PCR TOOL 3

Learning from Disasters

Introduction

In order to be able to build back better, we need to understand what caused the hazard that occurred to become so disastrous for the people it affected. This involves not only studying why houses were vulnerable to collapse, but also the underlying causes for that; these lie in the vulnerabilities of people themselves. What happened in the Alto Mayo earthquake, described in the box, right, explains why. Although a study of housing revealed that some building technologies were more resistant than others and that certain residents and local builders had the capabilities to construct well, within those technology categories there were variations too. These often resulted from people, who were getting poorer, being no longer able to afford to build or maintain their houses well.

Vulnerability is now receiving more attention, not just in the context of disaster reduction, but also with respect to issues such as drought, food security and increasingly climate change. It is not enough, though, to only know people's vulnerabilities, or weaknesses. We also need to explore their coping capabilities, because these are the strengths on which to base better reconstruction. In the case of the Alto Mayo, one coping capability was the local knowledge of resistant building technologies.

Vulnerabilities and assets – which include capabilities – are key components of sustainable livelihoods analysis, which goes back to the thinking of Robert Chambers in the 1980s. The livelihoods approach puts people at the centre of development. Livelihoods analysis is helping us to understand that poverty is multi-dimensional and that disasters are not the only risk poor people are facing. For some poor people, day-to-day survival may be a greater concern than the distant threat of a disaster. People do not willingly run the risk of death or asset losses, but short-term pressures such as the need to make a living or to feed a family may force them to accept the more remote risk of disasters. For example, a study of the Karakoram region of Northern Pakistan from the 1980s found houses to be dangerously located on slopes. The owners were aware of the risks these locations posed, but opted to build there rather than using the little arable land they had for housing.

The Alto Mayo earthquake of 1990

When a moderate earthquake struck the Alto Mayo of Peru in 1990, the region was in economic decline. Its main product was rice, but the government had disbanded the agency buying rice from farmers and failed to properly maintain the one major road that linked the region to the markets of the main cities on the coast. Many incomes therefore declined; this reduced people's capabilities of building and maintaining their houses well, and this proved to be a major factor in the damage and casualties the earthquake caused. The region's inhabitants had become more vulnerable because their livelihoods had been negatively affected by external events, in this case a government failing to do its duty to them. What is more, when aid started to flow into the region in the aftermath of the disaster, it included a lot of imported rice, at a time when local stores were full to the brim of rice farmers were unable to sell. This further worsened their potential for recovery, as it now became nearly impossible to sell rice locally. However, observations of the impact of the disaster also showed that not everybody was equally affected. Houses built with heavy rammed earth (tapial) or adobe walls – built by people who had migrated into the region from Cajamarca - had generally performed badly, but those with much lighter mud-and-pole (quincha) walls quite often stood up. The latter technology then, with some improvements, became quite popular in reconstruction supported by Practical Action.

Earlier thinking on reconstruction did not pay much attention to people's livelihoods and vulnerabilities. It tended to concentrate on technical issues, e.g. the weaknesses of housing, and how these could be overcome, often by construction experts rather than the people themselves. Affected people were frequently forced to relocate away from sites considered dangerous; some chose not to occupy the alternative houses offered, whilst others moved out to return to places where they could resume their livelihoods and social networks. In other cases, new houses were built using technologies so alien or expensive, that inhabitants were unable to maintain or replicate them and ultimately reverted to the old ways of building, reinforcing their vulnerability. This thinking is now changing, but only slowly.

It is important to understand what people's vulnerabilities were before a disaster struck, but to

photo © Chris Martin

Reconstruction with improved quincha after the 1990 Alto Mayo earthquake in Peru

also be aware that the disaster may have increased them. Reconstruction will have to help tackle vulnerabilities, and the influx of external resources often offers a unique opportunity to do so. Building back better should not only apply to housing, but equally to rebuilding the livelihoods of people affected by a disaster, and of local markets. Ideally, that should happen through an integrated approach or in close co-operation between agencies involved. PCR Tool 6: *Integrating Livelihoods*, explains this in further detail.

How can learning from disasters help to build back better?

The early research into how traditional housing behaved in disasters, from the 1960s until the 1990s, was generally undertaken by technical professionals. They would make observations in the field after disasters occurred, perhaps do further laboratory tests and calculations, and draw conclusions with respect to particular construction weaknesses. These results were communicated largely with other professionals and sometimes to NGOs and authorities, often in ways that are alien to poor people. Therefore, little of this information actually reached those affected by the disasters, or others potentially at risk. People-centred reconstruction (PCR) offers more opportunities for learning than previously dominant research and reconstruction approaches. Involving affected people in reconstruction processes from a very early stage, that is from the moment when damage and needs are assessed, can lead to clear changes in how those people perceive and understand disaster risks, what they can do by themselves to reduce these, and where they need external support.

In many rural areas of developing countries there is a tradition of vernacular construction; evolved over many generations in response to local customs and culture, climate and availability of low-cost local materials. This often incorporates measures to mitigate local hazards, including for example: special types of foundations to prevent houses sliding down steep slopes; building on raised plinths or on poles fixed deeply into the ground where flooding sometimes occurs; and bracing frames and ties to resist high winds. In the historic centre of Lima, Peru, for instance, a number of vernacular houses built with quincha survived several strong earthquakes, including those of 1746 and 1940, and remained standing where many modern masonry buildings collapsed.

Where people abandon their vernacular ways of building, for example, when they move from a rural to an urban area or for reasons of status, they are likely to also abandon some of the traditional ways of mitigating disasters (for instance, reinforcing roofs prior to the hurricane season, or repairing houses after rains). Building in rigid masonry, as in the above case of Lima, is not inherently unsafe, but does require different measures to make it more earthquake resistant. A major change in construction technology usually requires a change in the way a building is protected from disasters. The knowledge for this does not come automatically, nor is it easily acquired by simple observation. There is therefore a risk that many such buildings are poorly constructed and unsafe. This can happen, for instance, in urban and peri-urban areas, where people choose to construct reinforced concrete buildings but lack the knowledge and resources to adequately reinforce main structural elements such as beams or columns. Another risk occurs where people cut corners in construction. They may, for instance, decide to do all the building work themselves, without hiring a skilled builder to help with the more complex parts. Alternatively, they may try to save on materials, for example, by using less cement in concrete than is commonly required, or making foundations much more shallow than they should be. In high density suburbs, people may decide to add floors to a building which is not structurally capable of carrying such extra weight. All of these factors can increase the risk of damage to, or collapse of, houses in a disaster scenario.

The participatory process of learning from disasters can help all involved in reconstruction (communities, authorities, humanitarian agencies) to better understand the strengths and weaknesses of local construction methods, the underlying reasons and vulnerabilities, and the capabilities of residents and local builders.

The importance of learning in reconstruction had been recognised for a long time. Yames Y.C. Yen for example, founder of the Rural Reconstruction Movement in China in the 1920s expressed the ideals of people's participation in development and improvement, highlighting in particular, the importance of learning in the process (see box to the right).

In post-disaster reconstruction, many of the most recent successful examples illustrating Yen's principle of Starting with what people know, have begun with architects and engineers finding out how people are building already, and, in particular, what they are doing already to reduce disaster risks. They then work to produce improved designs that incorporate much of the traditional elements. In such cases, the architects and engineers must not assume that they know better than the traditional builders. They must work together in partnership, perhaps modifying the design several times before arriving at a model all stakeholders are happy with. Some recent reconstruction projects and programmes, e.g. the ERRA programme in Azad Jammu and Kashmir and North West Frontier Provinces of Pakistan (see case 1 in the section Applications below) have followed this approach.

What do we need to learn?

In order to build back better, stakeholders in reconstruction jointly need to find answers to four sets of key questions:

1. Why were people vulnerable to the hazard that occurred? Did vulnerabilities differ amongst various categories of people (e.g. men/women; owners/tenants; land owners/landless; able/disabled)? Has the disaster further aggravated the pre-disaster vulnerabilities? Who are the individuals or categories that are particularly at risk and will need special attention in reconstruction? These questions can be answered through vulnerability assessments.
2. What made people's housing vulnerable to the hazard? What were the predominant building technologies and what were their relevant strengths and weaknesses? What factors affected disaster resistance within single technologies? These questions can be answered. through damage assessments.
3. What is the likelihood of disasters happening in this particular location? Does it have particular geographic features that make it vulnerable? Are there any other risks besides those directly related to the disaster? These questions can be answered through disaster risk assessments.
4. What are the local capabilities, amongst residents as well as builders, to build in disaster-resistant ways? Are the required resources for reconstruction (manpower with the right skills and materials) available at the necessary scale? Damage assessments can be designed to find out more about capabilities. Determining whether the resources are available should be part of assessments of needs and resources, treated in more detail in PCR Tool 4.

James Y.C. Yen on Learning

'Go to the people
Live among the people
Learn from the people
Plan with the people
Work with the people
Start with what the people know
Build on what the people have
Teach by showing; learn by doing
Not a showcase but a pattern
Not odds and ends but a system
Not piecemeal but an integrated approach
Not to confirm but to transform
Not relief but release.'

How can we learn?

The four assessment methods highlighted in the above section are examples of learning methods specifically designed to provide answers to particular questions. We will explain those in more detail in the text below and PCR Tool 4: *Assessment of Reconstruction Needs and Resources*. There are, however, a number of additional participatory tools available that can help to answer the above questions. Many planning tools start off with developing an understanding of a particular set of problems, which is a learning process. Practical Action South Asia has summarised participatory learning and action tools in a technical brief. Community Action Planning (CAP) can also be a good learning experience for participants; this is further described in the Community Planning Website. For more detail, see the resources at the end of this tool and PCR Tool 7: *Planning with the People*.

1 Vulnerability Assessment

Disasters do not result from hazards alone, but from the impact of those hazards on communities that are vulnerable and poorly prepared. Disasters are not inevitable and communities are not helpless. Action can be taken to build resilience to hazards and strengthen capacity to adapt to change. Practical Action has developed "from Vulnerability to Resilience (V2R)", a framework to analyse vulnerability and plan for building community resilience to guide this action. Vulnerability is multi-dimensional; its roots may lie in weak livelihoods; hazards and stresses; future uncertainty (i.e. related to climate change); or a poor governance environment. In the case of the Alto Mayo, highlighted at the start of this tool, livelihoods had weakened, governance was worsening, and there were known risks of earthquakes and floods in the region. More recently, in Haiti, poverty played a major role, in exacerbating vulnerability to the earthquake. As 72.1% of the population lived on less than $2 per day, people could not afford to employ qualified labour and built houses with poor quality materials.

In such contexts where governance is weak, there are no real mechanisms to enforce building codes. In cities like Port-au-Prince, where many were housed in poor and densely-packed shantytowns and badly-constructed dwellings, the devastation has been great and the death toll heavy. All of these dimensions of vulnerability need to be analysed, together with communities. The V2R framework provides the background information and various methods for doing so.

Within the context of this toolkit, the livelihood dimension of increasing resilience is largely dealt with in Tool 6: *Integrating Livelihoods*, and the dimension of involving communities in governance is dealt with particularly in Tool 7: *Planning with the People*. In this tool, we will therefore concentrate on the assessment of hazards and stresses, and to an extent on how these might change in future. Vulnerable people often lack a good understanding of hazards and their associated risks. If they are to become more resilient, they will have to develop capacity to analyse and understand the hazards and stresses that affect their lives. To achieve this, agencies can work directly with communities to carry out a systematic vulnerability analysis, and/or train community leaders to facilitate community analysis. An analysis of vulnerabilities can be done in a participatory way, and can help to identify households within a community and those most in need of support. For an example of Participatory Vulnerability Analysis, see case study 3 in the section Applications.

2 Structural Damage Assessment

The experience of previous disasters has taught us that buildings can be at risk of damage or collapse for a number of reasons, the most common of which are listed in the box below. These are the kind of issues a damage assessment team will have to look out for in particular.

Damage assessments should be done in teams which include representatives of all stakeholders involved in reconstruction. It is particularly important for communities to identify their indigenous knowledge on disaster mitigation. When it comes to building houses, the starting point is to learn from how people are building already, and how they are incorporating specific details to reduce disaster risk. Where livelihoods are concerned, it is important to understand the strategies already in place to cope with other types of crisis. Ideally, such assessments are to be done by practitioners visiting settlements, making observations and having discussions with local builders and small groups or representatives of different categories of inhabitants. Their conclusions then need to be presented and discussed with larger groups of residents.

Where disasters have affected thousands of people and large reconstruction programmes are

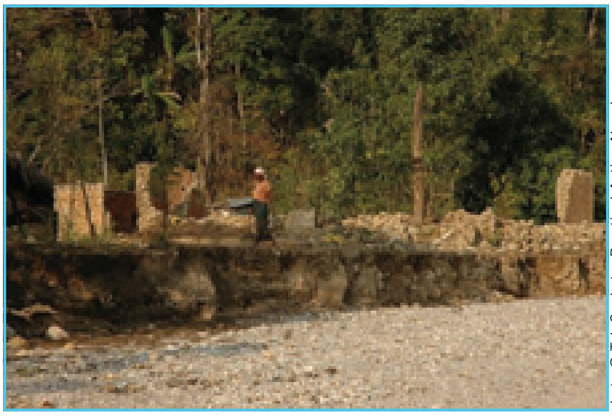

photo © Tek Sapkota, Practical Action Nepal

House destroyed by flooding of the Jugedi river near Khetbari, Nepal in September 2006. In a disaster risk assessment, this location would be classified as high-risk.

envisaged, it becomes very difficult to ensure everybody participates equally in assessments. Reconstruction agencies may have to work with representatives of the communities, but they should ensure that this does not lead to the exclusion of the opinions of vulnerable groups. Information and communication technologies (ICTs) can help to inform and involve larger numbers; e.g. providing people with cameras or video equipment and a bit of training can enable them to produce their own stories of damage and vulnerability. Communication is discussed in more detail in PCR Tool 9: *Communicating Better Building*.

The aim of damage assessments is to find our why some houses were badly damaged and others less so; the box to the right indicates some of the issues that need to be investigated. In addition, it is important to learn what actions local people had already taken to protect themselves from disaster risks. Were these effective? If not, why not? How could they be improved? Would these improvements be suitable for the community to carry out themselves during reconstruction, or would additional support be needed?

If field workers involved know about similar scenarios in other locations, where particular improvements have proven to work well, they can bring those into the discussion as examples. However, field workers should take care not to take on the role of experts and perhaps manipulate communities towards certain solutions. The purpose of the damage assessment is to learn why the damage was caused, and how this could be mitigated, not to immediately decide how houses should be reconstructed. Field workers should in particular be cautious not to suggest too many technologies that are alien to local residents and builders, since these would require additional training, might require materials from elsewhere, and quite possibly extra funding.

If particular types of houses survived the disaster well, these can become the model for future reconstruction. Alternatively, if it is observed

Analysis of Hazards and Stresses

The following method is a guide for the analysis. Since each context is different and specific, you may add other questions that appear useful to ask. Ask people to tell you stories on past events, how hazards impacted on their lives, and how they coped. Try to build up a rich and detailed picture of the kinds of hazards and stresses people faced, which groups were most affected, and what opportunities exist for strengthening resilience.

1. Identify what different hazards and stresses have affected the community or particular groups in living memory, both on a regular basis and one-offs.
2. Prioritise the different hazards, e.g. according to severity, numbers affected or frequency.
3. Further explore the prioritised hazards with the following questions and tools:
   - What is the typical frequency and duration of this hazard; has it changed over time?
   - Are there any warning signs that a hazard event is likely to occur; are there any early warning systems?
   - Are there any underlying causes of the hazards or stresses and does the community understand them, or how to address them?
   - Which groups within the community are most affected and how?
   - Which communal or individual assets are affected and how?
   - How do different groups typically respond immediately after the hazard occurs (are there contingency plans, safe areas, emergency resources, response organisations etc.)?
   - What particular long term coping strategies do these people (and particularly vulnerable groups) use to recover from the hazard impact?
   - Based on the issues raised, what opportunities and capacities are available, or could be strengthened to help people cope and recover when hazards and stresses occur?

Suggested tools to use: group discussion; hazard mapping; story telling; EMMA toolkit (to analyse changes to market systems).

Common Reasons for Disaster Damage to Buildings

1. The technology chosen is inherently unsafe for the type of hazards that may occur in a given location. An example of this is the traditional house of adobe, stone or brick walls, with wooden poles lying across those supporting cane and mats covered by a heavy layer of earth. Such roofs tend to move during earthquakes, pushing the walls outwards, caving in on inhabitants. Earth walls are also very vulnerable to rain and flooding.
2. The building is poorly designed, e.g. with windows and doors close to corners or wall intersections weakening the walls, or with irregular shapes which reduce its resistance to earthquakes, or with large roof overhangs or verandas that can be ripped apart by strong winds.
3. Buildings are poorly located, e.g. on steep slopes with a risk of land slides, on alluvial plains at risk of flooding or liquefaction, or on sites particularly exposed to strong winds (addressed in more detail under disaster risk assessment).
4. Protection provided is insufficient to resist hazards of more than a medium magnitude, e.g. houses are built on plinths or columns, but only to a height that saves them from minor floods.
5. The quality of work is not good enough. This happens when people build themselves where a skilled craftsman is needed, or use novel technologies they do not properly understand. Reinforced concrete frames can provide resistance to several disasters, but they are often poorly erected, and therefore regularly collapse.
6. The protection provided is stretched beyond its specification, e.g. people add floors to a building, or make changes to its design.
7. Residents are unable to maintain their houses adequately, which can cause components to weaken e.g. through humidity or insect attack.

that although some of the houses performed better than others there is still scope to improve them, then a modified design can be developed. However, if such modifications add a lot to the cost of construction, their take-up is likely to be low – certainly when limited external assistance is available – even if people recognise them as being more disaster-resistant. Fortunately, though, it is often possible to make houses a lot more disaster-resistant without adding more than 10% to the original construction budget. This works best if any such change is accompanied by awareness raising initiatives, demonstration, and training on how to build and maintain such houses.

3 Disaster Risk Assessment

Important Aspects of a Risk Assessment

Important aspects of a vulnerability assessment:

- Underlying reasons of vulnerability: reasons that explain why people settle where they are and why they are vulnerable, e.g.: the distribution of natural resources; means of livelihoods; rights to property and land; access to institutions or influential people; access to finance; concentration of poverty; impacts of previous disasters or conflicts.
- Dynamic pressures: including migration and urbanisation; pollution and loss of resources because of production processes; weak institutions and governance; policies that are not pro-poor; housing policies; markets and commercialisation; scientific and technological change.
- Conditions that make people vulnerable: these may have to be broken down by gender, age, religion, class, etc. and would include shortfalls in nutrition and health; food insecurity; weak or threatened livelihoods; limited levels of organisation and participation; limited risk awareness; poor access to information.
- Conditions that threaten people's assets: including dangerous location; poor quality design and construction; lack of maintenance; changes in use, such as vertical or horizontal extensions to buildings; changes in risks, e.g. a river changing course.

Risk is defined as the probability that people may suffer injuries or damage as a result of a disaster. Risk may be calculated, based on three elements: 1) the frequency and severity of a threat; 2) people's vulnerability; and 3) the capacity of people, communities and institutions to respond and recover. Risks are greatest when threats are large, people are very vulnerable, and there is a low capacity to respond and recover.

A risk assessment is a methodology for evaluating probable damage and loss as a result of a disaster and to identify measures to prevent or reduce those. It involves:

1 Knowing the disaster history and local experience and knowledge of prevention and coping strategies.

2 Identifying and assessing the probable Risks and Threats within the location analysed.

Production of Threat Maps	Production of Vulnerability Maps
1. Initial Inputs • Analogical maps of the area • Digital maps of the area • Typing of maps 2. Field Trip • Identification of the work area • Identification of existing threats • Plotting of GPS points of these threats • Plotting of control points of the town centre 3. Preparation of threat maps • Identification of existing threats • Determination of physical variables (slope, soil type,..) to use in generating the threat map • Definition of the specific work area • Preparation of the threat map in quantitative values 4. Analysis of the threat map The threat map obtained in step 3 is made up out of numbers that need to be reclassified by assigning relative values of threat, e.g. 1=low; 2=medium; 3=high; 4=very high. For example: a community on a steep slope receiving much rain is considered a value 4, whereas another community on relatively flat stable terrain with the same rain is considered a value 1.	1. Initial Inputs • Existing socio-economic data • Design of vulnerability forms 2. Field trip • Completion of vulnerability forms 3. Preparation of vulnerability map • Preparation of a database • Preparation of the map based on three variables: • Accessibility to vehicles, transportation and communications • Basic services in houses, such as electricity, water, sanitation and building materials • Capacity of local institutions 4. Analysis of the vulnerability map A formula to associate the above three variables to a 1 to 4 range is generated, using the same classification of values as for the threats. For example: isolated communities accessible only via footpaths or poor unpaved roads, with low levels of services and no CBO or local authority presence nearby, would be classified with a value of 4, whereas urban communities with better access to services and a functioning local authority could be classified with a value 1.

3 Analysing the Vulnerability of people and their assets.

4 Evaluating local capacities to reduce the risks or respond to an emergency.

5 Estimating the potential damage and loss as a result of a specific risk.

6 Zoning or mapping of risks in a sketch or plan.

Risks can be mapped out. A Practical Action project in Peru developed a method to prepare Risk Maps, which is summarised below and described in more detail in Practical Action's Technical Brief: Preparation of Risk Maps. The method uses geographical information systems, to produce maps of both threats and vulnerabilities; the latter includes an assessment of capacities, or rather the lack thereof. Production of such maps involves the following steps:

Applications

Some examples of reconstruction projects in which aspects of learning are highlighted are outlined below. These mainly cover demonstrating safer housing construction to mitigate risks from particular natural hazards.

Case 1: Rebuilding Timber Frame Houses in Rural Areas of Pakistan

The 2005 earthquake in Kashmir destroyed 450,000 houses completely, and caused damage to hundreds of thousands more. These included houses built with traditional as well as modern materials and technologies. Many of these houses were in remote rural areas that were difficult to supply. This was an important reason to try and rebuild as far as possible with local technologies.

It was therefore very important to diagnose which types of construction had performed well during the earthquake, and which ones did not, and why. If this is done by both experts and local people, it also helps to give the latter reassurance in the technologies chosen for reconstruction. It was found that one particular type of construction, Dhajji Dewari (lightweight patchwork walls, made of a braced timber frame with stone and mud infill) had withstood the earthquake relatively well. But it was a dying technology, with only about 5,000 houses existing before the quake. In some places, local residents started to rebuild Dhajji Dewari houses quite soon after the earthquake, if they had the skills and resources. But it took the government reconstruction programme (ERRA) somewhat longer to adopt it as one of the options, partly because it was not investigated soon enough, and because there was some objection to it which claimed it did not meeting the required standards. The use of owner-driven reconstruction with Dhajji Dewari was particularly instigated by UN-Habitat. More than 100,000 houses were ultimately rebuilt with it, at a fraction of the cost of new materials and a significant reduction in vulnerability. This required a huge communication effort with different target groups: engineers needed reference materials; builders needed how-to-build Guides and quantities; and residents needed to know the costs and benefits, and be able to visualize the solution through demonstration.

See: Stephenson (2008) in the Resources section.

Case 2: Retrofitting and Rebuilding of Schools in Aceh, Indonesia

After the 2004 tsunami, inspectors checked the safety of schools in Aceh province that had not been destroyed. Many were found to have been poorly built and badly maintained and therefore vulnerable to the earthquakes that regularly occur in the region. The charity Save the Children decided to retrofit 58 deficient schools to make them more earthquake resistant. They also decided to use the retrofitting process as an opportunity to raise awareness of seismic safety and to mitigate the risks of damage and collapse of buildings. Pupils and community members participated in discussions about vulnerability assessment, design and construction. A team of local builders was put together and trained in retrofitting technologies. Teachers, pupils and local people were encouraged to observe the retrofitting process and an engineer explained to them what was happening and why it was being done.

See: Shrestha in the Resources section.

Case 3: Participatory Vulnerability Analysis in the Andaman and Nicobar Islands, India

The islands suffered the impact of the tsunami in late 2004, destroying as many as 10,000 homes and killing over 3,500 people. When the government drew up a list of people entitled to permanent housing, many vulnerable households were left out for a number of reasons. The NGO Action Aid opted to work with them. Participatory Vulnerability Analyses (PVA) were conducted to identify the most vulnerable and in need of housing support. The programme also targeted the capacity building of vulnerable communities. This built on people's knowledge, traditions, building practices, designs and materials used, and strengthened the weak aspects of those through training and technical support. Action Aid staff also performed a quality control role in the selection of materials and the actual construction work.

See: UNDP India in the Resources section.

Resources

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[web addresses accessible as per July 10, 2010]

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