

CIGAS Workshop Houston

16 -17 October 2014

Report, Results & Reflection

Contested Issues Game Structuring approach:
Exploring stakeholder-based joint commitment to action
for flood protection decision-making
in the Houston Galveston Bay Area

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Preface: CIGAS Approach & Workshop

What is CIGAS?

CIGAS stands for Contested Issues Game Structuring Approach. CIGAS is a practice developed specifically for contested environments, which strives to enhance participant's insight by means of game structuring and system modeling techniques (Cunningham et al., 2014). Within this practice participants are understood to have different interests and values. The purpose is thus not to reach consensus nor to solve conflicts, but rather to explore the existing different interests, values, preferred futures, as well as the potential clusters of actions belonging to these futures and the associated restrictions, objections and hurdles. The workshop method rests on operations research traditions, using game theory and system modeling in particular. This potentially offers the participants in such a contested social negotiation a wider view on their own and others' positions, both now and in the future. The aspiration is that this leads to commitments to joint action on the part of participants.

Ideally, knowledge of the biophysical and social systems and the effects of infrastructural measures serve as substantive inputs to the process. This knowledge yields the 'bandwidths' within which system responses can occur. So, if there is disagreement about whether a particular intervention will lead to one situation or another, the focus lies on determining a bandwidth, or different bandwidths, and the order of magnitude within which effects could occur, based on systems understanding and models. The method focusses on determining which bandwidths are associated with which outcomes or futures and how different stakeholders view and value these outcomes/futures.

How did this workshop come to be in Houston?

A workshop based on the CIGAS approach was developed and carried out for a case in South Africa by a team of South African, Dutch and American researchers based in The Netherlands at Delft University of Technology (Slinger et al., 2014).

Following a visit to the Netherlands of several Texans, including university professors, the vulnerability of the Houston Galveston Bay Area to flooding came to our knowledge. Although the context here is more complex and involves a wider study area than in South Africa, it manifests comparable issues: flood risk management, coastal bay area, and safety risks for the petrochemical industry, residents, and the bay ecosystem. Therefore the idea of using the CIGAS approach by carrying out a workshop in the Houston Galveston Bay Area was proposed; the research aim being further development of the CIGAS method, and potentially delivering insights to stakeholders involved in, or concerned with, the decision-making regarding flood risk in the Houston Galveston Bay Area.

Hosts

For this workshop the Severe Storm Prediction, Education and Evacuation from Disasters Center of Rice University (SSPEED) kindly acted as our host. They put a great deal of effort into helping in selecting and inviting workshop participants and hosted the first day of the 2-day workshop. For the second day the City of Seabrook was so kind as to host the workshop.

Follow-up

As academic researchers we plan to publish an academic journal paper focused on the further development of the workshop method, to be published in 2015. As workshop facilitators and moderators we deliver the document at hand to each of the participants and the hosts for discretionary use in the furtherance of decision-making regarding flood risk in the Houston Galveston Bay Area.

It is the responsibility of the workshop group to determine their further actions. By the end of the workshop some participants expressed the desire to meet again with other participants to follow up on the experience and the insights gained in the CIGAS workshop.

As expressed by workshop participants and hosts, there is a potential benefit to be expected of a follow-up CIGAS workshop in the Houston-Galveston Bay Area. As concerned individuals, we would be honoured if this were to enhance flood safety in the Houston Galveston Bay Area and as academic researchers we are interested in extending and developing the CIGAS Approach in this context. Such a workshop should focus on the hydraulic, geo-morphological, ecological and technical systems knowledge and its role in developing fundamental system level requirements for flood safety that do justice to the underlying values of stakeholders both now and in the future. Participants would need to have knowledge of system processes and would need to perceive the workshop as a neutral meeting ground. As such it is important that the invitation of participants be undertaken by a 'neutral' authority, which could also host the workshop.

This document

This document is a reflection of the CIGAS workshop of 16 and 17 October 2014. It represents the knowledge sharing and discussions of the workshop participants and was initially distributed amongst the participants of the workshop, and the workshop hosts. The document is not intended as a full academic reflection on the CIGAS method. Instead it serves primarily as documentation of the event and feedback to participants and hosts, and may be used in the furtherance of decision-making regarding flood risk in the Houston Galveston Bay Area and in further development of the CIGAS approach.

The CIGAS method entails six steps:

1. Getting acquainted
2. Identify stakeholders and main interest groups
3. Determine relevant systems and their values
4. Develop possible outcomes
5. Ranking outcomes
6. Explore the space for commitment to action

The workshop documentation will follow these steps and conclude with a reflection.

Finally we are grateful to all participants, to Antonia Sebastian in Delft, and to our hosts in Texas - Jim Blackburn and Phil Bedient - in particular, for their efforts in supporting and enabling this initiative.

References

- Cunningham, S. W., Hermans, L. M., Slinger, J. H. (2014). A review and participatory extension of game structuring methods. *EURO Journal of Decision Processes*, (DOI) 10.1007/s40070-014-0035-8
- Slinger, J. H., Cunningham, S. W., Hermans, L. M., Linnane, S. M., Palmer, C. G. (2014). A game-structuring approach applied to estuary management in South Africa. *EURO Journal of Decision Processes*. (DOI) 10.1007/s40070-014-0036-7

1

Introduction

Step 1. Getting acquainted

The purpose of this first step in the CIGAS process is to introduce the participants to each other both at a personal and a professional level. Participants already had name badges, so this was about understanding their motivation for being present. Participants were asked to *'Please indicate on the map where you live, where you work and what your area of interest is.'*

Each participant was allocated 3 minutes to talk about themselves, their job, interests and function at work. They each drew on a large hand-drawn map of the Houston-Galveston Bay Area located on a table in the middle of the room, with the participants clustered around. Markers of different colors were available so that they could distinguish features more easily. The facilitators also introduced themselves by drawing on a small map of the Netherlands located in a corner of the larger map.

At the close of this first step all participants were comfortable with one another and knew whether other participants had personal reasons for being concerned with flood risk in the Houston-Galveston Bay Area.

The knowledge surfaced in the first step includes:

- The map is not accurate; discussions arise about what location is where and which features are missing or wrongly drawn.
- The map shows that some parts of the Bay Area are not represented in the room. Specifically the eastern shore (Chambers County) and Bolivar Island are pointed out as missing representation. The group decides to stay aware of this and aims to consider possible stakeholder perspectives of this area as well, in order to get the best possible comprehensive systems-representation of the Houston-Galveston Bay Area in this workshop.
- Present in the room is interest in, specific knowledge of, and/or experience with the Houston Harbor Area, Galveston Island, the shore and Bay, the coast and coastal area, Houston city, Galveston City and several cities along the western Bay shore. Also there are alumni and students from both Rice University and Texas A&M Galveston.

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2

Who cares?

Step 2. Identify stakeholders and main interest groups

The purpose of the second step of the CIGAS process is to identify the diversity of stakeholders in the Houston-Galveston Bay Area i.e. Who cares about the Houston-Galveston Bay Area?, and to cluster these into composite representative groups of stakeholders sharing common interests.

To this end, each participant was given several large Post-it papers and a marker pen and was asked to *'Take 5 minutes for yourself and write down all stakeholders/actors you can think of. Write one stakeholder per Post-it.'* After individually generating and writing down their ideas, participants were asked to gather around a large empty table and then to select one stakeholder Post-it, stick it on the table, and explain to the group why they considered this stakeholder relevant. Each participant was given a turn to indicate their first stakeholder, then a second round commenced in which participants nominated a second, different stakeholder. By the third round, all stakeholders on the Post-it's had been nominated. Although, we had not planned to cluster stakeholders from the beginning, the workshop participants began to do this during the nomination rounds. When a newly nominated stakeholder corresponded on common potential actions or common interests with one or more stakeholders already on the table, these were clustered together.

Next, participants were asked to *'Condense to maximum 5-8 main clusters of stakeholders and give each main cluster a name.'* The following main clusters of stakeholders or **interest groups** were identified:

- 1a. Federal government & US Army Corps of Engineers & Flood insurance underwriting Fed. Govt.
- 1b. American people
2. Environment & Tourism interest
3. State government & Local government
4. Infrastructure & Emergency response
5. Citizens on the Water Front
6. Citizens in the Surge Zone
7. Industry & Business & Ports.

The names assigned to the interest groups were then written on large Post-it's and stuck on the wall so that participants could continue to refer to them during subsequent discussions.

It is interesting that the range of stakeholders named is broad, with many participants writing down the same stakeholder. Clusters emerge quite naturally with all participants taking part in the discussion on clustering. Clearly, this knowledge is very familiar and easily accessible to the participants, who indicate in the break thereafter that they found this a somewhat boring exercise. Two difficulties occurred, namely:

- Condensing to 5-8 main clusters (which is the maximum to make the rating calculations feasible in later steps) is not easy. We end up with 8.
- 'Agriculture' seems difficult to place in a cluster, there is some discussion, and it is finally placed under 'business'.

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Why we care

Step 3. Determine relevant systems & their values

Step three focusses on the Houston Galveston Bay system and its characteristics, rather than the stakeholders. The purpose is to clarify why people care about the bay area and the associated flood risk, and which aspects of the bay systems are important to them. Participants were asked to *'Explore the Houston Galveston Bay area, explain what stakeholders care about and what it delivers to them.'*

The set-up for this step in the CIGAS workshop differs from the previous two steps. Here people were seated in a semi-circle facing a large whiteboard covering almost the whole of one side of a long rectangular room. Participants are encouraged to propose new or even additional issues, and to speak freely whenever they had another idea or opinion on the system. The moderator captured and systemized the suggestions of participants by writing short notes or sentences on the whiteboard using a variety of colors.

Participants expressed surprise concerning the vast amount and diversity of sub-systems and issues that appear on the whiteboard: 'Having it visualized like this makes you comprehend much better how much is at stake and how intricately it all connects.' In addition, participants found this an exciting exercise and liked the systematization of such a large range of issues. They were particularly intrigued to note the family life and community aspects that came to light in this step.

The systems determined as relevant to the Houston-Galveston Bay Area by the participants are listed in the table that follows (Table 1).

At this stage, participants characterized the main clusters of stakeholders or the interest groups – the output of step 2 - as ('Who cares') and the relevant systems and their values – the output of step 3 – as ('Why we care').

Table 1: WHY WE CARE
Systems determined as relevant to the Houston-Galveston Bay Area by participants
(in no particular order)

Systems named	Values named	Comments
Commercial and recreational fishing	<ul style="list-style-type: none"> • Commercial • Recreational • Attendant Industry 	~ One third
Recreation	<ul style="list-style-type: none"> • Boating • Fishing • Economy • Marina • Tourism • Vacation Home • Quality of life • Yachting • Birding • Relax • Close to the water • Enjoyment 	~ Parks! ~ Culture! ~ Close to water
History	<ul style="list-style-type: none"> • Galveston • Unique character • Landscape • Protected/sheltered harbor • Texas independence 	~ Once largest city east of Mississippi
Transport (by water)	<ul style="list-style-type: none"> • Inter-coastal waterway • Barges • Cheap infrastructure • Safe infrastructure • Houston Ship Channel • Economic competitive • Petrochemical ~ 2/3 of Economy • Export & Import, Sells • Land • Manufacture 	~ Could get you to Maine! ~ Part of economy
Family life & community	<ul style="list-style-type: none"> • Social • Psychological • Part of life, Quality • Time spent with family • Relaxation • Residential • Variety • Sense of place • Connection • Pride • Lack of utilization 	~ Distinctive identity ~ Different experiences on the Bay
Jobs	<ul style="list-style-type: none"> • Employment • People to fill jobs 	~ Can I live here?
Health	<ul style="list-style-type: none"> • Disease 	
Housing	<ul style="list-style-type: none"> • Retirement • Living Space • Second homes • Housing stocks 	
Economy	<ul style="list-style-type: none"> • Cheap natural gas • Refineries • Access to water • National economy • Protecting our future economy 	~ 49% from coast

	<ul style="list-style-type: none"> • Great ports • Industry, business • Tourism/Visitors 	
Psychological	<ul style="list-style-type: none"> • Memory of events • Big state • State with a coast <i>vs Coastal State</i> • Perception • Can I afford this? • Frustration 	
Safety	<ul style="list-style-type: none"> • Liability • Scare/Fear • Hurricane & Flooding • Dikes, Levees • Unprotected • Risks 	<i>~ Does this distance you from the Bay?</i>
Ecology	<ul style="list-style-type: none"> • Off-shore marine • Nursery for fish • Bio products • Habitat migratory birds • Ecosystem services - cleansing • Impacted by pollution • Wetlands 	<i>~ Huge role</i>
Population	<ul style="list-style-type: none"> • Landscape • Room to live? • Setting 	
Industry	<ul style="list-style-type: none"> • Needs water • Location, location, location • Transport 	
Cost of living/ Cost of operation	<ul style="list-style-type: none"> • Building codes • Cost of insurance • Changes in sea levels • Higher asset • Liability 	
Beaches	<ul style="list-style-type: none"> • Erosion • Access 	<i>~ How can I get there?</i>
Demography	<ul style="list-style-type: none"> • People leave 	<i>~ Affected by Ike</i>
Power & politics	<ul style="list-style-type: none"> • NIMBY • Resistance to planning • Federal funding • Personal investment • Laws • Public access to shore • Generosity • Enough to go around 	<i>~ Why not more funding for Texas and its coast?</i> <i>~ Changes by hurricane</i>
Tax base	<ul style="list-style-type: none"> • Continuity • Fair use for protection • Rich & Poor 	
Utility	<ul style="list-style-type: none"> • Sewage • Moving poisons • Pollution • Ship channel 	

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4

Outcomes

Step 4. What do we want or not want? And what does that look like?

The purpose of step four of the CIGAS process is to determine and describe potential outcomes for the Houston-Galveston Bay area. This step builds upon the knowledge generated in the previous step regarding the values associated with different system characteristics, as the outcomes have to be system-achievable and cover a wide range of possible states and values. As this is a potentially difficult exercise, the participants are first given a try-out exercise upon which they receive feedback before being asked to complete the full task.

For the try-out exercise, participants are divided into 2- or 3-person teams. The allocation to the teams is rather random with the exception that two participants who were rather silent in step three were grouped together into a 2-person team to ensure their active participation. Each team was supplied with empty A3 paper, pens, pencils and markers. They were given the task of developing one outcome, and then reporting this back in an informal plenary setting within 20 minutes.

Every team was able to come up with at least one outcome description within the try-out exercise. Some had the beginnings of three outcomes. Following the informal plenary feedback, the participants were encouraged to proceed further and develop at least one 'negative' outcome and one or possibly two 'positive' outcomes. The setting for generating these outcomes was informal with packed lunches being provided and small group clusters in the workshop venue. Some moved to enjoy their lunch outside while working on generating their outcomes. The facilitators moved from one group to another, checking on progress, and answering questions as needed.

The instructions given to the participants were to *'Describe potential outcomes for the Houston Galveston bay area, what it would look like (but not how to get there). Describe the state of the things that are cared about (positive and negative). Try to think of outcomes that are far apart.'* The aim is that participants are not constrained by thinking about what people would consider socially acceptable, nor constrained by physical resources and immediate feasibility; for example that it can't be build in so many years, that there's no funding. They are to presume no resource limitations, yet the outcome should be logically possible. Possible outcomes have to be systems-feasible, but not actor-feasible. So they are instructed to think in a divergent way, and told that there are no wrong answers.

Next, each team then presented their outcomes to the plenary group and named them. The moderator captured the names and specification of the outcomes on Flip-over sheets, which were then stuck on the wall so that they were visible to all participants. Finding agreement within the team was not easy for some with two teams dividing the task and developing outcomes apart from each other. Most groups came up with two outcomes, some with only one, but this was then very detailed. Expressions of surprise were heard when some groups presented 'unexpected' outcomes e.g. *'Let the storm come'*. The twelve possible outcomes identified by the participants, and their characteristics, are captured in Table 2. Five of the outcomes are perceived by the group as positive and five are deemed negative. Two outcomes are viewed by different participants as the 'status quo'. Clearly, there is a divergence of opinion regarding the final outcome that would result from a persistence of the present situation, and present policies, over time. True to the non-consensus seeking basis of the CIGAS process, this divergence of opinion is acknowledged by retaining two 'status quo' outcomes for the Houston-Galveston Bay area.

It was near the end of the first day of the workshop and participants evinced signs of tiredness. However, the task of combining outcomes into a feasible number to consider in the further analysis still remained. This task was conducted with the participants seated facing the Flip-overs on the wall. The participants were asked to 'Combine outcomes (to a maximum total of 7 or 8) and give each group of outcomes a short but clear and descriptive name.' and the moderator then moved the Flip-overs next to one another, combining them visually. This task was experienced as difficult by participants, and the moderator proposed some combinations which were then agreed upon by the whole group. This resulted in the seven combined outcomes listed hereafter. The letters in brackets reflect the labels of the outcomes described in Table 2.

Seven combined outcomes

- Slow Boat Cabaret (FI)
- Taken Out (B)
- Let The Storm Come (C)
- An Enhanced and Rejuvenated Relationship (CK1)
- Self-Reliant Communities (EG)
- Over-Engineered Solution (J)
- Waiting for the next one (DHK2)

Finally, a participant from each team was asked to reflect on the twelve outcomes, their characteristics, and step four of the CIGAS process. All expressed a degree of amazement at the breadth and depth of the generated outcomes. Two indicated that the combination of outcomes was difficult.

Table 2: Twelve possible outcomes as expressed and named by participants (randomly ordered)

Note: Two outcomes are accidentally numbered K. In the calculations these are renumbered.

	Possible outcome name	Characteristics	Rating
A	Let the storm come	<ul style="list-style-type: none"> • Benefits of the storm • Loss of housing stock • Better built, more reliable homes • Impetus to improve infrastructure • Better waste water 	Positive & Negative
B	Taken out	Petrochemical plant	Negative
C	Rebuild wetlands and oyster reefs		Positive
D	Loose your first defense	<ul style="list-style-type: none"> • Loose barrier islands • Moves inwards and inwards • We fail to do things • Inter-coastal waterway • Ship channel affects 	Negative
E	Community Focus	<ul style="list-style-type: none"> • A focus on what we can do on a community level • What is best for Galveston? • Why focus on Ship Channel • Increased appreciation of Galveston • So much relies on Galveston and its Seawall • We want <u>this</u> for Galveston • Help the community 	
F	Cabaret	<ul style="list-style-type: none"> • In-fighting among agencies • NOT sustainable Long-term • NOT full public support • Down sides, big • Denial of what's right there in your face • "Life is wonderful" • Tremendous effect • No economy • Environmental catastrophe 	

		<ul style="list-style-type: none"> • U.S.A. has to resolve • World is also affected 	
G	Yo-Yo Houston	<ul style="list-style-type: none"> • Political Infighting • Squabbles between all interested parties • If you don't work together you will loose what you value • No illusion making • Surge Solution <ul style="list-style-type: none"> ○ Affordable ○ Environmental friendly, ○ sustainable, long term ○ Get public support • Self Reliance 	
H	Waiting for the next one	<ul style="list-style-type: none"> • Do nothing – neutral • Spiral down ecological • Costs and benefits • Sitting and waiting • More development in flood zone • Houston development direct beneficiary, everyone else loses • Contractors win 	Status Quo - version A
I	Slow Boat	<ul style="list-style-type: none"> • Less subsidence • We can dredge less • We are making construction change today • More sustainable harvest • Less use of shells from the bay • Using limestone • Could we do more 	Status Quo - version B
J	Over-Engineered solution	<ul style="list-style-type: none"> • Regional focus • More drought, water table affected up to Dallas • Cost of fresh water to Bay • Over-engineered in the Bay • Deplete the health • Cut-off water • Nothing flushes • Lots of mosquito • Smell! • Everyone negatively affects each other • Second order problems • Engineering which creates new problems 	Negative
K (1)	Rejuvenate the Bay	<ul style="list-style-type: none"> • Strengthen the integrity • Strengthen the ecology • Improve the access • Back to the natural integrity • Principal access, public waterfront protected • Needed for sea-level rise • Preferred ideal is dependent upon starting position (pragmatic approach) 	Positive
K (2)	Houston for Houston	<ul style="list-style-type: none"> • Protect Ship Channel • Centennial Gate 	Positive

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5

Pay-offs

Step 5. Rating the outcomes

In step five of the CIGAS process the interest groups identified in step two and the seven combined outcomes from step four are used. The purpose of step five of the CIGAS process is to rate the seven combined outcomes from the perspective of each of the eight main interest groups. This step seeks to assess the extent to which the values of the eight main interest groups are represented in the seven combined outcomes for the Houston-Galveston Bay area.

Participants worked in the same 2- or 3-person teams as for step 4, and were asked to step into the shoes of an interest group. Four teams were each assigned one interest group, and one team was assigned two interest groups (Citizens on the Water Front; Citizens in the Surge Zone). The remaining interest groups (Federal Government; American People) were represented by the moderators, and checked or corrected by the participants. The teams were allocated roles that they do not usually have, as far as possible, and were asked to *'Discuss the pay off's of each combined outcome from your stakeholder's point of view'*. Then each team was given 12 stickers: 8 positive (green) and 4 negative (orange), which are identifiable by the interest group name on them. They were asked to *'Distribute ratings over the combined outcomes.'*

The number of twelve stickers allocated to each 'stakeholder', eight positive and four negative, was designed to enable teams to indicate clearly to which outcomes their interest groups was averse, to which they were indifferent and which they favored strongly. The teams placed green stickers on combined outcome Flip-overs if their interest group rated the characteristics or values associated with the combined outcomes positively. If they rated the characteristics or values associated with the combined outcomes negatively from their stakeholder or interest group point of view, they placed orange stickers on the Flip-overs. Teams were not allowed to place both green and orange stickers on the same (single) combined outcome. More than one sticker of the same color could be placed on a single combined outcome. In fact, if a team so chose, they could have stuck all of one of their colors on one combined outcome. It was not necessary to place a sticker on each outcome. Some outcomes could receive no sticker, some outcomes one or several, and some all greens or all oranges, or a mixture from different interest groups.

When the teams had finished placing their stickers, each team explained to the plenary group where they had decided to put their stickers and why their interest group valued the combined outcome in this way. Each team was able to present cogent arguments as to why they voted as they did. However, everyone was tired by the end of the day and did not have much energy left to enter into vigorous discussion. Participants showed a tendency to want to spread their rating over a number of combined outcomes with no team placing all their green or orange stickers on any one outcome. This is confirmed by the participants indicating that they found distributing the stickers a difficult task, particularly because the number of the stickers did not correlate easily with the seven combined outcomes. This was a deliberate choice of the CIGAS design team. Additionally, there was some dissent particularly within one team regarding the ratings.

The first day of the workshop closed with this step. The rating of combined outcomes from the perspective of the eight main interest groups is presented in Table 3. The number of green stickers allocated to a combined outcome is represented by a positive number, whereas the number of orange stickers is represented by a negative number.

Table 3: Rating of the seven outcomes by each of the eight interest groups

	Federal Government	American People	Environment and Environmental Tourism	State and Local Government	Infrastructure and Emergency Response	Citizens on the Water Front	Citizens in the Surge Zone	Industry, Businesses & Ports
	1a	1b	2	3	4	5	6	7
Slowboat Cabaret [FI]	-2	-1	-1	-1	-1	0	0	-1
Taken Out [B]	1	-1	-1	-1	-1	-1	-2	-1
Let the Storm Come [A]	1	0	2	1	0	0	3	-1
An Enhanced and Rejuvenated Relationship [CK]	2	2	3	3	2	5	5	1
Self-Reliant Communities [EG]	4	2	2	4	3	3	0	2
Over-Engineered Solution [J]	1	-1	0	-1	3	0	-2	0
Waiting for the Next One [DHK]	-1	2	-1	0	-1	-1	0	4

6

Calculate

Intermediate Step: Pareto front, potential coalitions, and potential approaches

This analysis step in the CIGAS process was performed by the moderators on the evening of the first day of the workshop. Calculations to locate the Pareto optimal front were made.

First, the ratings were rescaled to lie between zero and 100% (Table 4). This is necessary to enable rating/calculation of a mix of combined outcomes at a later stage.

Next, the ratings of combined outcomes made on behalf of all the interest groups/stakeholders were explored. The following principles were applied in analyzing the re-scaled rating table. First all the outcomes in which any interest group is made substantially worse off than they are today is eliminated. This is equivalent to scrapping all lose-lose outcomes and the (substantially) lose-win outcomes. To identify outcomes for elimination from further consideration, it is sufficient to show that an outcome is dominated by one other outcome (Table 5) as this means that it is not located on the Pareto front. What remains are win-win outcomes in some sense, with some interest groups winning more than others.

Next, a check is undertaken regarding the alignment of interests. There is often a broad space of agreement among interest groups about which outcomes are most desirable. Which interest groups consistently want the same things? These groupings/coalitions of interest groups that appear to consistently prefer the same outcomes are termed 'broad interest coalitions'. The broad interest coalitions were identified.

The outcomes which - given the situation today - offer the most value for the most stakeholders, were identified next. A lack of clarity on the 'status quo' or the situation today and how it would extrapolate into the future if present policies persist was also identified. This is consistent with the two versions of the status quo identified in the combined outcomes of step 4.

Finally, the observations were synthesized into outcomes from Day 1 of the CIGAS workshop and choices were made by the CIGAS moderators regarding the potential approaches towards commitment to action, using the principles of arbitration and principled negotiation.

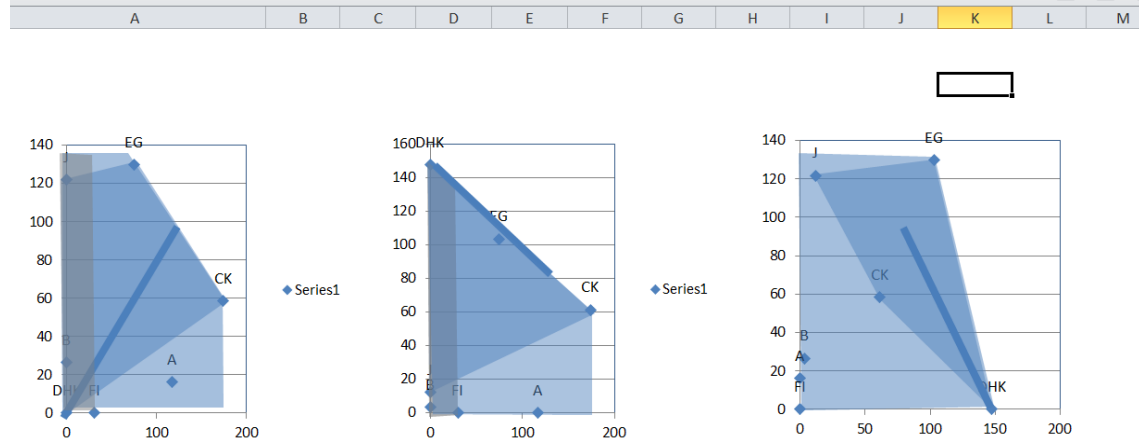
Table 4: Rescaled matrix of rated outcomes: 0% is worst and 100% best

	Federal Government	American People	Environment and Environmental Tourism	State and Local Government	Infrastructure and Emergency Response	Citizens on the Water Front	Citizens in the Surge Zone	Industry, Businesses & Ports
	1a	1b	2	3	4	5	6	7
Slowboat Caberet [FI]	0	0	0	0	0	17	29	0
Taken Out [B]	50	0	0	0	0	0	0	0
Let the Storm Come [A]	50	33	75	40	25	17	71	0
An Enhanced and Rejuvenated Relationship [CK]	67	100	100	80	75	100	100	40
Self-Reliant Communities [EG]	100	100	75	100	100	67	29	60
Over-Engineered Solution [J]	50	0	25	0	100	17	0	20
Waiting for the Next One [DHK]	17	100	0	20	0	0	29	100

Table 5: Identifying outcomes near, or on, the Pareto front by eliminating dominated outcomes

	1a	1b	2	3	4	5	6	7	
Slowboat Caberet [FI]	0,0	0,0	0,0	0,0	0,0	16,7	28,6	0,0	Dominated by CK and others
Taken Out [B]	50,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	Dominated by CK and others
Let the Storm Come [A]	50,0	33,3	75,0	40,0	25,0	16,7	71,4	0,0	Dominated by CK and others
Enhanced and Rejuvenated [CK]	66,7	100,0	100,0	80,0	75,0	100,0	100,0	40,0	
Self-Reliant Communities [EG]	100,0	100,0	75,0	100,0	100,0	66,7	28,6	60,0	
Over-Engineered Solution [J]	50,0	0,0	25,0	0,0	100,0	16,7	0,0	20,0	Weakly Dominated by EG
Waiting for the Next One [DHK]	16,7	100,0	0,0	20,0	0,0	0,0	28,6	100,0	

Figure 1: Exploring the space to identify the Pareto optimal front



7

Game structuring and mediation

Step 6. Exploring the space for commitment to action

The second day of the workshop commenced with a welcome to the City of Seabrook by the hosts. Next, the steps and artefacts from the previous day were summarized so that all present had an overview of the process up to that point. This was done using the interest group sheets (step 2) and Flip-overs from the previous day (steps 4, 5), which were stuck on the walls of the Seabrook city hall. The only artefact from the previous day that was not present was the ordered list of systems determined as relevant to the Houston-Galveston Bay Area by participants (Table 1: Why we care) from Step 3. The analysis of the results from Day 1 was then presented and discussed.

Results

The first result is the identification of broad interest coalitions. These constellations of common interest represent alignments of interests, that is interest groups that appear to consistently prefer the same outcomes. Three potential constellations of common interest were identified, namely:

- All in it for the Bay (*everyone except industry and ports*)
- American Economic Prosperity (*industry, business, ports, state & local government, American People*)
- Infrastructure Planners (*infrastructure, emergency response, federal government*)

The interest groups within the broad interest coalitions are potential coalition partners in any follow-up actions to the workshop.

The second result is the identification of four non-dominated outcomes (Table 5). Loosely speaking these are the win-win outcomes in some sense, with some interest groups winning more than others. They are located near, or on, the Pareto optimal front, and may be termed efficient combined outcomes.

- Enhanced and Rejuvenated [CK]
- Self-Reliant Communities [EG]
- Over-Engineered Solution [J]
- Waiting for the Next One [DHK]

The Enhanced and Rejuvenated outcome received the highest total rating (and so is identified as the Hicks Optimal in game theory).

The third result is the clarification of a lack of shared understanding of the status quo on the part of the workshop participants. Two versions of the status quo were identified on day 1 of the workshop, and there was talk of even more specification, and splitting further on the first day. Clearly, there is a lack of clarity regarding where the Bay stands today and regarding its health and performance. With no agreement on how things are today, it is impossible to decide where they will head in future. However, this lack of clarity can be solved. Knowledge of the present situation is obtainable by scientific investigation and interpretation, and is for the most part not a value-based issue.

If the status quo is the Slowboat Cabaret, this precludes all other outcomes except a mixture of:

- Enhanced and Rejuvenated [CK]
- Self-Reliant Communities [EG],

because anything else would make some interest group worse off than they are under Slowboat Cabaret.

If the status quo is Waiting for the Next One, then the broad interest coalition of American Economic Prosperity would demand:

- Protection of the ship channel (protecting investments, as well as continued operation)
- That port and industry workers get back to work after a hurricane (continued port operation).

This potentially excludes environmental interests, local communities and Galveston Island. To bring this broad interest coalition to the negotiation table, it is necessary to generate, or envisage, an outcome that would lead them to do much better than they would be doing under the status quo of Waiting for the Next One.

Subsequently a number of possible approaches that were formulated by the moderators, premised upon the participants acknowledging the present situation, and choosing to take (collective) actions, were presented and discussed.

Six Possible Approaches

The first four approaches envisage forming broad coalitions of interest, whereas approaches 5 and 6 are most effective if forming a grand coalition is not possible, or is not desired by some.

1. The first approach is termed ***Retain Useful Ambiguity***. Instead of clarifying the status quo via scientific research and stakeholder consultation, it seeks to retain uncertainty about the situation today and its likely outworking in the future under the persistence of present policy. Ambiguity is retained and a combination of outcomes is pursued, namely:
 - Self-Reliant Local Communities
 - Enhanced and Rejuvenated
 - Waiting for the next one

This approach has value particularly if the status quo happens to lie closer to Waiting for the Next One, as it keeps open negotiation and the possibility of a collaborative outcome that incorporates the environment, communities and economic interests.

2. The second approach is termed ***Clarify and Inform***. It seeks to resolve the uncertainty about the status quo through empirical research (socio-economic, ecological health, stakeholder consultation etc.). This approach will make people no worse off than they are at present, and perhaps better off. It seeks to establish the status quo and through information sharing improve the common understanding of the Houston-Galveston Bay Area.
3. The third approach is termed ***Establish Different Status Quo***. This approach aims to explore whether a status quo different from those already identified may not exist. If such a status quo does exist, the approach envisages informing stakeholders. This would act to change the present situation, and open new horizons that are unclear at present. The idea is that as the new horizons become clear, collective action will be taken to move towards them if so desired.
4. The fourth approach is termed ***Consider and Include Other Stakeholders*** and focuses on fleshing out constellations of common interest. This approach increases the number and range of stakeholders, leading to increased complexity. But, it also leads to better-arbitrated outcomes and prevents surprises later e.g. additional requirements from previously unheard stakeholders. Through such an expanded network additional issues are raised at an early stage e.g. requirements on outcomes from stakeholders from Anahuac or Bolivar Roads. It is possible to acquire additional resources, and new capabilities to argue and defend your interests by seeking to consider and include other stakeholders.

5. The fifth approach is termed **Prepare for Continued Dispute**. It focuses on forming action coalitions i.e. constellations of common interest with the commitment to, and capabilities for, action. This approach hones your ability to recognize your potential friends and allies. It seeks to gain capabilities for the group, so as to use resources to achieve the embraced aims. This approach can be characterized as:
- Use resources to act for what YOU want
 - Create alignments for YOUR cause.

The approach is not oriented to collective action for the common good, but seeks to fragment and then align for the good of the action coalition.

6. The sixth approach is termed **Supply Information**. It seeks to create more detail about the values embraced within, and the situation arising from, the potential combined outcome of
- Self-Reliant Communities
 - Enhanced and Rejuvenated Relationships.

It then employs this detailed combined outcome when talking to engineers, contractors, state, local and national government about the future of the Houston-Galveston Bay Area. This approach has the possibility to build a ground swell, and create a vision of a future for the Bay. This vision creation can act to alter the negotiation game and open up new possible outcomes. Its potentially a game changer.

Participants' discussion

The discussion that occurred during the presentation of outcomes and potential approaches, ranged widely. The participants recognized the existing confusion about the present status quo. They also expressed thoughts and some criticism about the combination of some of the original twelve outcomes into composite outcomes, especially the concatenation of the Houston for Houston outcome into the Waiting for the Next One status quo.

Discussion followed on the lack of leadership in the Houston Galveston Bay Area to come to a shared approach regarding flood protection. The group of participants identified a lack of political leadership as a main source of the current problematic situation in the Houston-Galveston Bay area, namely: contention, and no joint plan of action, to address the risk of flooding in the bay area owing to hurricanes. Very symptomatic of approach 5 above. The need for leadership was exemplified by the question "Who will drive the train?" and the statement "There is no leader right now". Many options for leadership were proffered. Some suggested a legislative committee as lead, yet others stated a "Harris County Judge has to lead", others the Six County Surge District and yet others the Bay Area Houston Economic Partnership (BAHEP). BAHEP was viewed as central to a shared approach, as was the Six County Surge District. This was created by the governor, following Hurricane Ike. The County judges and three other representatives of citizens and industries (Moody, Dow Freeport, Beaumont/Port Arthur) sit on the Board of the Six County Surge District. Whatever the leadership, the Surge district would need to orchestrate a study of flooding risk on the Houston-Galveston Bay area, but does not have to conduct all the studies themselves. The Surge District is not very toothsome, politically. However, in an alliance with the General Land Office, which controls the coastline, there is potential for a workable match. Other qualifiers on the potential leader were that their vision should not be too parochial, but more regional, and that it is possible to be too political. Such a leader needs to be above politics, which was why there was support for BAHEP taking a key role.

Further comments related to the need for a local groundswell and that the federal government is waiting for the proposal of a shared and supported solution. Sound information, not necessarily collated in understandable form, can create a groundswell. The report cards for the Bay form a very good example of such information. Indeed, Texas A & M and Rice University are undertaking system analyses/synthesis, while University of Texas, Houston, are undertaking the requisite model simulations. A common base of knowledge and respect for different opinions are prerequisites for committing to joint action.

The discussion then moved to focus on the possible approaches. The insightful comment was made that it was possible to combine approaches 1 and 6. Embracing Ambiguity meant agreeing on assumptions and proceeding from there to create the information that could change the situation by allowing self-reliant communities to evolve. The participant group responded very positively to this suggestion, favoring self-reliant communities and the enhanced and rejuvenated relationship outcomes, while still considering that the economic interests should be borne in mind. They indicated a desire to pursue this option by meeting together in future.

The workshop closed with participants providing feedback on the CIGAS method, how they had experienced it, and the results of the workshop itself.

8

Reflection

Dilemmas, reflection and recommendations

During the second day of the workshop, the dilemmas facing both the participants and the moderators were presented and discussed. In reflecting on the CIGAS process, it is necessary to clarify these dilemmas, and the responses of both participants and moderators in turn.

Participants' dilemma

The dilemma faced by each participant in the CIGAS workshop relates to what they do with the knowledge they have gained and the relationships that have developed over the workshop. First, they have gained insight on the lack of clarity regarding the status quo and are faced with a choice of acknowledging where they are now, and where they will be if the present policies persist, or choosing not to do this. Second, the CIGAS intervention has provided system and game-based insights on information generated during the workshop and the participants need to decide on potential steps towards the future. It is not the task of the moderators from Delft University of Technology to make choices in this regard. We merely present an analysis of the outcomes and the options facing participants. It would be presumptuous to do more. Finally, even though the workshop only extended over two days, participants have formed personal bonds. It is their choice whether they extend these relationships beyond the CIGAS workshops and use the insights and common ground created to form a platform for further joint action.

Participants' reflections and comments on the CIGAS process and outcomes

Each of the participants provided a personal reflection and commented on the CIGAS process and the outcomes. These reflections are reported anonymously hereafter.

Participant A found the process enlightening, and considered that the outcomes to be reflective of the group of participants. He noted that not all stakeholders were represented. He liked that participants were forced to think about why they cared.

Participant B found it tough to see the political reality that some people weren't present. He considered that it reinforced the need for communication. He found it good to think outside of his own specific interests, and liked the holistic nature of the approach.

Participant C liked the map exercise (introductory exercise) and qualified the system view as a good straw-man. She found the voting and debate on outcomes interesting, but incomplete. The resulting array was intriguing. In her opinion, the complex issue of flood risk needs a multi-stakeholder group to be tackled sufficiently, with a strong local/regional leader and outside facilitation so that the process of engaging communities is managed well. She liked the supporting argumentation for Self-Reliant Communities and the Enhanced and Rejuvenated outcomes.

Participant D questioned the representative nature of the group. What about other stakeholders such as Agriculture?

Participant E found the CIGAS a complex process that did not reflect the complexity of the actual situation. He expressed the need for a central location to discuss this further.

Participant F found the CIGAS process engaging and original, particularly imagining both the negative and positive outcomes, rather than the mechanics of getting there. She identified that the main impetus for addressing the problem of flooding safety lay with academia and that the forces of power were lacking. In particular, the county is missing, what about the Houston Galveston Area Council, and the potential driver of BAHEP?

Participant G indicated that there is a great deal of social capital in the bay communities. BAHEP was trying to build momentum starting from South East Houston. They are not fixed to a particular approach, but try to advocate studies, accelerate their dissemination and find funding. In response to a question regarding support for the Ike Dike, it was stated that the form of the Ike Dike is not fixed, but that BAHEP is supportive of investigating the concept of a coastal spine. He invited others to prove this incomplete or inaccurate as solution and indicated again that BAHEP's role is that of catalyst, so that the best solution will emerge.

Participant H found the CIGAS process an interesting exercise. She noted that only the west side of the Houston-Galveston Bay area was invited. She emphasized the resilience of the bay and stated that the people also needed protection, not just industry.

Participant I considered it good to focus on outcomes, yet found it difficult during the workshop not to be offended but to realize that everybody has a piece of the truth. In her opinion, the average Houstonian is not invested in the bay to the extent that the present participants are invested. To ascertain the effect of this affinity with the bay, she suggested that it might be interesting to do the workshop with people with little knowledge of the bay (control group). Then you would be able to ascertain the bias in the present group. But, she is of the opinion that there is no neutral perspective. However, in future it would be good to include a mid-town worker or two in such a workshop.

Participant J considered the CIGAS process and the system overview worthy of compliments. He thinks the outcomes are a long way to being roughly right and would rather be roughly right than precisely wrong.

Participant K considered information a key driver, and updates or new information as important. A legislative connection can act as network connector for communication updates. She suggested using ICT and web information management to explain why this issue requires money, and answer the question "Why does this matter to me?" It also enables all involved to keep up to date and find the information relevant to them.

The session closed with a suggestion from Participant I that participants could meet together in future, with some participants agreeing to this – addressing the third issue in the participants' dilemmas.

Moderators' dilemma

The moderators' dilemma relates to the arbitration of the process following the analysis of the rating of the outcomes. It relates to which type of mediation to choose. In the diagram below, the Nash equilibrium is represented by the inner white circle labelled Arbitrated Outcomes. The Nash equilibrium represents an equitable outcome in game theory. The outer white circles reflect the three possible choices, namely:

1. Describe your Good Outcomes
2. Develop Functional requirements
3. Process Management.

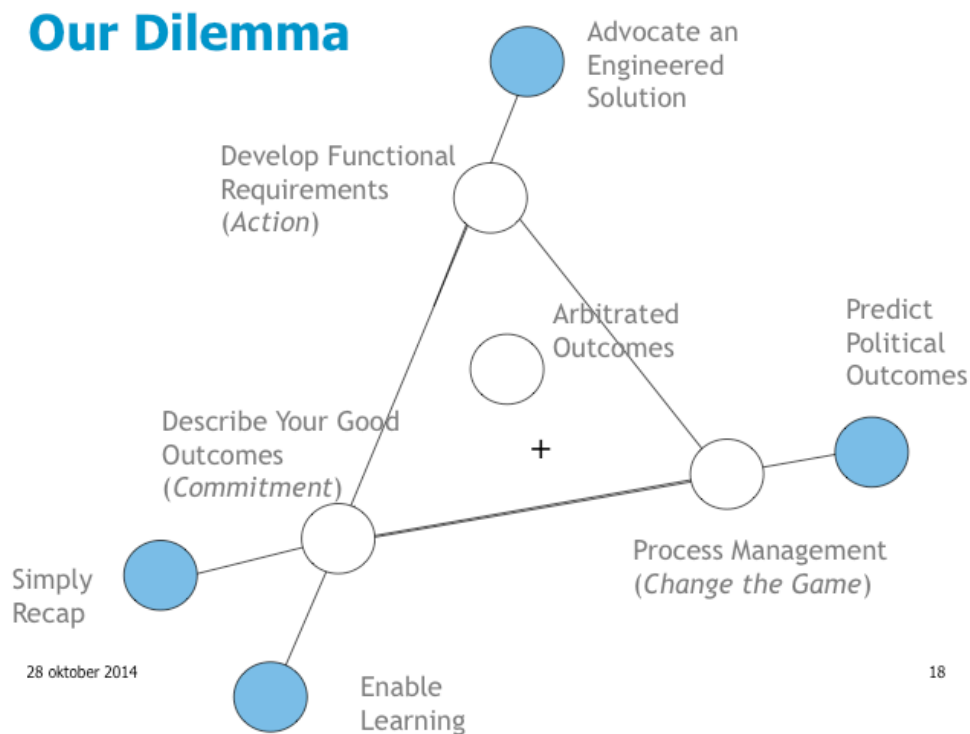
A workshop focused on the surfacing of biophysical and technological system knowledge would lend itself to Develop Functional Requirements, a choice above and to the left of the centroid (Figure 2), whereas a workshop that surfaces insights on coalition forming and information acquisition by stakeholders would lend itself to Process Management, a choice below and to the right of the centroid.

The blue circles are extreme consequences of our options to mediate. If we choose to do no more than gather participants together, encourage learning and discussion then in the extreme we would Simply Recap or Enable Learning. By pursuing Describe your Good Outcomes to an extreme we would simply recap on all that we had heard in detail regarding the system and the value-based descriptors of the generated outcomes. Or, we could enable stakeholder learning (the other extremum) by asking participants to explain further why they value one system situation more than another. This would then focus further on stakeholders learning about the positions and values of other stakeholders. This seemed unsatisfactory to the moderators.

We could choose the extremum of attempting to describe and Predict Political Outcomes both now and in the future as it relates to decision making on flood safety in the Houston-Galveston Bay area. This seemed speculative at best, and decidedly unsatisfactory.

We could choose the extremum of matching outcomes with desired engineering solutions, but this requires detailed additional information utilizing simulations of the effects of engineering options on measurable quantities of interest in the bay to the stakeholders. Indeed, the system description of step 3 would have had to be based on a comprehensive systems analysis underpinned by model-based calculations to facilitate this. Such information was not available to us. Even the choice to focus on translating the desired outcomes into engineering requirements (Develop Functional Requirements) was not possible without additional skills amongst the participants and substantially more time. In short, a different group of participants would be required to enable such mediation, and a longer workshop would be necessary.

Figure 2: Moderators' dilemma and choice



Moderators' reflections

Whereas the original intention was to come to a discussion of functional requirements that matched with identified outcomes, this proved unattainable. Instead, we chose some intermediate arbitration actions, and discussed fairness, commitment, and changing the game. The present group of participants allowed an exploration of 'game changing' and process-based actions, related to coalition forming and information acquisition that we as researchers and moderators of the workshop had not foreseen at the outset. Our arbitration focused therefore on process-based insights of possible approaches to move towards commitment to action. We locate this choice at the position (+) between 'Describe your Good Outcomes' and 'Process Management'.

Recommendations

Participants in the CIGAS workshop gained system knowledge regarding the Houston-Galveston Bay area and the values underpinning the preferences of different stakeholders regarding future outcomes. While the CIGAS process recognizes diversity in opinions and values, it endeavors to encourage a commitment to action. Accordingly, the participants and hosts are encouraged to consider using the insights and common ground created in the workshop to form a platform for joint action.

Further, a follow-up workshop focused on determining functional requirements for flood risk management of the Houston-Galveston Bay area could deliver insights against which the performance of various proposed engineering solutions could be evaluated. These insights would complement the process-based mediation of the present workshop. Participants in such a workshop would need to possess engineering and systems knowledge.

9

Participants

Workshop participants

Ben Bass	Rice University
Bernard Legrand	WorleyParsons
Bill Kiene	NOAA
Dan Seal	BAHEP
David Robinson	Houston City Council
Diane Sheridan	Citizen Advisory Panel
Marie Robb	Coastal Solutions
Mary Jane Naquin	Citizen Advisory Panel
Richard Ruchhoeft	Port of Houston
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