation, http://doi.org/10.15083/00007589 [2]

## Social impact

The social impact module facilitates a community-based "bottom-up" component in impact characterization for risk-informed decision support. The aim of this module is to determine the differential impact on different social groups that the future multi-hazard scenarios might have in the city, particularly those most marginalised quantitatively and qualitatively. It does so by:

- Disaggregating outputs from the Physical Infrastructure Impact module based on overlapping inequalities.
- Assessing the influence of outputs from the Physical Infrastructure Impact module on disruption/improvement of mobility patterns and other flows of people, services, and commodities for individual and intersecting social groups that are specified in the Visioning Scenario Development module.

## Computed Impact Metrics

Computed Impact Metrics are the formal quantitative and/or qualitative summaries of the Social Impact Module outputs. These impact metrics are used to compare and assess developed Visioning Scenarios in Stage 4: Risk Agreement of the TCDSE. The development of these metrics must be transparent and well documented to enable participatory assessment of the risk characterisation process. Impact metrics may also be temporal e.g. the number of displaced populations within six months of the event.

## Outputs of the Computational Model

The qualitative and/or quantitative multi-hazard impacts, derived from the computational model are used in the Risk Agreement module in Stage 4.



Inputs and outputs of the computational model, Source: Tomorrow's Cities



**Multi Hazard Impact Assessment**

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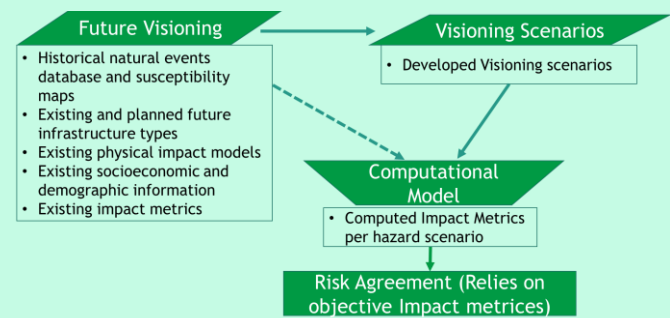
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# Tomorrow's Cities Decision Support Environment (TCDSE)

## WORK PACKAGE 4: RISK AGREEMENT AND SCENARIO ASSESSMENT

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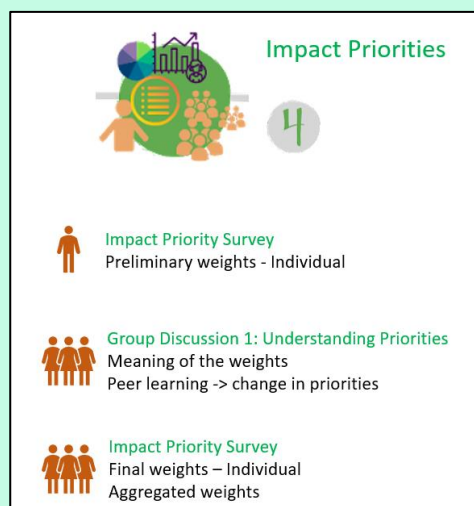### WP4: Risk Agreement and Scenario Assessment

The **Risk Agreement** translates the objective impact metrics into subjective measures of risk for each social group. To do so, we need to identify the priorities (i.e., relative importance) of each social group towards the different impact metrics. After reaching an agreement on such priorities across different social groups, we rank the visioning scenarios according to the subjective definition of risk. One or more "optimal" visioning scenarios are selected, i.e., those that minimise risk.

To achieve this, we follow the method that includes 4 key elements:
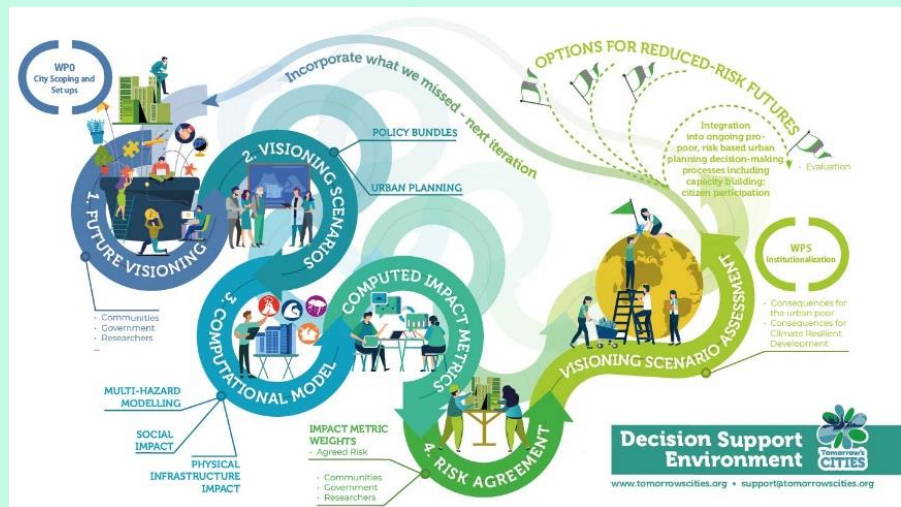


Tomorrow's Cities Decision Support Environment (TCDSE)

- **Impact priority survey**: a survey designed to capture priorities (i.e., relative importance) towards the impact metrics in the form of quantitative weights. Together with the quantified impact metrics, such weights are used to rank visioning scenarios for decreasing risk.
- **Discussions around impact priorities**: group discussions designed to identify the underlying reasons for the captured priorities
- **Visioning scenarios negotiations**: negotiations designed to give room for compromise around impact priorities. Accordingly, such compromises are reflected on the definition of risk and the ranking of visioning scenarios. One of more visioning scenarios that minimise risk are selected
- **DRR Consequences discussions**: discussions around unintended benefits and consequences of the selected policies in the selected visioning scenarios



Impact Priorities
4

Impact Priority Survey
Preliminary weights - Individual

Group Discussion 1: Understanding Priorities
Meaning of the weights
Peer learning -> change in priorities

Impact Priority Survey
Final weights – Individual
Aggregated weights

### Risk Agreement and Visioning Scenarios Assessment

The risk agreement consists of an (1) impact priority survey, (2) followed by a group discussion around impact priorities, (3) followed by repeating the impact priority survey. The outcome of such survey includes a set of impact priority weights that can be used to rank visioning scenarios based on risk.

Risk agreement methods

## Risk Negotiations and DRR Consequences Discussions

The negotiations include (1) discussing the visioning scenarios ranking in separate social groups, (2) negotiating impact priorities among different social groups, (3) a DRR Consequences discussion.

Rankings of visioning scenarios are calculated based on risk, including the observed impact metric values and the priority weights of a disaggregated social group.

The negotiation occurs between the different disaggregated social groups once they have been presented with their rankings separately. The object of negotiation are the impact priorities rather than the visioning scenarios themselves. In fact, social groups can amend their impact priorities which in turn changes their visioning scenarios rankings. The outcome of this negotiation can be a complete agreement, partial agreement, or disagreement.

The DRR Consequences discussions add a layer beyond risk and impacts to the conversations. It includes a policy mapping exercise to link the effect of the selected policies with unintended benefits and consequences. The benefits and consequences under focus are carbon footprints and land values, although other co-benefits can be considered with the same framework.



Optimal Visioning Scenario 5

**Group Discussion 2: Understanding Impact Metrics**
Ranking of Visioning Scenarios (VSs)
Discussion on impact metric maps – w/ Dashboard

**Group Discussion 3: Visioning Scenario Negotiation**
Compare ranking of VSs of each disaggregated group
Negotiate on the optimal collective VS

**Group Discussion 4: Co Benefits**
Compare ranking of VSs of each disaggregated group
Negotiate on the optimal collective VS

Negotiations and visioning scenario assessment methods



Risk Agreement in Khokana, Nepal

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