

# The role-playing game: engineering students meeting real world wicked problems

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## Structured Abstract

The traditional and core focus of civil engineering education is the provision of students with the technical skills needed to solve problems and create solutions to human settlements, infrastructure and the environment. However, these solutions are often challenged by the complexity of the socio-economic system when multiple actors have different views on the issues at stakes and multiple solutions, a so-called wicked problem (Rittel and Webber, 1973). The main objective of the course Coastal Zone Management at Griffith University is to expose civil engineering, planning and science students to real world problems and situations in coastal engineering and management. In this paper we focus on the Role Playing Game, a graded assignment introduced in Coastal Zone Management in 2011, and used in the last three years of this course. This assignment, which is based on the student's engagement in a simulated stakeholder workshop, is designed to address critical learning outcomes for today's engineers and planners such as critical thinking, negotiation and communication skills and the ability to work in teams.

The Role Playing Game, currently used for the course Coastal Zone Management, can be easily adapted to other planning or management courses in engineering or other disciplines. The purpose of the assignment is to expose planning and engineering students in the last years of their studies to real world stakeholder engagement processes, building conflict resolution and communication and negotiations skills.

The Role Playing Game is designed to allow students to choose a real world stakeholder role and create and negotiate objectives and actions as part of the development of a hypothetical project or plan. In the course Coastal Zone Management we developed the role-playing game around the creation of the Coastal Management Plan for Dugong Bay, a hypothetical location in Queensland. The role-playing game consists in a 3 hours workshop facilitated by the course instructor, involving students as stakeholders from a range of hypothetical locations and sectors. In this case we used four hypothetical councils: Dingo Island Aboriginal Council, Muddy Creek Council, Pleasant Port Council, White Beach Council. In addition, we have identified and described 15 different stakeholder groups from the private and public sectors, such as council officers, State Government, tourism operators, environmental groups, developers, etc.

The Role Playing Game is a graded assignment with the following assessment criteria: Participation in the workshop, Contribution to the debate and the Draft Plan, Answer to final questions.

The results obtained indicate that the Role Playing Game is a successful mechanism for achieving the desired learning outcomes. This is reflected both in the results for this assignment, where students take the workshop very seriously to achieve good marks, and in the SEC (Student Experience of Courses) surveys, which have included positive comments on the learning experience for this course in all three years.

The Role Playing Game for civil engineering described here has shown to be a very effective assessment item for students in their last two years of their studies as it allows them to experience possible real world situations with multiple stakeholder interests and objectives. This experience has shown students that often technically sound solutions can have multiple facets in a multi-stakeholder environment. By building capacity in critical thinking, communication and negotiation, the Role Playing Game teaches students that in the real world the chosen solution is often the one that minimises stakeholder conflicts.

## BACKGROUND

Role Playing Games or role play are real world simulations where, commonly, students are assigned a specific stakeholder role with specific objectives over an engineering or planning project (Bhattacharjee et al., 2013, Andersson and Pernille, 2010, Mulder et al. 2013, Druckman and Ebner, 2013). The use of Role Playing Games in Engineering education is not a common practice, however, there is a strong need to get students to better understand complex reality in the engineering professional life. This teaching practice was introduced in 2011 as part of a redesign of the Coastal Zone Management curriculum. A Role Playing Game used during a European project ([www.eco-imagine.org](http://www.eco-imagine.org)) was adapted to the Australian context, including the creation of hypothetical location, stakeholders and data.

This assignment fits very well in the Curriculum of civil engineering students which is commonly not equipped with courses dealing with socio-economic, environmental or stakeholder issues. In particular, it fits very well in CZM, a multidisciplinary course connecting settlements and infrastructure, ecosystems, physical processes and stakeholder interactions in the coastal zone. The course is structured around five assignments:

1. Critical review of scientific paper. Where students are required to select a relevant paper from the scientific literature and respond to a set of questions.
2. Project Proposal. Where students, in teams, are required to prepare a proposal for a real, pre-selected, tender on coastal management, and compete against the other teams in class.
3. Role Playing Game. The subject of this paper.
4. Coastal Policy Analysis. Where students analyse selected case studies – each student chooses one – in depth, looking at coastal management issues, existing solutions and possible responses.
5. Oral presentation. Where students present in 10 minutes their Coastal Policy Analysis case study, testing their presentation and oral communication skills.

## PURPOSE

Prior to the introduction of the RPG, students didn't have much exposure to stakeholder engagement issues, which are a very relevant and often underestimated elements in planning and engineering projects. The RPG was introduced as an assignment to improve the learning experience and understanding of students of real life problems and to practice their negotiation skills in a simulated environment. Previous to the game, students are given a lecture on negotiation and communication skills as part of the CZM course. This information is very relevant as it provides them with elements to improve their capacity in dealing with other actors with conflicting interests.

## DESIGN/METHOD

The RPG is run as an assignment half way through the course, during week 8. Students are required to select a role (up to three students per role) using an online sheet uploaded on Google Drive and to read the exercise background documentation. The objective of the simulation game is to negotiate in a multi-sectoral stakeholder environment and contribute to the development of a Coastal Management Plan for Dugong Bay, a hypothetical location in Queensland (figure 1).

The workshop (simulation game) involves stakeholders (students) from the public and private sectors including four (hypothetical) coastal councils:

- Dingo Island Aboriginal Council
- Muddy Creek Council
- Pleasant Port Council
- White Beach Council

Representatives of (real) State Government organizations:

- Queensland Government Department of Environment and Heritage Protection
- Queensland Government Department of Natural Parks, Recreation Sports and Racing

The (hypothetical) private sector:

- Brick & Steel, a developer
- Black Carbon, coal mining and exporting
- Sugar Cane and Banana growers
- Fishermen Co-operative
- Salt & Sea sailing operators
- Manta Diving, scuba operators

And community organizations:

- Friends of the Dugong, environmentalists
- White Beach Surf Life Saving Club
- Australian Workers Union QLD, a (real) trade union



Figure 1. Map of Dugong Bay, the hypothetical location used for the Role-Playing Game.

Before the workshop starts students are provided with factsheets about the hypothetical location and a detailed profile of the stakeholder groups. Groups of students, normally 2 or 3, are required to choose one of the available stakeholder beforehand – in this case we used an online spread-sheet to add names against roles. In class, students/stakeholders are required to read all the available documentation and to identify a set of actions to be included within the plan and expose them to the rest of the students/stakeholders in a 2 minutes presentation. Finally students have about one hour to identify, discuss and solve conflicts with other stakeholder groups. The final agreed actions are included in a draft Coastal Zone Management Plan, in the form of an online spread-sheet, which includes pre-determined general and specific objectives.

As part of their homework, students are finally required to answer a set of simple questions:

1. Does the set of actions suit the initial objectives of the plan?
2. Do you see any potential conflicts with plans and regulations at other levels (e.g. federal, State)?
3. Do you see any conflict with other actions within the plan?

### Example: Pleasant Port location profile

Below I report the example of the description of one location, one stakeholder group (table 1):

*Pleasant Port is the only port of Dugong Bay. With a basin of 60,000 m<sup>2</sup>, it is equipped for 570 12-m boats equivalent (650 declared). The town of Pleasant Port is lively, provides services to sailing and motorboats and is a popular destination for boating aficionados. There's no beach as most people use it as a base for navigation. Pleasant Port is an important point that services pleasure boating, fishing and commercial transportation for industrial activities along Muddy Creek (250 people employed). This situation often provokes traffic problems and does not allow using space and infrastructures at their best, also due to shallow waters that need periodical dredging and cleaning operations. An enlargement project has recently been presented that would allow to host other 450 boats equivalent and a better division of functions and dredging, so as to allow the mooring of large boats. It is expected that each new 12-m boat equivalent could generate (a) 0.2-0.25 new jobs (direct and indirect), (b) an income of \$6,500/year for the parking, and (c) an income of \$4,300/year for the maintenance. The same company that has proposed the construction of a hotel at White Beach – Brick & Steel Pty Ltd - has presented a project for the development of high rises behind the enlarging marina. Should the enlargement of the port be done in the proposed terms, it will be subject to environmental impact assessment (EIA), as this port expansion could affect beaches downstream. This issue is a source of conflict between Pleasant Port and White Beach.*

<b>Socio-economic profile</b>	
Population	13,000
Shoreline Length	12,000 m
Built-up shore	3,000 m
Carrying capacity (tourists)	26,000
Unemployment rate	6%
<b>Water Quality and environmental issues</b>	
PCB (Polychlorinated Biphenyl ng/l)	0,2
TBT (Tributyltin ng/l)	1,0
Mineral Oils (mg/l)	0,5 (no oil film)
Nitrates (NO <sub>3</sub> mg/l)	50
Heavy metals (mg/l)	
Total coliforms n /100 mg	2000

**Table 1. Example of data provided to students for one hypothetical location, Pleasant Port.**

### Example: Dugong Bay Catchment Authority – NRM Organization (table 2)

*Regional NRM organisations deliver, in partnership with the Australian Government Caring for our Country program, projects at the regional level to protect and restore the natural environment and*

biodiversity. The Federal Government funds and recognise 56 regions and regional organizations throughout Australia.

Further information: Australian Government Caring For Our Country: [www.nrm.gov.au](http://www.nrm.gov.au)

Regional examples:

SEQ Catchments (South East Queensland region [www.seqcatchments.com.au](http://www.seqcatchments.com.au))

Terrain (Wet Tropics): [www.terrain.org.au](http://www.terrain.org.au)

<b>Objective</b>	Managing and protecting natural resources for the region, including land, waterways and coastal areas
<b>Unacceptable outcome</b>	Develop and implement the regional NRM plan, implement a CoastCare program for the region
<b>Strengths</b>	Funding and support from the Federal Government, independent body, community support
<b>Weaknesses</b>	Lack of funds to undertake CoastCare programs
<b>Opportunities</b>	Get funds from private donors and Councils
<b>Threats</b>	Reduction of funding from the Federal government in the future

**Table 2. Summary table of one of the hypothetical stakeholder, Dugong Bay Catchment Authority.**

## RESULTS

In order to give a better understanding of the final outcome of the exercise, we provide below the final plan created as a collaborative exercise based on the group interaction and online work by groups on a Google Sheet after class (table 3).

<b>Specific outcome</b>	<b>Proposed activities or actions</b>	<b>Potential conflicts</b>	<b>Stakeholders involved</b>
1. Promote sustainable coastal erosion management practices	Introduce a Sand By-Passing Project on the Northern Side of Pleasant Port	Conflicts with south beaches users and stakeholders	Surf Life Saving Club, White Beach Council, Brick & Steel Pty Ltd
	Coastal erosion study for Dugong Bay	None	Black Carbon Pty Ltd
	Coastal engineering study and management plan to reduce the erosion for White Beach	Tourism attraction	White Beach Council

**Table 3. Results of the exercise in 2013 for one of ten specific outcomes of the CZM Plan created by the students using an online spreadsheet.**

The outcomes of the change in the teaching practice were very positive. All students had the opportunity to be in class – average attendance in person is about 50% during lecture hours- meet and interact with other students and the staff. Students also had a good time and the final SEC/SET

report showed that this was a great learning experience for them. The RPG was carried out again in September 2014. After the game, students were asked about their opinion on the RPG experience answering three simple questions. Results are shown in table 4. Most respondents, representing about 1/3 of the class, agreed with the positive role of the RPG.

	--	-	/	+	++	
	1	2	3	4	5	Total
Do you think that the Role Playing Game was useful to understand Coastal Zone Management practice?			3	18	4	25
Do you think that the Role Playing Game was useful to improve your communication and negotiation skills?			5	16	4	25
Do you think that the Role Playing Game is effective for learning about the real world in CZM or is it too abstract?		1	4	16	5	25

**Table 4. Results of the students survey, October 2014. – means “strongly disagree”, ++ means “strongly agree”.**

## CONCLUSIONS

The Role Playing-Game is a great addition to the curriculum of engineering, planning and science students, and should be considered for integration in the last 2 years of their degree. Broadly speaking, it should be part of the introduction of policy analysis as part of the engineering Curriculum, where students get a better understanding of issues and complexities of the real world.

## KEYWORDS

Civil engineering, stakeholder engagement, real world, wicked problems.

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## **Acknowledgements**

Prof Charles Lemckert and the Griffith School of Engineering for providing funding for teaching in the last 4 years.