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FACULDADE DE TECNOLOGIA
DEPARTAMENTO DE ENGENHARIA CIVIL E AMBIENTAL
PÓS-GRADUAÇÃO EM TECNOLOGIA AMBIENTAL E RECURSOS HÍDRICOS

REGULATORY IMPACT ASSESSMENT (RIA): IMPROVING GOVERNANCE ON THE WATER AND SANITATION AGENDA

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Regulatory Impact Assessment (RIA): improving governance on the water and sanitation agenda

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Thesis specially prepared to obtain the PhD Degree in Civil Engineering Research and Innovation for Sustainability

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REGULATORY IMPACT ASSESSMENT (RIA): IMPROVING GOVERNANCE ON THEWATER AND SANITATION AGENDA

BRUNO EUSTÁQUIO FERREIRA CASTRO DE CARVALHO

TESE DE DOUTORADO SUBMETIDA AO DEPARTAMENTO DE ENGENHARIA CIVIL E AMBIENTAL DA FACULDADE DE TECNOLOGIA DA UNIVERSIDADE DE BRASÍLIA COMO PARTE DOS REQUISITOS NECESSÁRIOS PARA A OBTENÇÃO DO GRAU DE DOUTOR EM TECNOLOGIA AMBIENTAL E RECURSOS HÍDRICOS PELA UNIVERSIDADE DE BRASÍLA.
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RESUMO

ANÁLISE DE IMPACTO REGULATÓRIO (AIR): INSTRUMENTO DE MELHORIA DA AGENDA DE GOVERNANÇA NO SETOR DE SANEAMENTO BÁSICO

Autor(a) : Bruno Eustáquio Ferreira Castro de Carvalho
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Palavras-chave: análise de impacto regulatório; governança; serviços de abastecimento de água e esgotamento sanitário
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As transições na forma de atuação dos Estados têm mudado significativamente, o que acarretou em alterações nos arranjos de suas intervenções. Nesse contexto, verifica-se a necessidade de mudança no padrão de atuação, tornando a intervenção regulatória um instrumento essencial da política pública. No entanto, falhas na estruturação de decisões tomadas por agentes públicos, muitas vezes pautadas por objetivos ocultos, têm causado ineficiência, descontentamento e falta de legitimidade nas intervenções governamentais. Sendo assim, a apresentação de justificativas baseadas em sólidas teorias pode promover o debate e colocar o tema da regulação e seus respectivos impactos em pauta no âmbito da academia, assim como em diversas áreas da sociedade e, fundamentalmente, entre os tomadores de decisão. Essa questão torna-se mais relevante, sobretudo nos setores de infraestrutura em que a falha na transação é característica presente afetando, de forma independente, a perspectiva do usuário, do prestador de serviços, do regulador e do poder concedente. É nesse contexto que surge a *"better regulation agenda"* (BRA), em que a Análise de Impacto Regulatório (AIR) ganha força como instrumento fundamental de suporte à decisão e melhoria da qualidade da intervenção, e como elemento propulsor da governança. Tendo em conta o cenário apresentado e a pertinência temática da agenda de regulação no contexto econômico atual, o presente trabalho de doutorado pretende contribuir para a literatura abordando (i) a teoria da AIR (utilizando meta análise combinada com a teoria de modelo conceitual), (ii) a aplicabilidade da AIR em casos práticos no setor de saneamento básico em Portugal e no Brasil (utilizando o *framework* desenvolvido, métodos analíticos e de consulta), (iii) a relação da AIR com a governança e a operacionalização do conceito no Brasil (combinação de meta análise, métodos de consulta e analíticos) e (iv) a questão da obrigatoriedade da AIR no Brasil à luz das discussões atuais (utilizando uma abordagem descritiva). Após a análise das 4 dimensões acima descritas, foi possível concluir que: (i) o modelo teórico de AIR deve ser flexível e adaptado a cada circunstância de aplicação; (ii) a combinação de métodos que dão suporte à sua aplicação com as respectivas justificativas tende a conferir maior robustez e legitimidade aos resultados; (iii) a relação entre AIR e governança implica num entendimento mais amplo sobre os benefícios da implementação da BRA e AIR, uma vez que pode impulsionar princípios regulatórios; e, finalmente, (iv) a discussão sobre a obrigatoriedade de RIA no Brasil é pertinente e

deve estar alinhada com as boas práticas e modelos conceituais ainda que não se tenha maturidade institucional e nível mínimo de governança instalado quer seja no nível federal ou subnacional.

ABSTRACT

REGULATORY IMPACT ASSESSMENT: IMPROVING GOVERNANCE ON THE WATER AND SANITATION AGENDA

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The way States interfere in the Water and Wastewater sectors has significantly changed, and so has their intervention agreements. In this respect, it is noteworthy to proceed with a change of pattern in the way those arrangements are conducted, which makes the regulatory intervention stand out as an essential public policy instrument. However, public agents fail to structure assertive decisions and this is reflected in inefficiency, dissatisfaction and lack of legitimacy of governmental interventions. Presenting decisions justifications – that are supported by solid theories – raise a discussion on this matter of regulations and their respective impacts, and lead to promoting a debate, at first academically, and later in different areas of society, that is, among decision-makers in the infrastructure sector, where failure directly and independently affects customers, providers, the regulator; and the State as owner. The better regulation agenda (BRA) emerges in this context, where the regulatory impact assessment (RIA) gains recognition as a fundamental instrument capable of supporting decisions that improve intervention quality, and governance. Regarding the current economic scenario and relevance of the regulation agenda, this thesis intends to contribute to the literature by approaching (i) the RIA theory (using meta-analysis associated with the conceptual modeling theory), (ii) the RIA applicability in practical cases in the water and sanitation sector in Brazil and Portugal (using a developed framework, analytical and consultancy methods), (iii) the relation between RIA and governance and the operationalization of its concept in Brazil (using a combination of meta-analysis, analytical and consultancy methods), and (iv) the mandatory adoption of RIA in Brazil in view of current discussions (using descriptive approach). After analyzing the four dimensions mentioned above, it is possible to conclude that: (i) the theoretical model of RIA must be flexible and adapted to each application circumstance; (ii) the combination of methods that support its application and respective justifications tend to grant more robustness and legitimacy to the results; (iii) the relation between RIA and governance implies a broader understanding of the BRA and RIA implementation benefits, once they can drive regulatory principles forward; and finally, (iv) the discussion on the mandatory adoption of RIA in Brazil is relevant and should be aligned with good practices and conceptual models, even though it does not have a minimal level of established federal or subnational governance neither enough institutional maturity.

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ABAR: Associação Brasileira de Agências Reguladoras

AdA: Águas de Alenquer

ADASA: Agência Reguladora de Águas, Energia e Saneamento do Distrito Federal/Water, wastewater and energy Regulator of Distrito Federal

AdC: Águas de Cascais

AdF: Águas da Figueira

AdL: Águas do Lena

AGEAC: Public Services Regulator of Acre State

AGENERSA: Water, wastewater and energy Regulator of Rio de Janeiro State

AGEPAN: Public services Regulator of Mato Grosso do Sul State

AGER: Public Services Regulator of Erechim-RS

AGERB: Public services regulator of Buritis

AGERGS: Public Services Regulator of Rio Grande do Sul State

AGERSA: Public Services Regulation of Cachoeiro do Itapemirim

AGIR: Public Services Intermunicipal Regulator

AGR: Water and wastewater Regulator of Tubarão

AIR: Análise de Impacto Regulatório

AL: Affordability level

ANA: Agência Nacional de Águas

ANA: Agência Nacional de Saúde Suplementar

ANAC: Agência Nacional de Aviação Civil

ANACOM: Autoridade Nacional de Comunicação

ANATEL: Agência Nacional de Telecomunicações

ANEEL: Agência Nacional de Energia Elétrica

ANP: Agência Nacional de Petróleo

ANTAQ: Agência Nacional de Transportes Aquaviários

ANTT: Agência Nacional de Transportes Terrestres

ANVISA: Agência Nacional de Vigilância Sanitária

ARCE: Public Services Regulator of Ceará

ARES: PCJ rivers Water basins Regulator

ARIS: Water and wastewater Intermunicipal Regulator

AR-ITU: Public Services Regulator of Itu

ARSAE-MG: Water and wastewater Regulator of Minas Gerais State/Agência Reguladora dos Servicos de Água e Esgotamento Sanitário do estado de Minas Gerais

ARSAL: Public services regulator of Alagoas State

ARSBAN: Water and wastewater Regulator of Natal

ARSEC: Public services Regulator of Cuiabá

ARSEMA: Public Services Regulator of Maranhão State

ARSEP: Public Services Regulator of Rio Grande do Norte State

ARSESP: Water, wastewater and energy Regulator of São Paulo State/Agência Reguladora de Saneamento e Energia do estado de São Paulo

ARSETE: Public Services Regulator of Teresina

ARSI: Water, wastewater and infrastructure Regulator of Espirito Santo State

ATC: Adequacy of treatment capacity

AWWA: American Water Works Association

BA: Benefit Analysis

BBCR: Belo Horizonte, Betim, Contagem and Ribeirão das Neves

BCB: Banco Central do Brasil

BHMA: Belo Horizonte Metropolitan Area (Belo Horizonte, Betim, Contagem and Ribeirão das Neves)

BMF: Bolsa de Valores

BRA: Better Regulation Agenda

CAESB: Companhia de Saneamento Ambiental de Brasília

CBA: Cost-benefit Analysis

CCIA: Climate Change Impact Assessment

CESAMA: Companhian de Sanamento Municipal de Juíz de Fora

CI: Confidence interval

CIA: Cultural Impact Assessment

CM: Conceptual Model

CMap: Conceptual Map

COPANOR: Serviços de Saneamento Integrado do Norte e Nordeste de Minas Gerais S/A

COPASA: Companhia de Saneamento de Minas Gerais

CRP: Core Regulatory Principles

CRS: Cantareira Reservoir System

CS: Continuity of service

CU: Current Unity

CVM: Comissão de Valores Imobiliários

CWWW: Complaints about W&WW services

DA: Decision Aid

DAEE: Departamento de Aguas e Esgoto de São Paulo

DC: Decision Conference

DJF: December; January; February

DM: Decision Maker

EC: European Commission

EIA: Environmental Impact Assessment

ELECTRE: Elimination and Choice Translating Reality

EPAL: Empresa Portuguesa de Aguas Livres

ERSAR: Entidade Reguladora dos Serviços de Águas e Residuos de Portugal

FCM: Framework Conceptual Model

FFWIL: Fulfillment of the water intake licensing

GDP: Gross Domestic Product

GIS: Geographical Information System

HIA: Health Impact Assessment

HRIA: Human Rights Impact Assessment

IA: Impact Assessment

IBAMA: Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis

IBGE: Instituto Brasileiro de Geografia e Estatística

IDB: Inter-American Development Bank

IED: Integral Euclidean distance

Infra: Infrastructure

INMETRO: Instituto Nacional de Metrologia, Qualidade e Tecnologia

INPE: Instituto Nacional de Pesquisas Espaciais

IPCC: Intergovernmental Panel on Climate Change

IQR: Interquartile range

ISI: Institute for Scientific Information

IST: Instituto Superior Técnico

LE: Legislative Evaluation

LNSB: Lei Nacional do Saneamento Básico

LT: Long term

MACBETH: Measured by Attractiveness through a Categorical-Based Evaluation Technique

MAUT: Multi-Attribute Utility Theory

MC: Modelo Conceitual

MCDA: Multicriteria Decision Analysis

MGS: Minas Gerais State

MRIA: Mandatory Regulatory Impact Assessment

NEPA: National Environmental Policy Act

NGT: Nominal Group Technique

NIS: Negative ideal solution

NIS: Negative Ideal Solution

NPC: No Policy Change

O&M: Operation and maintenance

OA: Operational Audit

OECD: Organization for Economic Co-operation and Development

PA: Physical accessibility

PDIA: Post-Disaster Impact Assessment

PIS: Positive Ideal Solution

PL: Projeto de Lei

PO: Policy Option

PPI: Programme for Investment Partnerships

PPP: Parceria Público Privada/Public-private partnership

PROMETHEE: Preference Ranking Organization Method for Enrichment Evaluations

PRO-REG: Programa de Fortalecimento da Capacidade Institucional para Gestão em Regulação

PWS: Portugal or Portuguese Water Sector

QSW: Quality of supplied water

QUALIFLEX: Flexible Multiple Criteria Decision-Making Method

RA: Risk Assessment

RAND: A research institution that initially focused on national security issues and later concentrated on scientific, educational, and charitable endeavors for public welfare

RCM: Resolução do Conselho de Ministros

RCP: Representative Concentration Pathways

RIA: Regulatory Impact Assessment

RMBH: Região Metropolitana de Belo Horizonte

SAAE: Serviço Autônomo de Água e Esgoto

SABESP: Companhia de Saneamento Básico do Estado de São Paulo

SAE/PR: Secretaria de Assuntos Estratégicos da Presidência da República

SCM: Standard Cost Model

SCS: Soil Conservation Services

SD: Sludge disposal

SDG: Sustainable Development Goals

SEA: Strategic Environmental Assessment

SEAE: Secretaria de Acompanhamento Econômico do Ministério da Fazenda

SEC: Standardized energy consumption

SEMA: Secretaria do Meio Ambiente do Distrito Federal

SIA: Social Impact Assessment

SMAP: Soil Moisture Accounting Procedure hydrological model

SNIS: Sistema Nacional de Informacoes sobre saneamento

SP: Stakeholder’s participation

SPMA: São Paulo Metropolitan Area

SRF: Simos’ Procedure

ST: Short term

TOPSIS: Technique for order preference by similarity to ideal solution

WLDS: Water losses in the distribution system

WS: Water Services

WWS: Water and Wastewater Services

WWU: Water and Wastewater Utilities

RESUMO EXPANDIDO

ANÁLISE DE IMPACTO REGULATÓRIO (AIR): INSTRUMENTO DE MELHORIA DA AGENDA DE GOVERNANÇA NO SETOR DE SANEAMENTO BÁSICO

As transições na forma de atuação dos Estados têm mudado significativamente e, ao mesmo tempo, acaretado mudanças nos arranjos de sua intervenção. Desde a dominância do Estado na provisão dos serviços, entre 1950 e 1970, com um planejamento voltado para o desenvolvimento, passando pela dominância dos mercados, com o planejamento voltado para resultados, entre 1980 e 2000 até o mundo contemporâneo em que as transformações ocorridas sobretudo, nos últimos anos, apontam para uma continua redução da atuação direta do Estado, verifica-se cada vez mais evidente o seu papel regulador em detrimento a um papel de produtor de bens e serviços, num planejamento que envolve a governança para resultados.

Isto não significou apenas um redesenho das fronteiras do Estado, mas uma mudança no padrão de atuação em que a intervenção regulatória torna-se essencial instrumento da politica pública para o alcance dos objetivos setoriais e estratégicos pretendidos. No entanto, a baixa dedicação dos agentes na análise de custos e benefícios da intervenção tem, ao longo do tempo, se traduzido em ineficiência alocativa. Com isso, a apresentação de justificativas, assim como das teorias que lhe dão sustentação colocam a regulação no centro de muitas questões atuais relacionadas às políticas públicas, depositando em debate, a forma e os impactos da atuação estatal. Isso se torna mais necessário quando verifica-se que nos setores de infraestrutura, de maneira geral dado, (i) a existência de monopólio natural; (ii) a separação entre atividades de geração/produção e distribuição; (iii) a estrutura de redes; (iv) a especificidade de ativos e custos irrecuperáveis e (v) os serviços com alta demanda e inelásticos ao preço, é possível que ocorram falhas na transação entre o prestador de serviços, o titular, o regulador e o usuário dos serviços, como o caso do saneamento básico.

É nesse contexto em que a busca por uma agenda de *Better Regulation*, onde se insere a Análise de Impacto Regulatório (AIR)[1], poderá não somente permitir um equilíbrio no sistema

[1]Nesse trabalho, a AIR, entre inúmeras definições que balizaram a construção do modelo conceitualc, refere-se a uma ferramenta de gestão que permite avaliar os impactos, sistematicamente, das passadas, presentes e futuras decisões dos governos (Estados Centrais e Reguladores). Para tanto, a AIR pode ser estruturada em quatro estágios: (i) *status quo, momento* em que se define a proposta, opções, critérios, descritores e indicadores para avaliação dos impactos; (ii) *avaliação, momento* em que se realiza a análise dos níveis de assunção da intervenção, das opções/alternativas e ganhos e perdas em distintos contexto de sensibilidade e robustez; (iii) *consulta, momento* em que se realiza todo o processo de legitimação da AIR, trazendo para a solução a transparência e participação e, (iv) implementação/revisão que consiste na transição da análise e respectivo resultado para a prática da atuação governamental. Trata-se de fato de um conceito "espiral" em que dado as características de sua aplicação pode e deve ser adequado, porém sempre em busca do aperfeiçoamento que se deseja com a atuação do Estado. Por último, tão importante quanto a definição, verificou-se ao longo do desenvolvimento do trabalho que a AIR tem funções para além da qualidade da regulação, entre as quais: (i) *accountability*, (ii) capacidade administrativa, (iii) *rule of law* e (iv) *open government*, detalhados no Capítulo 5 dessa tese.

regulatório e na intermediaçao dos interesses, mas dar mais racionalidade ao processo decisório, transparência e participação, legitimar o decisor e, ao mesmo tempo, possibilitar maior eficiência alocativa do investimento, além de um melhor entendimento de como a sociedade e os individuos serão afetados pela intervenção.

Muito embora tais discussões sejam recentes, a idéia da avaliação de impacto não o é. Os primeiros registros formais de sua utilização passaram pela análise de sistemas, pesquisa operacional e políticas públicas entre as décadas 1950 e 1970. Isso se aplica a AIR, ou seja, ela também não é recente. A história formal e explícita sobre AIR refere-se a inclusão da análise de custo-benefício na análise do impacto da inflação nos Estados Unidos há 47 anos atrás e, em seguida, pelo Canadá no final dos anos 1970. Na década de 1980, a AIR ganhou expressão por meio da Ordem Executiva nº 12.291 promulgada pelo Presidente Reagan com a finalidade de aumentar a coordenação e o controle regulatório pelo governo central. Seguidamente, Alemanha, Austrália, Reino Unido e os Países Baixos adotaram a AIR em meados da década de 1980. Atualmente, o número de países em que a AIR é considerada como requisito, no âmbito da OECD, tem se mantido estável. Fora do conjunto dos países membros dessa organização, entre economias emergentes e países em desenvolvimento, existem vários exemplos e tentativas de introduzir a AIR como uma avaliação sistemática do impacto de novas legislações ou regulamentações em curso num contexto de suporte e reforma pelos organismos multilaterais sobre racionalização de sistemas do licenciamento de negócios.

Trabalho recente realizado pela OECD, em 2015, complementado pela análise da literatura realizada nessa tese, mostraram que, embora a AIR esteja fundamentada legalmente, sua empregabilidade na prática ainda necessita de avanços. Quer seja no ambiente prático de tomada de decisões, quer seja no âmbito acadêmico, o debate atual em torno da AIR tem se intensificado, embora concentrado, não somente em função da capacidade do Estado realizá-la, mas fundamentalmente em relação a um melhor entendimento conceitual, metodologia, estrutura, aplicação e sua relação com a governança[2]. É nesse contexto em que se insere a presente tese de doutorado, motivada também, pelo cenário de intervenção do Estado na economia.

Isto posto, a presente tese de doutorado pretende contribuir para a literatura abordando em quatro dimensões: (i) o tema da AIR e a proposição de modelo conceitual (através da

[2] Nesse trabalho, a definição de governança refere-se a um processo sobre o qual os atores do "Estado e não-Estado" interagem para planejar, desenvolver e implementar políticas relacionadas aos setores regulados sob um certo regime regulatório (princípios e normas).

aplicação de meta-análise combinado com teoria de mapas conceituais), (ii) a verificação do modelo proposto no setor de abastecimento de água e esgotamento sanitário, em Portugal e no Brasil (através da combinação de métodos analíticos e de consulta), (iii) a relação teórica da AIR com a governança e, (iv) a obrigatoriedade da AIR no Brasil. As quatro dimensões foram desenvolvidas a partir de metodologias específicas e detalhadas em cada um dos capítulos que, na presente tese, correspondem a artigos científicos.

Para a primeira dimensão, a revisão da literatura a partir da meta-análise combinada com a ferramenta de construção de modelos conceituais foi utililizda para dar forma a uma proposta de modelo conceitual e de *framework* para a AIR. Na segunda dimensão, a verificação do modelo conceitual foi aplicada a partir de três estágios do *framework* da AIR desenvolvido: (i) *status quo,* (ii) avaliação e (iii) consulta adaptada ao contexto dos requisitos acadêmicos. Não foi realizada no presente trabalho nenhuma verificação ou acompanhamento dos resultados da implementação, dadas características do trabalho. Distintos métodos analíticos e de consulta (métodos de suporte a decisão) foram empregados ao longo dos estágios mencionados.

Como caso de aplicação da AIR, ainda na segunda dimensão, foram selecionados os países Portugal e Brasil em função da origem do trabalho, acesso aos dados e capacidade de envolvimento dos atores no processo de verificação do *framework* da AIR.

No caso de Portugal, embora não se tenha registro de aplicação da AIR, mesmo com a existência de diretrizes legais, a utilização dessa ferramenta centrou-se na necessidade de avaliar os impactos do Decreto nº194/2009 num contexto de distintos objetivos dos serviços de água “em baixa” (dos reservatórios públicos urbanos às residências) prestados pelas concessionárias por meio de um arranjo de parcerias público-privadas (PPPs). Nessa aplicação uma profunda participação com envolvimento da Entidade Reguladora dos Serviços de Águas e Residuos de Portugal (ERSAR), Tribunal de Contas, empresas prestadoras de serviços e representantes das localidades foi realizada para o desenvolvimento da proposta de AIR. A combinação de Delphi com o método multicriterial TOPSIS (*Technique for Order Preference by Similarity to Ideal Solution*) foi empregada de modo a atender a complexidade do problema. No presente caso, restou evidente a contribuição do referido Decreto nº194/2009 quando comparado com um cenário de “não se fazer nada”, no entanto, a assimetria de satisfações quer seja usuário, prestador e titular também ficou evidente. Ainda, uma análise comparativa em termos de objetivos pretendidos com o Decreto nº194/2009 resultou na necessidade de se avaliar a componente de que trata a sustentabilidade econômica da prestação dos serviços, seguida pela proteção dos interesses dos usuários e, finalmente, do meio ambiente.

Para o caso do Brasil, ainda que não se tenha verificado registros de uso da AIR, sobretudo no setor de saneamento básico e, embora o Programa de Fortalecimento da Capacidade Institucional para Gestão em Regulação (PRO-REG) tenha se proposto a introduzir e estimular um sistema de AIR, a aplicação se deu no contexto da avaliação da Resolução nº08/2016 no que tange as metas propostas pela Agência Reguladora de Águas, Energia e Saneamento Básico do Distrito Federal (ADASA-DF). Para tanto, levou-se em conta distintos perfis de atratividade em função da perspectiva, se usuário, regulador ou prestador de serviços para, então, avaliar o impacto das opções apontadas pela sua respectiva Resolução nº08/2016, bem como aquelas obtidas a partir de influência estatística, considerando os critérios definidos pela referida resolução. A combinação de método de consulta com o método multicriterial MACBETH (*Measuring Attractiveness by a Category Based Evaluation TecHnique*) foi escolhida dada necessidade de se avaliar a sensibilidade e robustez requerida por um problema em que a alternativa estava para entrar em vigor, o que requer um melhor entendimento da hierarquização das opções regulatórias. De modo geral, os resultados das alternativas se mostraram distintos a depender da perspectiva. Sob a perspectiva do usuário e regulador, a melhor alternativa presente na própria Resolução nº08/2016 foi a de “longo prazo” (LT) em comparação com a de “curto prazo” (ST) e também ao fato de “não se fazer nada” (NPC), o que de fato deve interagir com os planos de investimento do setor pelo Prestador.

No caso da aplicação da AIR na região metropolitana de Belo Horizonte (RMBH) (em quatro localidades, Belo Horizonte, Betim, Contagem e Ribeirão das Neves), essa centrou-se nas avaliação de impacto de opções regulatórias para solucionar o *gap* de conexões domiciliares em relação a presença da rede de esgotamento sanitário num contexto *ex-ante* e também com distintos objetivos (i) proteção dos interesses dos usuários, (ii) sustentabilidade econômica e (iii) proteção do meio ambiente. A presente verificação contou com um *focus group* composto por representantes da Agência Reguladora dos Serviços de Abastecimento de Água e Esgotamento Sanitário do estado de Minas Gerais (ARSAE-MG), do prestador de serviços, outras representatividades locais, acadêmicos e um analista para a implementação do método. O método MACBETH foi utilizado na sua plenitude, explorando, inclusive, a relação custo-benefício das opções em relação aos agrupamento dos objetivos pretendidos traduzidos em benefício agregado. Como resultante do processo, verificou-se que a aposta em uma opção regulatória intermediária de alcance dos serviços, ou seja, expansão dos serviços até (75%)

apresentou benefícios similares a proposta de “universalização” para o mesmo período entre 2017 e 2026. A aplicação da AIR no presente caso contou com a formalização de um instrumento de cooperação e transferência de conhecimento entre a Universidade de Lisboa, e a referida ARSAE-MG, sem o qual não teria sido possível a realização de profunda análise.

No último caso de aplicação no Brasil, ainda que diferente das demais, a AIR foi utilizada como *frame* de suporte a avaliação de impacto de como as mudanças climáticas, os recursos hídricos poderiam estar refletidos na modelagem tarifária levando em conta a intervenção da Agência Reguladora de Saneamento e Energia do estado de São Paulo (ARSESP) (programas de bônus e penalidade) no período de crise hídrica na Região Metropolitana de São Paulo. Na presente avaliação restou evidente, questões de planejamento, envolvimento das partes interessadas e questões relativas a melhoria da estrutura tarifária não foram levadas em consideração. A análise desse caso contou com apoio do Instituto Nacional de Pesquisas Espaciais (INPE), Agência Nacional de Águas (ANA) e Secretaria de Assuntos Estratégicos da Presidência da República (SAE/PR).

De modo geral, respeitando as particularidades de cada caso de aplicação, tanto em Portugal quanto no Brasil, verificou-se que as restrições de contorno para o desenvolvimento da AIR se assemelham na dificuldade obtenção da informação, no desconhecimento da AIR, porém se diferenciam com relaçao a qualidade da informação e nível de maturidade do *enforcement* do regulador em relação ao prestador e outras instâncias de governo observada nas relações institucionais e, como consequência, a capacidade de trazer para a realidade os potenciais resultados da AIR.

Na terceira dimensão de contribuição, a combinação de revisão da literatura sobre AIR e governança resultou no desenho de principios centrais de governança (*Core Regulatory Principles – CRPs*[3]), que relacionam ambos temas dessa tese de doutorado. Muito embora a literatura tenha discutido os limites da AIR, ao confrontar-se com sua capacidade em impulsionar a governança a partir dos CRPs, verificou-se, analiticamente, que a AIR entre outros pode: (i) permitir validar que a atuação do regulador se dê sobre os limites legais de sua função técnica cumprindo com requisitos legais e constitucionais; (ii) realçar o *accountability*, ou seja, em função da percepção geral de que os reguladores são obrigados, como uma questão de boa governança, justificar decisões e serem responsáveis pela conduta no processo de regulamentação; (iii) permitir colaboração que maximise o *open government* como claro

[3] CRPs refere-se a normativos centrais que orientam o regime regulatório. Sobre uma perspectiva legal, os CRPs caracterizam o regime regulatório sendo, no presente trabalho, composto por: (i) capacidade administrativa, (ii) *accountability*, (iii) *open government* (transparência e participação), (iv) qualidade regulatória e (v*) rule of law*.

entendimento de que o envolvimento das partes interessadas legitimam e, ao mesmo tempo, enriquecem os resultados da AIR; (iv) melhorar a qualidade regulatória dado que essa seria a motivação central de aplicaçao do referido instrumento e, por último; (v) impulsionar a capacidade administrativa dado que a AIR requer minimamente recursos das diversas naturezas, podendo ser comprometida em função da existência ou não desse recurso.

Ainda nessa dimensão, procurou-se ato contínuo a essa revisão da literatura, a operacionalização de tais conceitos utilizando-se de consulta a especialistas no tema para construção dos critérios relacionados aos CRPs. Adicionalmente, utilizou-se suporte da Associação Brasileira de Agências Reguladoras (ABAR) para obtenção das informações junto aos reguladores. A presença dos CRPs, ou seja, de nível de governança relacionado a AIR foi verificada junto a 23 reguladores do setor de saneamento básico a partir de um total de 45 convidados a participar. Para tanto, utilizou-se o *Elimination and Choice Translating Reality* (ELECTRE-TRI) com o objetivo de categorizar os reguladores. De modo geral, a análise resultou em significativa heterogeneidade de nível de governança, com extremos de “boa presença de governança” em São Paulo, passando por Rio Grande do Sul, Minas Gerais e Ceará até níveis mais baixos como o caso do Acre e Maranhão. Uma análise de sensibilidade foi realizada e mostrou que, partindo do pressuposto que a AIR impulsiona os CRPs, melhorias em tais principios são capazes de impulsionar 9 reguladores da amostra a patamares superiores conforme parametrização proposta para as categorias de governança descritas.

Finalmente, na quarta dimensão, pretendeu-se com uma abordagem mais descritiva, e levando em conta a relação da AIR com a governança, avaliar o cenário institucional em que a obrigatoriedade da AIR está sendo discutida no Brasil, mesmo num ambiente em que ainda persiste o *gap* de governança quer seja no nível federal quer seja no subnacional, conforme abordado na terceira dimensão de análise nesse capítulo. A revisão de literatura especifica sobre documentos que tratam da tentativa de adoção da AIR levou ao entendimento de que a discussão em torno do fenômeno da agencificação no Brasil, combinado com as tentativas via Projeto de Lei (PL) nº52/2013 e nº1539/2015, bem como consulta pública aberta recentemente pela Casa Civil da Presidência da República no tema, apontam para: (i) conflito entre a tradição legal administrativa e a reforma regulatória, que leva a uma incompleta transição da intervenção do Estado regulador; (ii) a existência de baixa capacidade regulatória que leva a um uso limitado de ferramentas de suporte a decisão agravado no nível subnacional e (iii) as competências desfocadas que levam a supervisão e controle inadequados. Isso posto, não restam dúvidas das capacidades, já discutidas da AIR, em impulsionar o ambiente de governança, o que torna a sua obrigatoriedade um requisto para que o nível federal possa influenciar o nível subnacional fortalecendo o papel do regulador no exercício de sua função regulatória e controle social atenuando a percepção de ilegitimidade na elaboração de regras no âmbito do regulador.

A limitação relativa as dimensões 3 e 4 se deram em função da inexistência de literatura empírica na relação entre AIR e governança, na aquisição de dados para formação de critérios e operacionalização do método, bem como a lacuna de produção científica atual sobre a AIR.

Para além das limitações apresentadas, verificam-se ainda lacunas de conhecimento não capturadas pelo presente trabalho, entre as quais a necessidade de: (i) investigar a teoria sobre pesquisa operacional e identificar métodos complementares que apoiem o processo de AIR, (ii) investigar potenciais e complementares viéses, bem como técnicas de minimização ou correção que influenciam o processo de decisão, (iii) aplicar quali-quantitativamente a AIR, em setores de serviços dependentes da regulação de recurso natural, (iv) aplicar a AIR para avaliação do excesso regulatório "*red tape*", (v) investigar como potenciais informações que suportam a AIR *ex-ante*, influenciam os resultados finais a partir da análise de séries de dados, estatística entre outros e (vi) investigar possíveis (des)motivações que podem (des)estimular a adoção de AIR na cultura das instituições para além do explorado nessa tese.

CHAPTER 1. INTRODUCTION

1.1 THE CONTEXT OF THE STUDY

The current experience suggests that the changes that took place in the past few years, especially after the financial market collapse in 2007, have caused the Government to indirectly intervene in the infrastructure sector assuming the role of a regulatory State (Marques, 2011) in order to achieve its their sectorial objectives (Sustein, 2003).

Financial constraints require a more extensive involvement of private sector agents which brings many opportunities, but it also has some risks that the regulatory State needs to manage (Weigrich et al., 2017). In fact, without a regulatory and coordinator role of governments, infrastructure investment would simply not happen (Weigrich et al., 2017). Moreover, in an Era of Governance, the legitimacy of public decisions can be improved when accountability mechanisms, open government, administrative capacity, regulatory quality and rule of law work effectively.

Additionally In addition to the situation described above, policymakers do not often focus on assessing the losses or neither the benefits of their interventions, which frequently result in significant ineffectiveness and inefficiency, creating several opportunities for corruption practices that compromise the public goals: (i) distorting spending structure, (ii) inflating prices, and (iii) delayed and low-quality provision and non-competition of services (Fazekas et al., 2013).

In order to remedy this situation, the Organization for Economic Co-operation and Development (OECD), the European Commission (EC), the World Bank and scholars on this matter pointed out a Better Regulation Agenda (BRA) and Regulatory Impact Assessment (RIA) as central elements of the regulatory system that can support governments' decision makingmake decision based on evidence and also ensure a good understanding of how individuals and society will be affected by regulation (Radaelli, 2004).

Since the 1960s several specific forms of impact assessment (IA) have been adopted worldwide to address the outcome of policies based on a scientific, social, economic and environmental analysis. Nonetheless, each one has its own particularities as per scope, methodology, approach, implementation, and more importantly: a different rationale behind their adoption. Probably the most successful – and well known one – is the environmental impact assessment (EIA) firstly introduced in the U.S. in 1969 to assess possible impacts of enterprise activities in the environment. Currently, EIA is employed across the world with a relevant emphasis on biophysical, economic and social impacts (Taylor et al., 1990).

Regarding RIA, its notion comes from the North American experience and it is not recent (Figure 1.1). Some Anglo-Saxon countries, for example, Canada, in 1978; Australia and the U.K., in 1985; and New Zealand, in 1995 adopted RIA as a recommendation of OECD. The second group, consisting of Austria, Belgium, Finland, France, Iceland, Ireland, Italy, Korea, Mexico, New Zealand, Norway, and Switzerland was motivated by the agenda of "improving the quality of government regulation" and enacted requirements for appraising the impact of regulations. In 2001, another important year for RIA's popularity, a promotion of BRA and RIA spread within the European political agenda, e.g., White Paper on Governance by the European Commission (2001). Later in 2002, the European Administrative State began to focus on promoting administrative and regulatory reforms, e.g., in Bulgaria, Greece, Lithuania, Portugal, Romania and so on (De Francesco, 2010). Indeed, the number of countries that adopted RIA is now stable.

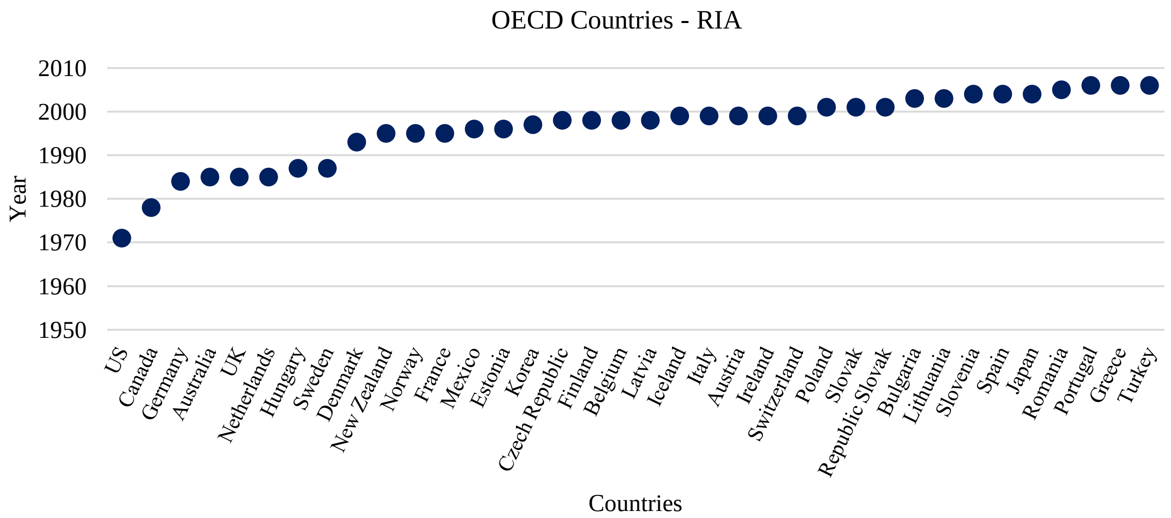


Figure 1.1 – Cumulative frequency OECD countries (Source: OECD, 2015; 2012).

Outside OECD countries, among emerging economies and developing nations, there are several examples of attempts to introduce RIA as new legislation or existing regulation

(Renda, 2014). In these countries, RIA is based on the approach that was originally developed in the 1980s by OECD (Kirkpatrick, 2016). In many cases, RIA has also been adopted as part of donor-financed projects and programs. By 2009 some form of RIA has been used in, at least, 50 developing countries, a number that should have increased since the last survey (World Bank, 2010), including Brazil.

Undeniably, despite being a milestone in evidence-based policymaking, the effective RIA's implementation in all OECD countries – and elsewhere – it still seems challenging, and its effective adoption requires compatibility between such a regulatory innovation and the institutional setting (World Bank, 2017; De Francesco, 2016; Renda, 2014). Moreover, debates concerning RIA have intensified around the world, not only in terms of state capacity and governance but also concerning its better understanding, methodology, strengths, weaknesses, opportunities, threats and governance into policy issues.

RIA's popularity and benefits had attracted researchers' interest in this issue, though they have also been concentrated on some particular subjects, e.g., social sciences, administration and economy, controlled by small group of RIA scholars (Chvalkovská et al., 2013), as well as its applicability (primary or secondary legislation) that can contribute to keeping this discussion far away from subnational and local utilities sector (Figure 1.2) as the case of this thesis.

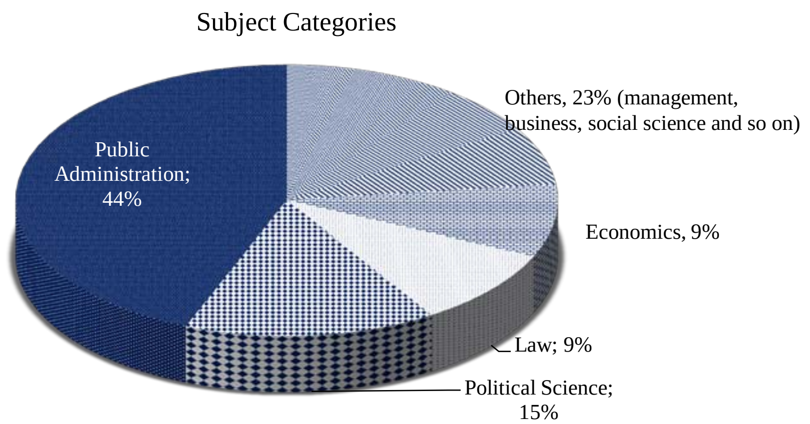


Figure 1.2 – Subject categories of the studies surveyed on RIA.

Moreover, there is no developed RIA method that, for most countries, can be practically mainstreamed for a relevant and timely policy analysis. In this sense, questions such as: (i) 'what are the costs of regulation?' or 'how can they be measured?', and example bias such as:

(ii) focus on costs and benefits rather than the need for government intervention, (iii) focus on analysis rather than public debate, (iv) focus on attempt to finding 'the right answer' rather than rejecting the worst solution and the unnon clear relation of RIA's contribution to the governance agenda are a major challenges to overcome. Indeed, because of the perverse incentives and a discreet relevance of RIA, policymakers do not wait to see the quantitative results before they make decisions, which results in ineffectiveness and inefficiency of ongoing or new regulations (Jacobs, 2016).

Keep this discussion in mind, the need to invest in the RIA approach requires: (i) to establish a clear conceptual, rational and participatory framework considering different perspectives including customers, providers and politicians, (ii) to verify RIA in diverse sectors and (ii) to establish the link between the theory of governance and (iv) the RIA's advantages and limits. This proposed approach, in which the theoretical and empirical literature provision on the matter is unprecedented demands: (i) an additional comprehensive research to verify theoretical models, (ii) the available tools, data, interaction with experts and applicability, (iii) a comprehensive theoretical link between RIA and governance, data and its operationalization and, (iv) the theoretical and practical reasons to support a mandatory RIA, as an example, in Brazil where the discussion in on the "table". This process shows how multidisciplinary this subarea of knowledge is. To explore RIA in such a manner, the author and supervisors chose to study Portugal's and Brazil's case studies to attend handle the regional aspects in which the project was inserted, as detailed bellow.

In Europe, as mentioned before, BRA aims to ensure that (i) decision-making is open and transparent, (ii) citizens and stakeholders can contribute throughout the policy and law-making process, (iii) EU actions are based on evidence and understanding of impacts, and (iv) regulatory burden on businesses and citizens is kept to a minimum. In 2006, RCM no.64/2006 (Resolução do Conselho de Ministros, in Portuguese) defined RIA as mandatory for all primary laws in Portugal, although there is no record of RIA in practice (Ferreira, 2009). Also, in 2006, the "Simplex" Portuguese administrative program was designed to create a rational approach in administrative procedures. RCM no.95-A/2015 assured that the adoption of legislative acts is approved if accompanied by the necessary regulations for its effective implementation. In 2017, the RCM no.44/2017 approved RIA as an (ex-ante) model in a context of "think small first" of the Small Business Act initiated in Europe. Despite the mentioned legal requirements due to since Portugal beinghas been a member of OECD countries, the RIA register found in the literature was about theory regarding the utility sector through the national authority of communication (ANACON, in Portuguese). However, this case study was just for the training and development of an organizational culture on RIA.

Focus on the water sector (WS) in Europe, although the adequate provision of water and waste water services (WWS) continues to be an essential requirement for protecting public health and maintaining basic living conditions, many countries have suffered a radical evolution motivated by economic constraints that have transformed the relationships among stakeholders (public and private arrangements) (Massarutto et al., 2013). Such a situation has brought the need for more studies: (i) to overcome the obstacles of governance and (ii) to improve the quality of regulations considering the rationale, transparency, accountability and a structured procedure in which RIA should be inserted.

In the Portuguese water sector (PWS), based on the current legal framework review of public water supply, wastewater and municipal waste (Law no.194/2009), the applicability of a 'framework conceptual model of regulatory impact assessment' (FCM-RIA, hereafter) provides a unique opportunity to observe a nationwide multi-target experiment of regulatory appraisal to make an overall assessment of its outcomes focused on water retail services and public-private partnerships (PPPs).

Even though, as OECD noticed in 2008, "Brazil does not use RIA systematically", the framework of the Program for the strengthening of the institutional capacity for regulatory management (PRO-REG) intends to introduce the RIA system in which the implementation asks for more joint effort among agencies (Castro, 2014), under a central and strong body and more powerful and acknowledged by stakeholders. In this respect, there is also an opportunity to develop the RIA approach based on a conceptual and framework model, besides the learning processes of its applicability in Brazil WSS sector.

In Brazil, three case studies were selected based on the relevance of the intervention in WSS, (i) data available, (ii) pertinence, (iii) and the interest of decision-makers in each situation. In Brasilia, the capital of Brazil, the RIA approach focuses on evaluating the targets proposed by the state water, energy and wastewater regulatory agency (ADASA) considering different interaction under customers', regulator and provider's perspective. In a small group of cities in Belo Horizonte metropolitan area (BHMA), RIA was employed in a partnership with the state water and wastewater regulatory agency (ARSAE-MG) as an ex-ante instrument to support the discussion regarding the impact of household connection’s gap on public network systems. Complementarily, the RIA framework was adopted in a quali-quantitaive way to interplay the instability of environmental phenomena, water supply, and demand observing ARSESP’s intervention between 2014 and 2016.

Additionally, to close the interaction between RIA with WSS in Brazil, core regulatory principles (CRPs) are used to evaluate the presence of governance into the Brazilian subnational regulators. Finally, the institutional setting in Brazil was evaluated with respect to the current discussion that a “mandatory” RIA (MRIA) could be an appropriate policy, despite the weak governance environment.

It is the author’s belief that what was succinctly presented above adds up and makes the topics of this thesis quite relevant and timely. Moreover, the potential outputs of this work might contribute positively to shed a light on the discussion regarding regulatory State, making it a valuable important piece of work. The author hopes that the current thesis provides a useful resource for regulators, state and local governments, especially considering the governance and the society’s growing pressure for the quality of services, transparency, participation, accountability and equality.

1.2 DEFINITIONS’ ADOPTED

There is no uniformity in the academic literature about both concepts of "regulatory impact assessment" and "governance".

In fact, RIA conceptual and framework model may vary from author, country, level of government and/or international organization (Carvalho et al., 2017a; Adelle et al., 2015; OECD, 2015; Staroňová, 2014; Jacob et al., 2011; Radaelli, 2004). In the title of the thesis, “regulatory impact assessment” (RIA) mainly stands for a policy tool that systematically evaluate the potential impact arising from government regulation and allows broad collaboration with stakeholders (Carvalho et al., 2017a). Terms and conditions for implementation of RIA are based on a giving institutional setting as detailed in administrative requirements under which the RIA procedure will be determined, usually comprising four stages: (i) determination of status quo, (ii) assessment, (iii) consultation and (iv) review

(Carvalho et al., 2017a). As pointed out before, RIA is not recently and variesying a great deal from one country to the next, so as well its supervision that is reflected in different levels of application, if all types of regulations, major regulations and primary law. In the Portuguese case study, RIA was adopted in a context of primary law enacted by the Presidency of the Republic. Conversely,on the other side, in Brazil, RIA exercise was tested in a context of subnational regulations.

The idea that good governance is particularly important in the public sector is fairly recognized by the literature (Bevan and Hood, 2005; Osborne, 2006), the other motivation's word in the title of the thesis. The notion of governance tends to be associated with a mode of governance so-called "regulatory state" (King, 2007; Scott, 2004; Majone, 1996). Such relevant mode of governance encompasses rule making, monitoring, and enforcement of administrative rules and impartiality intervention (Heritier & Rhodes, 2011; Rothstein & Teorell, 2008; Scott, 2004). In fact, one can refer to regulatory governance as the governance of regulatory regimes (or, the "governance of regulation" as opposed to "governance by regulation" (Levi-Faur, 2011). Here, governance was referred as the process under which state and non-state actors interact to design and implement policies related to utility regulation (the policy) under a certain regulatory regime (formal and informal norms, principles and tools).

As discussed before, the connection between RIA and governance was associated with the idea that RIA is about embedding good governance into the rule-producing machinery of government to improve its decision-making quality (Adelle et al., 2015). Moreover, as noted in recent studies, governance systems establish the rules guiding the adoption of RIA but each element of the system affects the RIA process itself (Berg, 2013; Meuleman, 2014). Moreover, a related approach to regulatory governance appears in the OECD (2012, 2011, 2010, 2000) documents since the 2000s under which regulatory governance "is concerned with the design and implementation of regulation as well as with ensuring compliance". Thus, RIA can contribute to regulatory governance beyond the internal managerial dimension of the administrative machinery. In fact, governance is "tangible" and the best way to measure governance performance can be by objective evaluation of the outputs (Rotberg, 2014). This situation calls for the need to create a link between governance and RIA through the common principles or, in other words, core regulatory principles (CRPs). CRPs translate core normative values of a giving regulatory regime. From a legal perspective, CRPs provide the foundation of regimes and set their main characteristics. As they are general statements under the form of legal norms, CRPs may be enforceable. From a managerial perspective, CRPs translate the pillars under which regulatory governance is construed to direct the outcomes of a given regulatory regime.

Finally, to deal with the proposed definitions, in theory and practice, a mix of tools were adopted to allow not only to test the RIA conceptual and framework model in all stages in the proposed case studies on WSS, but also to evaluate and compare governance practices across Brazilian subnational regulators within a regulatory environment that would be extremely helpful.

1.3 THESIS SCOPE AND OBJECTIVES

Taking into account that:

- Decision makers (regulators) have made interventions regardless of new or existing regulations without a clear idea of positive and negative effects;
- Despite the fact that RIA's requirement is still concentrated on OECD countries, some attempts to strengthen the public sphere and reduce patronage have been made in developing nations, even though they frequently dependent on donor support;
- RIA enhances the evidence base, consequently improving the decision-making process, especially concerning utilities' multiple objectives, e.g., WSS;
- RIA influences the design and implementation of governance environment and vice-versa;
- RIA promotes transparency by improving the stakeholders' representation;
- RIA studies are still concentrated among some scholars and in particular areas of knowledge; and
- RIA's practice is increasing, although it is focused on traditional and central sectors.

This project, which was jointly developed by the University of Brasilia and the University of Lisbon (co-tutorage program), intends to contribute to the literature by encompassing four major concerns (as mentioned in Section 1): (i) the standardization of a RIA conceptual and framework model, (ii) the verification of RIA in a WSS background in Portugal and in Brazil, (iii) the definition of the link between RIA and governance (the operationalization of the concept link) and (iv) a MRIA in Brazil.

In Chapter 2 of this thesis, background, theory, methods, strengths, weaknesses, opportunities and threats of the RIA method are analyzed involving several studies surveyed about that matter. The objective was: (i) to examine the literature on RIA and (ii) to develop a conceptual and framework proposal model to support the discussion of the thesis.

Regarding Chapters 3 and 4, the intention was to test whether the proposed RIA framework was capable of assessing the multiple dimensions of (i) the impact of Law no.194/2009 in the PWS (ex-post) exploring consultation methods, multicriteria decision analysis modeling, and also techniques to reduce bias; (ii) the impact of Resolution no.08/2016 regarding the proposed targets to the water services in Brasília; (iii) the impact of household connection's gap to public network wastewater systems in BHMA; and support the assessment of (iv) the interplay between 'natural resources management and services' provider' motivated by the ARSESP's intervention during the drought period between 2014 and 2016.

In Chapter 5, the first step was to find the link between RIA and governance, reviewing the several studies in the literature with provision of experts' opinions. After that, it was operationalized within the subnational regulatory environment with support of the Brazilian Association of Regulatory Agencies (ABAR). A total of 45 regulators were invited to join that process. Finally, the Brazilian institutional setting was evaluated with respect to the existing arguments about adopting or not a "mandatory" RIA in Brazil.

Following those points previously discussed, the general objective of this project is to:
Analyze the theory of RIA and verify its applicability and capacity to improve the level of regulatory governance.

In a specific way, the secondary objectives are:

- To establish a standard, and set a flexible conceptual framework model for RIA;
- To evaluate the impact of legal review (Law no.194/2009) in the Portugal water sector focused on public-private partnership (PPPs) based on the RIA approach;
- To evaluate the impact through RIA approach in Brazil according to each proposed case; and
- To ponder on the link between RIA and governance that determines the condition under which RIA or MRIA takes place.

It is expected that this project achieves important conclusions and possible applications of the results obtained in the analysis of ongoing or new regulations by WSS policymakers, filling the unprecedented gap between RIA's theory and its practice, with relevant contributions to the national and international literature.

Finally, to access the data required in this project and fully understand all the perspectives addressed in this thesis, the author had to do a good deal of research on internet sites; visit public organs, such as regulators, audits and providers; and participate in meetings and discussions' group with players of RIA.

1.4 METHODOLOGY

Each of the four concerns of this thesis involved their own methodological approach. The main research methodology adopted in every paper is thoroughly described in the respective Subsection of the Chapters and Subchapters. Therefore, the current introduction briefly mentions the main strengths and limitations of the methods.

Chapter 2 asserts the state of art review combined with the proposed model of RIA citing several reference studies. It implemented meta-analysis to (i) identify the trend concerning publications on RIA, and (ii) to extract the theory and definitions that support the discussion about its conceptual and framework model (CM & FCM-RIA). Critics of this research strategy often argue that "literature review" on this specific issue is only appropriate for the exploratory phase (Yin, 1994). However, Figure 1.3 proved that the investigator follows a systematic procedure and does not allow biased views to influence the direction of findings concerning CM & FCM-RIA and neither its application to the work. This chapter was contextualized with the existing papers, books, thesis, guidelines and multilateral reports.

Chapter 3 relies on RIA framework application in the PWS to evaluate the impact of Law no.194/2009 on public-private partnerships (PPP). In general, this RIA approach takes into account three steps: (i) the status quo, scenarios, and perspective; (ii) assessment; and (iii) consultation. Specifically, the link between the objectives of Law no.194/2009 which determine the regulatory framework in the PWS and its criteria was framed by Delphi technique in an innovative way, that is, under a different perspective that considers the customers, municipalities or concessionaires along the process. Additionally, Subsection 3 of

Subchapter 3.1 provides a summarized discussion regarding the Delphi technique and bias in the policy-making process. Regarding the assessment step, it was developed by technique in order of preference by similarity to the ideal solution (TOPSIS) modelling method for solving a multi-attribute decision-making problem, as the case of the referred law. Subsection 4 of Subchapter 3.2 offers the RIA's application in detail and a particular discussion about the multicriteria decision analysis (MCDA).

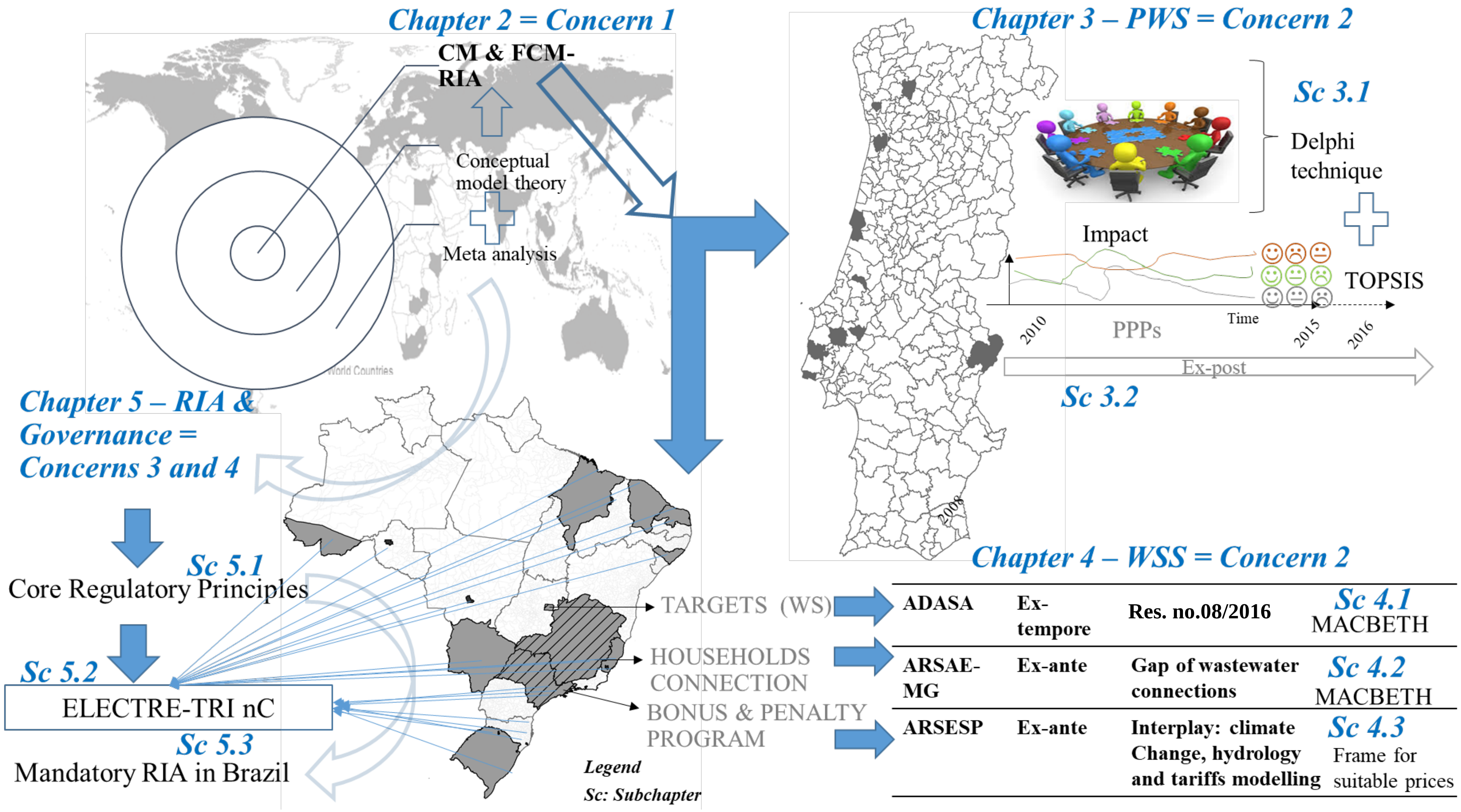


Figure 1.3 – Proposed methodology.

Chapter 4 proposes the RIA application to assess existing regulation in Brasilia and SPMA and a potential legal mechanism in the Belo Horizonte metropolitan area (BHMA)[4].

Subchapter 4.1 sets RIA by focusing on (re)thinking the new targets of the water sector in Brasília, under different perspectives: customers', regulator', and provider'. Here, the current alternatives and criteria were extracted by the Resolution no.08/2016 enacted by ADASA. The impacts of each option were assessed by attractiveness through a categorical-based evaluation technique (MACBETH) combined with the judgment by decision makers (DMs) who represented the customers', the regulator's and provider's points of view.

Facing the lack of coverage in wastewater services, the regulatory policy options were appraised through the following objectives: (i) protect customers concerning social aspects, (ii) safeguard economic, operational and infrastructure sustainability, and (iii) protect the environment. Subsection 4 discusses the methodology approach using the MCDA modeling method (MACBETH) with its sensitivity and robustness analysis and cost-benefit function to support the discussion around an adequate solution. The data required for this research was provided by ARSAE-MG due to an official partnership between the IST (Instituto Superior Técnico de Lisboa, in Portuguese) of the University of Lisbon and ARSAE-MG.

In both case studies mentioned before (see Subchapter 4.1 and 4.2) "do nothing option" was developed by statistical influence, although limited to the scope of the analysis. Moreover, the need to consider crucial stakeholders' opinion led to a different approach with the support of a PhD candidate and the Supervisors. The aim was to develop a common understanding of the issues at hand and an "on-the-spot" decision analysis model in each case study.

At the end of Chapter 4, Subchapter 4.3 tries to propose a frame for suitable prices (available resources, utility costs, water tariffs, and demand) and a quali-quantitave impact of a such proposal motivated by the ARSESP's approach in 2014 and 2016, when SABESP, had made few investments in order to reduce the area (population) supplied by Cantareira reservoir system (CRS), and the water leakage when SPMA faced a major water crisis. In Subsection 2 of Subchapter 4.3, climate and hydrological models can provide the required inputs to RIA framework where tariff design takes place. Subsection 3 provides a brief discussion regarding (i) the initiatives that can improve the resilience of water systems and communities, (ii)

[4] Focus on Belo Horizonte, Betim, Contagem and Ribeirao das Neves.

disaster response and (iii) recovery as well as how to decrease economic losses. Here, the main idea was to focus on the rationale to scarcity avoiding random and arbitrary reasons.

Chapter 5 was developed on the belief that (RIA) is about embedding good regulatory governance into the rule-producing machinery of government in order to improve the quality of decision-making (Adelle et al., 2015). Governance, in a broad definition, covers not only the processes of decision-making but also the related institutions, instruments and the roles of non-governmental actors (Meuleman, 2014). Thus, RIA can be understood as an important instrument of governance, although the main issue is how to connect them in a productive way.

On Subchapter 5.1 the literature review on governance principles related to RIA was developed and combined with the opinion of experts regarding to what extent the RIA model may improve overall regulatory governance and overcome RIA's own limiting factors. The experts were selected based on academic and professional experience with RIA and/or regulatory governance worldwide. A total of 90 experts worldwide were invited to participate, evaluate and improve the survey's form. Here, the idea was to create a framework for future policy analysis that could explain the potential contribution of RIA to regulatory governance that would balance its potential benefits with its own limitations (RLF).

The CRPs approach used as a 'link' between RIA and governance was translated in criteria and adopted to measure the governance's level that considered the opinions of legitimate stakeholders among the Brazilian subnational regulators. In addition, to the best of the knowledge, there are few existing studies on this subject that adopt a MCDA approach, which reinforces the originality of Subchapter 5.2. To conduct the assessment, the application of a multicriteria decision analysis model by elimination and choice translating reality (ELECTRE-TRI nC) was adopted. The absence of data on this issue led to a contact the ABAR to obtain their support for the proposed analysis. The data for most of the variables used in this phase were gathered through questionnaires sent to the regulators on WSS in Brazil. A total of 45 regulators were invited to participate through the ABAR. The information on one regulator that did not provide all required data was removed from the assessment. The revised Simos' procedure (SRF)[5] was used to determine the relative

[5] SRF referes to a method tha has been used to determine the relative importance of intrinsic weights through a very simple procedure (the pack of cards technique) (for more details, seeFigueira et al., 2009; Figueira et al., 2013; Greco et al., 2016).

importance of intrinsic weights through a very simple procedure (the pack of cards technique) (Figueira et al., 2009; Figueira et al., 2013; Greco et al., 2016). The discriminating thresholds were defined by using the knowledge of the focus group to evaluate performance as well as the operational instructions used to define criteria when, the values to be allocated to preference, indifference and veto were determined (Pinto et al., 2017). In fact, the proposed analysis helps to understand the strengths and limits of regulators in terms of governance's capacity, which should be reflected in RIA's adoptions and vice-versa as pointed out in this thesis.

1.5 THESIS STRUCTURE

After this briefing introduction, the thesis is organized into six chapters, references, and one Appendix (Table 1.1). Since the scope of the thesis is divided into four concerns, the document has four core chapters as well. Chapter 2 deals with the literature on the RIA and conceptual model theory resulting in a proposal of CM &FCM-RIA. Chapter 3 and 4 addresses RIA applicability in different types of evolving real cases on WSS. Chapter 5 tackles the third concern in which RIA may be a vehicle to overcome certain institutional deficiencies of agency rulemaking and the operationalization of such link. Finally, MRIA in Brazil is provided as a final concern in Chapter 5. These four chapters encompass the work carried out for obtaining the PhD degree. The Appendix comprises the supplementary material that supports the discussion of each Subchapter.

The PhD candidate is the first and main author of 7 papers out of 9 contained in the thesis. Subchapters 4.2., 5.1 and 5.2, have a collaboration in a specific manner. The paper in Subchapter 4.2 had the collaboration of a colleague who works at the ARSAE-MG. The paper of the Subchapter 5.1 had the collaboration of a Post-Doc colleague (in law) and focuses on the legal discussion. The paper of the Subchapter 5.2 had the collaboration of the PhD candidate Ana Sara who is a specialist on mathematical models for performance evaluation.

This Introduction provides a succinct description of the practical relevance of the theme of the thesis (see Subchapter 1.1). To avoid unnecessary redundancy and curb the length of the document, the current chapter does not contain lengthy explanations regarding the theoretical relevance of the research topics covered in the thesis (since these theoretical arguments are provided individually in each paper).

Table 1.1 –Table of contents.

Parts	Chapters	Title	Status*
-	1.	INTRODUCTION	-
I	2. REGULATORY IMPACT ASSESSMENT		
		Regulatory impact assessment (RIA): from the state of art until conceptual and framework proposal model	100%
II	3. REGULATORY IMPACT ASSESSMENT: PORTUGAL WATER SECTOR		
	3.1	Delphi technique as a consultation method on regulatory impact assessment (RIA): the Portuguese water sector	100%
	3.2	Regulatory impact assessment (RIA): an ex-post analysis of water services by the legal review in Portugal	100%
III	4. REGULATORY IMPACT ASSESSMENT: BRAZIL, WATER & WASTE WATER SERVICES		
	4.1	Rethinking Brasilia's water services "new targets" using the Regulatory Impact Assessment (RIA) tool	95%
	4.2	Assessing the impact of household connection to public networks wastewater systems	90%
	4.3	Adapting water tariffs to climate change – an impact assessment	95%
IV	5.GOVERNANCE & RIA		
	5.1	Regulatory governance & Regulatory impact assessment (RIA): links and potential way to the contemporary agenda	90%
	5.2	The presence of governance: an assessment based on innovative core regulatory principles for Brazilian regulators	90%
	5.3	Better utilities regulation? Merits and implications of a "Mandatory" Regulatory impact assessment in Brazil	90%
	6.	CONCLUDING REMARKS	-
		REFERENCES	-
		APPENDICES	

*The status of each chapter was based on the following thresholds:
- definition of the chapter's objectives and structure - 20%;
- definition of the chapter's objectives, structure and methodological approach - 40%;
- chapter already written – 60%;
- chapter submitted – 80%;
- chapter reviewed by the supervisors and other reviewers– 95%;
- chapter accepted for revision in an international journal (ISI) - 95%;
- chapter accepted for publication in an international journal (ISI) - 100%.

Chapter 2 starts by presenting the origins of adopting RIA, emphasizing the forms of impact assessment, the theory regarding conceptual model and ends through the SWOT analysis of RIA worldwide.

The third chapter of the thesis addresses the application of FCM-RIA. The first paper of this chapter (Subchapter 3.1) uses consultation methods and techniques to determine the regulatory framework in the PWS and its potential criteria. The second paper evaluates the impact of Law no.194/2009 in a context of PPP in PWS using MCDA modeling method.

Chapter 4 contains three papers. The first paper introduces RIA as an innovative approach to rethink the potential effects of “new targets” for water service policies (WS) provided in Brasília considering different perspectives. After this opening paper, Subchapter 4.2 implements the MCDA modeling method to appraise the existing gap regarding household connection in BHMA. Following the second application, the third paper tries to evaluate in a proper manner (a proposed frame for suitable prices) the water scarcity in SPMA based on three scenarios.

Chapter 5 also contains three papers. The first paper (Subchapter 5.1) introduces the theory regarding the presence of RIA as a vehicle to improve regulatory governance and vice-versa. After this “review” paper, Subchapter 5.2 thoroughly uses CRPs to conduct the assessment of the governance presence considering the opinions of legitimate stakeholders among Brazilian subnational regulators. Finally, the last Subchapter 5.3, evaluates in a legal manner the merits and implications of a mandatory RIA, whose discussion has been taking place in Brazil, due to the creation of Bill no.52/03 and Bill no.1539/2015.

Finally, Chapter 6 concludes the thesis by summarizing the main findings, highlighting some policy implications and providing guidelines for further research on these matters.

CHAPTER 2. REGULATORY IMPACT ASSESSMENT

REGULATORY IMPACT ASSESSMENT (RIA): FROM THE STATE OF ART UNTIL CONCEPTUAL AND FRAMEWORK PROPOSAL MODEL

Paper published in Journal of Contemporary Management, B.E. de Carvalho, R.C. Marques and O.C. Netto

Abstract: This Subchapters adopts a meta-analysis approach to examine the literature on the regulatory impact assessment (RIA) and conceptual model theory to develop a conceptual and framework proposal model. Although RIA studies have increased in the past few years, they can hardly be found at the local level sectors, and this situation is even worse outside the OECD countries. This flaw can be linked to the lack of poor quality of RIA information, institutional arrangements, quality of training, capacity building, time, budget and its better understanding. The state of art review combined with the proposal model of RIA allows not only to revisit core concepts and theory's discussion, but also to draw a frame tool for policy makers that can promote a better prescriptive understanding of the status quo, assessment, consultation and review adding value to the decision process and improving the regulatory governance environment.

Key words: Concept and Framework Model; Decision-making; Meta-analysis; Regulatory Impact Assessment; Theory.

2.1 INTRODUCTION

Although the history of formal and explicit RIA data extends over 47 years, with the inclusion of benefit-cost analysis in inflation impact analysis in the United States (U.S), the greater emphasis given to RIA's use dates back to the 1980s, by President Reagan. Nowadays, debates around the world concerning RIA have intensified, not only in terms of state capacity and governance, but also concerning its better understanding, methodology, strengths, weaknesses, opportunities and threats into policy issues.

In order to add value to the literature regarding RIA, this work aims to cope with RIA's understanding challenges by (i) offering an overview regarding the absence of RIA's background, definition and framework and (ii) trying to answer the follow research question: "is there any possibility of building a prescriptive RIA conceptual and framework model independent of the author's perspective?". Those proposal objectives can be achieved by merging meta-analysis, which seek to synthesize empirical evidence from quantitative studies (Aguinis et al., 2010) and conceptual model (CM), by Concept map (Cmap) tool, that allows to frame a new, broader and flexible concept on the top of hierarchy definition (Daley, 2004; Caldas, 2012; Novak & Cañas, 2006).

The remainder of this Subchapter is organized as follows: the second Subsection deals with the qualitative and quantitative "Narrative Review" concerning RIA studies. The state of the art in terms of RIA is provided in the third Subsection. The CM, Cmap analysis and RIA conceptual and framework (CM & FCM-RIA) results are explained in the fourth Subsection. The final Subsection discusses the strengths, weaknesses, opportunities and threats before drawing some general conclusions.

2.2 NARRATIVE REVIEW

2.2.1 Methodology approach

Meta-analysis originated in the experimental sciences has been gradually gaining ground in economics, policy and engineering issues and so on (Van Ewijk et al., 2012). Despite the clear potential that meta-analysis has, especially in terms of seeking to synthesize empirical evidence from quantitative studies (Aguinis et al., 2010), such case follows a pattern suggested by Cooper (2010) to provide an overview of RIA and to answer the research question presented before. This systematic review of RIA literature by meta-analysis combined with CM theory carry out the following five steps as shown in Figure 2.1. Firstly, the "introductory question" that allows to explore the problem context and the motivational situation was presented. Secondly, all reliable studies were searched and a preliminary selection was done based on the following aspects: (i) the subject, (ii) the period of the studies, (iii) the relevance and (iv) the internet source. A third point of this analysis, each study was categorized in terms of year, source, subject categories and GDP in order to aid RIA's discussion. Further, the RIA's theory, forms, methods and (concept and framework) was mined as an input for the proposed analysis. Finally, not only the results grounded on studies surveyed, but also the CM & FCM-RIA proposal was displayed to accomplish the proposed meta-analysis scale.

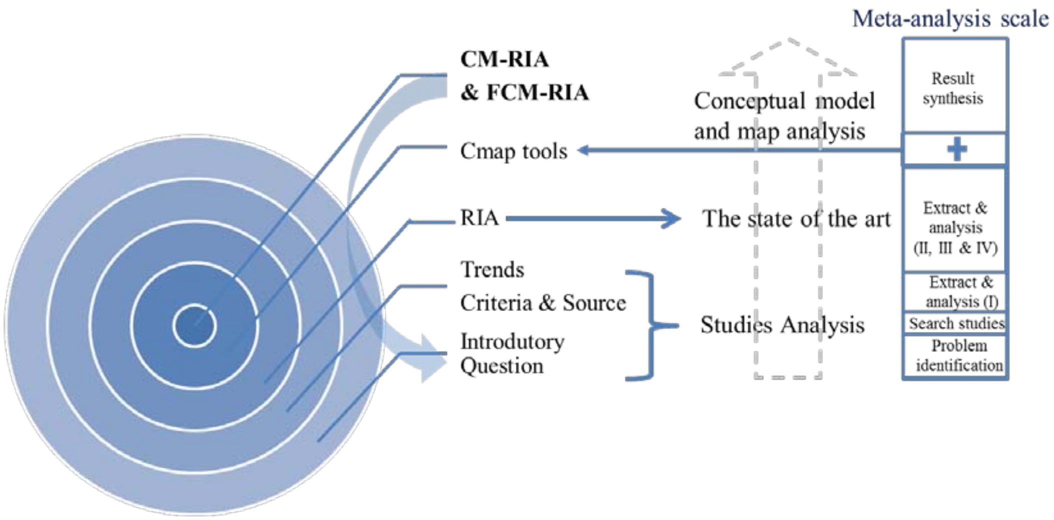


Figure 2.1 – Meta-analysis and CM theory.

2.2.2 Outcomes of the studies

This Subchapter is focused on specialized journal articles, papers (working papers, newspaper and magazine paper), books, books section, reports (official government and other organizations), thesis and so on (framework, private report, consulting and forms). The defined criteria and sub-criteria to select and evaluate these documents are provided in Table 2.1. A total of 175 studies were selected based on "RIA" keyword and relevance criterion. Two kinds of sources were used: (i) Google Scholar®[6] (86 studies selected) and (ii) Capes

[6] A freely accessible web search engine. Available online at the following website: https://scholar.google.pt/. Accessed in Oct, 2014/2015.

Periodicos®[7] (Brazilian web source) (89 studies selected). Moreover, Figure 2.2 shows a pattern based on the aspects defined before.

Table 2.1 – Introductory question, criteria (select & evaluate) and source.

Research question	*Criteria*	*Sub criteria I – period*	*Sub criteria II– Relevance*	*Source*	*Sub criteria III*	*Total number of registers*
Is there a possibility to build a prescriptive RIA conceptual and framework model independent of the author´s perspective?	RIA	1970* – 2016 *The year, which RIA was formal, introduced in United States.	To select more relevant papers according to the source	Google Scholar	General – more relevant studies	732,000/15,500 **86**
(search 2014-2016)				Capes Periódicos	Contain RIA in general source (tittle, author & topic)	10,569/24 (1970-2016) (2005-2016)
					Contain RIA in the topic	**89** Period available: (1983-2016) (2012)
					Contain RIA in the title	65 Period available: (1976-2016) (2010-2013)
					Contain RIA exactly in the topic	28 Period available: 1985-2016) (2011-2013)
					Contain RIA exactly in the title	17 Period available (1997-2016) (2012)

[7.] Digital library access to scientific information and technology produced worldwide. Available online at the following website: in: http://www.periodicos.capes.gov.br/index.php?option=com_phome. Accessed in Oct, 2014/2015.

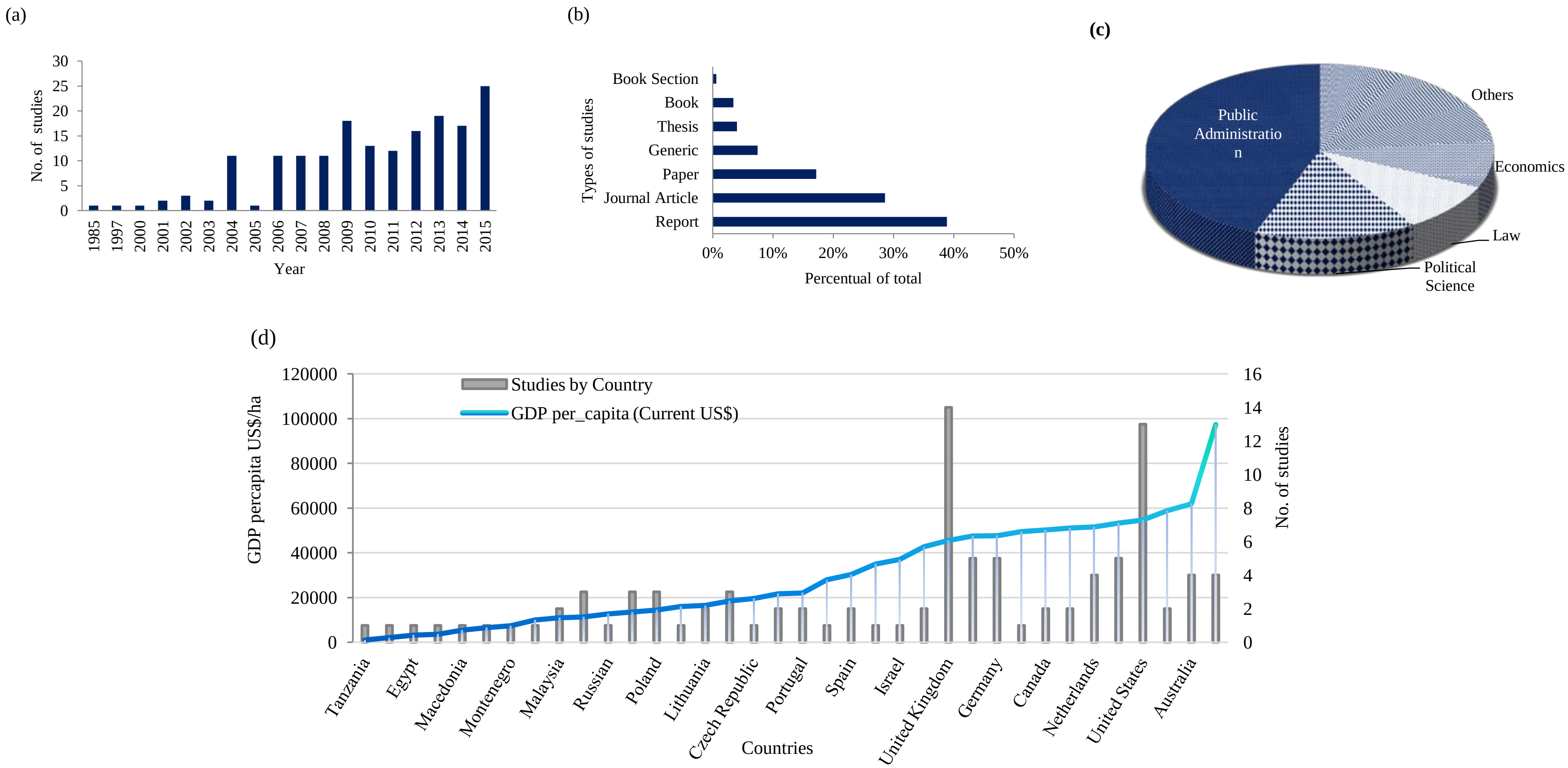


Figure 2.2 – Narrative review results in terms of (a) RIA studies, (b) type of studies, (c) categories and (d) GDP. (Source: author; World Bank Data, 2014[8]).

[8] Available online at the following website: in: httpshttp://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG. Accessed in Jan, 2016.

The trend in terms of publications around RIA issues shows that, in the last five years, more studies were produced than in the last 25 years, which could be associated with four hypothesis: (i) economic and social governance in times of crisis recovery and financial austerity can offer an opportunity for improving (R)IA systems (Meuleman, 2014); (ii) the incentives from the Organization for Economic Co-operation and Development (OECD) can stimulate BRA and business between the countries, (iii) the recent growing degree to which societal stakeholders are involved as a result of local conflicts and (iv) more academic interest (Baldwin et al., 2013). Into the sample of studies surveyed, approximately 85% correspond to reports, journal articles and papers, even though the majority of references cited by RIAs does not constitute scientific publications of case studies. The remainder of documents include, among other sources, books, book sections, thesis, other regulations, and newspaper articles.

In terms of subject categories, based on the ISI web of knowledge[9] public administration, political science, law and economics represent about 76% of the documents surveyed. The remaining subjects known as "others" are linked not only to environmental, management, business, social science and transport studies, but also to health policy, food science, operational research and medicine. This distribution shows how RIA is still concentrated in a particular knowledge area. A relationship between regarding gross domestic product (GDP) per capita, countries and number of studies may be associated with the improvements in regulatory management system in which leads to a significant and positive impact on GDP (Jacobzone et al., 2010). The U.K. and the U.S. are the main developed countries that have been focusing on RIA approach. In fact, it could be associated with their perception regarding the effects of RIA on the political systems (Dunlop & Radaelli, 2016). Furthermore, the number of studies (journal article, paper and report) made in European and North America represent over 75% from the total analyzed (131) which provides evidence of where RIA studies are predominant.

Consistent with those trends and in line with some suggestions for future research, there is an opportunity to explore this issue concerning both the "state of the art" and also its potential applicability through the conceptual model theory. In this regard, governments, regulators and scholars will be shaped a better understanding of RIA and its potentiality as a support tool to their decision or academic exercise.

[9]. Available online at the following website: in: http://admin-apps.webofknowledge.com. Accessed in Jan. 2016.

2.3 REGULATORY IMPACT ASSESSMENT (RIA): THE STATE OF THE ART

2.3.1 Extracting data – The origins and adoptions of RIA

The history of formal and explicit RIA data extends over 47 years in the U.S. Canada followed the U.S. towards the end of 1970s. Then, Germany, Australia, the U.K. and the Netherlands adopted RIA in the mid-1980s. Currently, RIA represents an unusually coherent policy argument from the perspective of the agency issuing the regulation (Desmarais & Hird, 2014).

Nowadays, the number of countries that adopted RIA is stable. A recent survey by OECD (2015) shows that the majority of OECD countries have established the requirement to conduct RIA in a legal or official document, but this trend is not at the same level if one wishes to conduct RIA in practice. This gap is more pronounced in the case of subordinate regulation. Moreover, as to the aid methods, the benefit analysis (BA), risk assessment (RA) and cost-benefits analysis (CBA) are a requirement, respectively, in approximately 88%, 60% and 29% of OECD (see Appendix I).

Outside OECD countries, among emerging economies and developing countries, there are several examples of attempts to introduce RIA as a systematic impact assessment of proposed new legislation or existing regulation (Renda, 2014). In many cases, RIA has been adopted as part of donor-financed projects and programs. In terms of numbers, by 2009 it has been estimated that some form of RIA has been adopted or discusses, at least, 50 developing countries, a number that has almost certainly increased since then (World Bank, 2010) as showed in Figure 2.3 (including developed countries).

Despite being a milestone of evidence-based policy making and one of the most promoted regulatory policy tools by OECD for the past 20 years, ensuring the effective implementation of RIA in all OECD countries (and outside) remains a challenge and its effective adoption requires the compatibility of an innovation with institutional and administrative settings (De Francesco, 2016; Renda, 2014; World Bank, 2010).

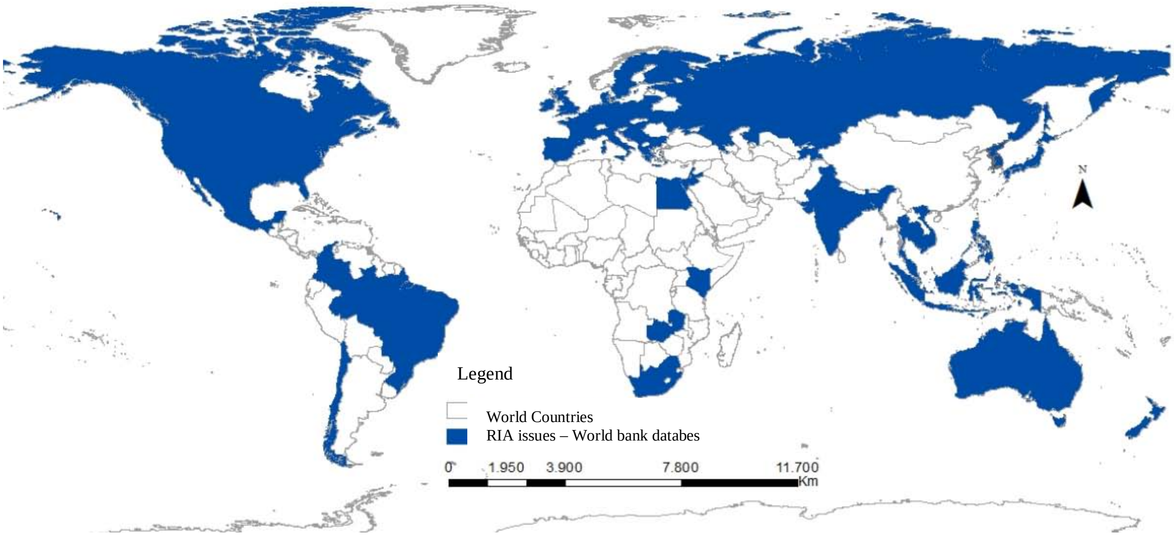


Figure 2.3 – RIA issued by or for national governments. (Source: World Bank, 2017; author's elaboration).

2.3.2 Extracting data – Forms of IA and R(IA) connections

Under the umbrella of impact assessment IA, a number of specific forms have developed since 1960s based on scientific analysis derived from analytic tools with a wide variety of different types, e.g., EIA, SIA, health IA (HIA), strategic environmental assessment (SEA) (Morgan, 2012) and legislative evaluation (LE), operational audit (OA). Moreover, Morgan (2012) pointed out other forms of IA that have emerged in recent years which include human rights IA (HRIA), cultural IA (CIA), post-disaster IA (PDIA), climate change IA (CCIA) and RIA. Nonetheless, some particularities in terms of time perspective, sponsor institution and predominant area of applicability of each one makes its adoption difference (see Appendix II).

Although the uses of IA systems have been growing worldwide, the reminder wider and common challenge identified in all tools can be associated, among others, with the lack of new ideas, methodology and conceptual barriers (Rattle & Kwiatkowski, 2003). Agreeing on this point, would perhaps also facilitate the understanding that building a CM & FCM-RIA are central to overcome this barrier and ultimately strengthen its theoretical basis, which reinforces the first concern regarding the thesis.

2.3.3 Extracting data – RIA as support of conceptual and framework proposal

2.3.3.1 RIA concepts and framework

RIA concepts and framework has several definitions, which vary among different researchers, countries and international agencies. Here are some of them: (i) RIA is a tool in the regulatory policy process (Radaelli, 2004) and (ii) RIA is seen as a tool for increasing evidence-based policy-making being integrated into decision-making procedures on a wide range of issues (Staroňová, 2014). It is equally important to point out some examples of RIA's framework (steps): (iv) select the policy proposal - description the problem - description the objectives - description the baseline scenario - options - consultation – review (Jacob et al., 2011); (v) justification - options - assessment - consultation - scientific analysis - support - institutional oversight (Staroňová, 2014) and (vi) proposal - objective - evaluation policy problem - alternative options - assessment impacts - results - compliance - monitoring – evaluation (OECD, 2008; OECD, 2015).

However, such meanings do not comprise a clear link between methods and steps into supporting policy decisions. Rethinking definitions, i.e., concept and framework, goals to the full incorporation of RIA into policy-making in a way to help governments manage critical problems that threaten economic, social and environmental progress and the effectiveness of their decision.

2.3.3.2 RIA's methods

The wider regulatory literature acknowledges that RIA's methods differs from country to country, sector to sector, data available, resources, capacity and expertise. In most cases of RIA's applicability, three types of family's methods have been used: (i) methods to generate and analyze data on specific impact; (ii) methods to integrate and aggregate data and (iii) participatory methods to facilitate the interaction between different stakeholders (Jacob et al., 2011).
According to De Francesco (2016), hybridization of RIA practices results from the diffusion of several methods of policy appraisal, such as CBA and standard-cost model (SCM). However, their uses depending on the depth of the RIA and the complexity of the problem in

which may result that the “assessment stage” become qualitative or quantitative, or a mix of the two (Renda, 2014).

Revisiting IA’s studies, logic model and cause-effect method allow to view the relationship between the problem, its causes and consequences (Cassiolato & Gueresi, 2010; Silva, 2014). Moreover, mono-criteria analysis allows to analyse different effects and the consideration of its earnings in one criteria, e.g., CBA and cost effectiveness analysis (CEA) (Harada & Cordeiro Netto, 1999). Multicriteria decision analysis (MCDA) modelling methods describe the collection of formal approaches, which seek to explain various criteria that help individuals or groups to explore the decisions that matter (Belton & Stewart, 2002). Risk analysis (RA) represents one fundamental assessment method in which responsible authorities discharge their regulatory duties to protect citizens from collective and potentially magnitude of severe risks (Vecchione, 2016; Jacobs, 1997).

Participatory or consultation methods as an example: (i) surveys, (ii) panels, (iii) semi-structured interviews, (iv) publication of consultation papers with written answers, (v) nominal group technique (NGT); (vii) decision conference (DC); (viii) Delphi and (ix) public consultation (presence and online) allow to discuss the contents of a proposed regulation getting feedback on existing regulations, building consensus and legitimacy and gathering valuable information for RIA (Blanc & Ottimofiore, 2016).

A scientific uncertainty can occur at each stage of the RIA process. However, the question is how to treat it. American and European IA guidelines provide solutions to this problem, but with different degrees of elaboration and standardization (Vecchione, 2016). To cope with the parameter default, dispersion of distribution, interaction of many variables and the corresponding parameters, the formal uncertainty analysis can be done by Monte Carlo simulation (Jaffe & Stavins, 2007) and so on. Montibeller and von Winterfeldt (2015) identified a subset of cognitive biases in decision and risk analysts that are difficult to correct, as well as several biases that can easily be corrected. For these authors, to reduce anchoring, the fixed value methods to reduce overconfidence and probing and prompting strategies to reduce omission biases are the best practice for reducing cognitive bias.
Keeping the discussion in mind and the idea of improving the design of appraisal systems, RIA’s concepts and framework were extracted from the studies surveyed as an input of conceptual model and map analysis.

2.4 CONCEPTUAL MODEL AND MAP ANALYSIS

2.4.1 Theory and methodology approach

The conceptual modelling is a widely accepted technique for the construction of interdisciplinary knowledge to frame a research project, reduce qualitative data, analyse issues and interconnections in a study and present the results (Daley, 2004). Through this approach, a relation between RIA's definitions is established.

Based on the research question presented in the "introductory section", the follow step focus on the construction of conceptual knowledge about RIA interrelated scientific concepts with a conceptual model (CM) approach by concept maps (Cmap) analysis. Formally, Cmap is a graph consisting of nodes and labelled lines.

For researchers on a such matter, the relevant structural attributes were (i) the 'volume' of a concept map (the total number of relations used in the learners' Cmap) and (ii) the amount of accurate propositions in relation to the volume (Schaal, 2008; Batarsson, 2012). Furthermore, 15 to 25 concepts will suffice to build a conceptual model. As a final point, Cmap tools® was used as a software to facilitate the Cmap's implementation (Novak & Cañas, 2007). In line with Novak and Cañas (2007), 15 concepts regarding to RIA conceptual model from a total of 40 identified on the studies surveyed were selected and 15 framework concepts from 25. In both, definitions by traditional countries, group organization, and group of traditional and modern scholars approach were used as criteria to select the definitions surveyed.

The scoring analysis allowed to compare all selected definitions and it was calculated for each component by Equation (2.1).

$$Cw_{i,j} = \frac{\sum cc - \sum mc}{\sum c}, \tag{2.1}$$

where:

cc=correct connection;

mc=missing connection;

c=maximal amount of possible interconnections i= number of concepts (1 to 15);

j=number of components (1-4).

$Cw_{i,j}$ value is between (-1) and (1), where (-1) means an absolute negative of the reference concept. The value (1) is consequently the result if the concept surveyed is identical to the reference map. The proposal concerning CM & FCM-RIA are linked with the highest $Cw_{i,j}$ value for each one component.

2.4.2 Result synthesis I: CM-RIA

The connections between the concepts selected and the highest value of $Cw_{i,j}$ in each component are available in Appendix III. As a result, the CM-RIA was well adjusted in a broader concept in which defined CM-RIA as a policy tool that systematically and consistently exams the potential impact arising from government action, under different perspective, i.e., if ex-ante, ex-tempore or ex-post.

2.4.3 Result synthesis II: FCM-RIA

Take into account the connections between the frame surveyed (Appendix IV), Figure 2.4 shows the final framework based on the methodology suggested and RIA studies surveyed. This spiral form of FCM-RIA has four steps. The first one, named “Status quo”, is composed of (i) the purpose, (ii) options and (iii) potential impact. “The purpose” contains the context scope, the extent of the situation and the complexity of the problem.

The options should be identified once the context has been provided. The “Assessment” is composed of the scenario and options analysis in each impact concerning profits and losses functions. The “Consultation” should not be limited to letting stakeholders provide their point of view on impacts, but also on the problem definition, on policy objectives and support to obtain data regarding RIA process (Hertin et al., 2009; OECD, 2008) and the final step consist in monitoring and evaluation of regulation.

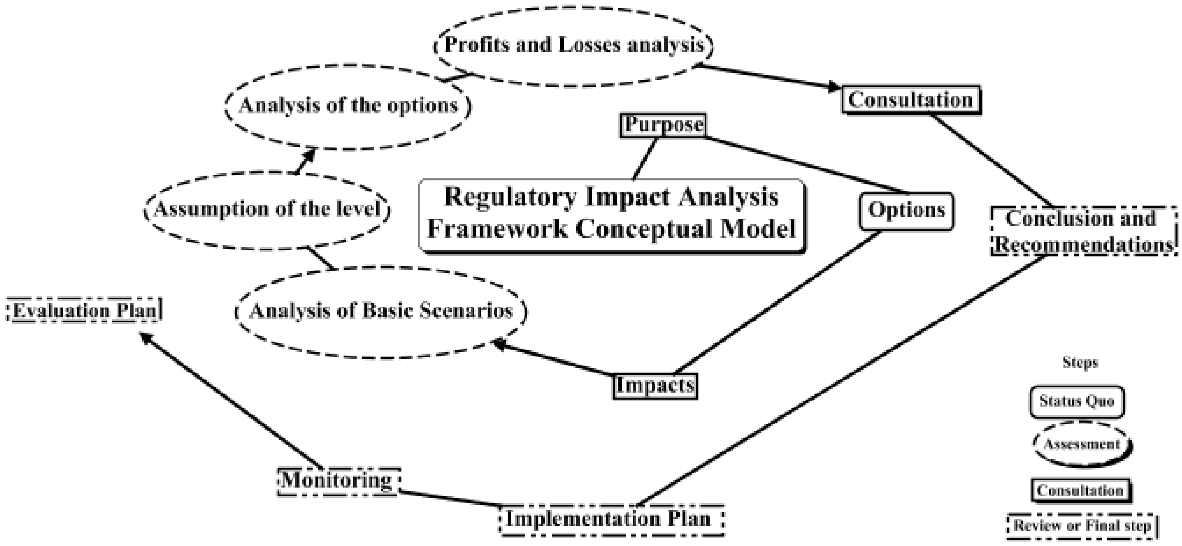


Figure 2.4 – FCM-RIA proposal.

2.5 CONCLUDING REMARKS

2.5.1 Strengths: RIA as a prescriptive tool

From a prescriptive perspective, RIA can help decision makers in generating purposes, scenarios, objectives; imagining consequences of alternatives; identifying impacts, criteria and its descriptors; assessing the alternatives in each criterion; adopting stakeholders' point of view and reviewing the whole process. This "spiral" definition has the capacity to make the RIA process more integrated, robust and transparent in the planning or reviewing public policy or regulatory acts. Moreover, running RIA tool allows to improve accountability, administrative capacity, open government, regulatory quality, rule of law as core principles of regulatory governance.

2.5.2 Weaknesses: RIA's gap

There is a significant gap between the best practice represented in the research and practice literature and the application of RIA on the ground, especially in terms of assessment methods in primary law and subordinate regulations. Many reasons can be listed here: (i) poor quality of RIA information; (ii) institutional arrangements; (iii) quality of training and capacity building in the RIA, (iv) time and budget available and (v) environment governance.

2.5.3 Opportunities: RIA is still evolving although concentrated

Based on the literature review, the latest five years correspond to the most intensive period of RIA studies publication. Although the number of studies produced is still concentrated in particular countries, the influence of theoretical debates and analysis is predominant over the case studies, which has been affecting the way in which RIA is viewed as well as closing minds to alternative ways to look at the processes that make up its activity. Despite the ideas outlined above, RIA could be accepted by the governments at different levels and sectors because, it can: (i) support decision makers in existing or ongoing laws or regulations, not only in terms of utility services, but also natural resources, (ii) allow impact assessors to work more constructively with stakeholders to develop processes that meet the needs of all parties, (iii) support the knowledge base of governance and (iv) aid policy makers in economic recession or crisis periods.

2.5.4 Threats: Recession, institutional cultures and corruption

Therefore, RIA is not “free”, i.e., the decision maker should know what RIA costs imply in a good understanding of institutional arrangements. While government looks at stimulating sustainable development growth to speed decision-making in its mandate, RIA process should be an impediment to achieve some goals defined a priori. Also, RIA should be a barrier, especially in corruption structures when the environment can be manipulated to bring about the result initially desired by policy makers. Finally, the vulnerability of governance environment, including its implicit values and traditions, can offer constraints to design and implement RIA system and vice-versa. For instance, RIA is a policy tool, not a decision tool, although is best used as a guide to improve the efficiency of existing or ongoing regulations. Based on it, such proposal presented here is informed by the theoretical framework of what RIA is for: (i) enhancing economic rationality, (ii) increase the control over regulators and (iii) legitimatize the decision-making (combining the previous ones). In conclusion, the profile of RIA can only increase as a concern when the communities and government recognize the importance of true anticipatory and prescriptive mechanism in their decision-making process.

CHAPTER 3. REGULATORY IMPACT ASSESSMENT IN PORTUGAL WATER SECTOR

3.1 DELPHI TECHNIQUE AS A CONSULTATION METHOD IN REGULATORY IMPACT ASSESSMENT (RIA) – THE PORTUGUESE WATER SECTOR

Paper published in Water Policy, B.E. de Carvalho, R.C. Marques and O.C. Netto

Abstract: This Subchapter explores use of the Delphi technique on regulatory impact assessment (RIA) in order to select criteria as well as to analyze the non-neutrality of stakeholders in the Portuguese case study. Although the decision-making process has been supporting a different prescriptive approach, there is no neutral decision, which can reflect on the (in)efficiency of the government's action. To cope with imperfect knowledge, the link between the objectives from Law no. 194/2009, which determines the regulatory framework in the PWS and its potential criteria was developed. Moreover, the elicitation weights for each criterion previously selected were framed in an innovative way, under a different perspective, either customers, municipalities or concessionaires. Evidence advises that there are relevant myopic, omission, splitting, and insensitivity biases for decision analysis, because of the distortion of input. Thus, the Delphi technique enables the decision makers to obtain reliable information before taking a decision. The results in terms of a different perspective for each criterion enables not only to identify the non-neutrality of decision analysis, but also to (re)think the stakeholder's participation into the context of the Law referred to. Finally, this approach could consolidate the understanding concerning the potentialities of the Delphi technique in RIA, especially in policies with several objectives.

Key words: Bias, Delphi technique; Portugal legal framework; Regulatory Impact Assessment; Water Sector.

3.1.1 Introduction

The ‘holy grail’ of research is establishing methodological rigor in order to obtain more reliable and robust results. This refers to a researcher, analyst and decision-makers’ responsibility to ensure that procedures have been adhered to and confounding factors eliminated to produce dependable outcomes (Hasson & Keeney, 2011).

Traditionally in quantitative research the decision process is based on stakeholder’s participation (SP), especially in the water agenda, where specific expertise is inevitable for decision making (Van Ast & Gerrits, 2016) and the practical application of SP remains problematic (Mostert, 2003). Although experts and decision makers need to provide judgment in decision modeling as contributions to estimate the possible impact of decision policy options, one has to be concerned with the self-interest of experts who may have a stake in the outcome of the analysis (Montibeller & von Winterfeldt, 2015).

Particularly crucial for assessing the possible impacts of ongoing or new regulations, RIA has become an important rational policy tool. Specifically, for the water sector, where interventions by governments have taken place without a clear idea of why or how or when (Jacobs, 2016), RIA might be required in order to improve the efficiency, transparency and accountability of regulatory decisions encouraging good governance and contributing to better business enabling environments (Kirkpatrick, 2016).

Although several RIA definitions have been found in the literature, hereafter RIA could be understood as a policy tool composed of four steps: (i) status quo, (ii) consultation, (iii) assessment and (iv) review. In this case study, the exercise of RIA is still limited to the status quo and consultation. Both are vital for the decision process influencing the inputs’ context into an assessment step. Here, different types of methods could be used, e.g., decision conference, nominal group technique (NGT), public consultation, Delphi technique and so on.

Since the 1950s, the usage of the Delphi survey method has undergone different stages of development, i.e., (i) secrecy/obscurity, (ii) novelty, (iii) popularity, (iv) scrutiny and (v) continuity. After a time of stagnation in the 1980s, the Delphi technique received increasing interest in the early 1990s (von der Gracht, 2012). More recent applications concentrate on the web-based implementation of the Delphi procedure, but still follow the technique’s fundamental rationale and consider consensus measurement to be a crucial component of analysis (Gnatzy et al., 2011). To measure the consensus, four key features may be regarded as necessary for defining a procedure as a ‘Delphi’, i.e., (i) anonymity, (ii) iteration, (iii) controlled feedback and (iv) the statistical aggregation of group response (Rowe & Wright, 1999).

Moreover, comparative advantages of the Delphi technique have facilitated its applicability because it enables a group of experts to be canvassed rapidly and inexpensively (eliminating printing and postage costs) without geographical limitations (Reppa, 2007), although the feedback time could be a disadvantage.

Despite the relevance of the topic of biases for decision analysis and its effects on the impartiality of government actions, there is a lack of articles discussing the trade-off between SP in a problem with several and controversial objectives. This situation has become more problematic in the last two decades, where water utilities in many countries have undergone radical evolution, which has transformed the basis of operation (Massarutto et al., 2013) and also the regulatory system with no measured impacts on the society.

Bearing this in mind, this Subchapter investigates the case study of Portugal through Law no.194/2009, which had several aims, one of them, maybe the main one, to improve the public-private partnership (PPP) model for the water sector. However, the expected outcome of this law has not provided the envisioned value for money.

Unfortunately, an ex-post analysis of policies with several objectives, as this case, is frequently neglected in the evaluation of the decision-making process or done in a strict way, i.e., without a clear definition of the criteria, methods and robustness, and sensitivity analysis. Notwithstanding this, a ‘modified and argument’ Delphi design (Hasson & Keeney, 2011) were developed as a consult or participatory step in the RIA approach.

This proposed consultation step (modified and argument) Delphi design was used in two stages. Initially, the link between the Law no.194/2009 objectives and their possible impact to select the more adequate criteria and reduce biases, e.g., myopic problem representation and omission bias (Montibeller & von Winterfeldt, 2015) was done. Secondly, argument-Delphi was used to capture the weighting coefficients (swing-weight), typically used with multi-attribute utility theory (MAUT) methods, in order to reduce the splitting, equalizing and insensitivity bias (Montibeller & von Winterfeldt, 2015).

The present Subchapter contributes to the literature by proposing a consistent evaluation methodology and the practical implications for managing the implementation of RIA in primary or subordinate laws, for which the case study of the PWS offers an excellent example. Furthermore, this work not only intends to propose how Law no.194/2009 might be improved, but also how this frame can support governments to develop new and/or ongoing regulations beginning through the status quo. This proposal is innovative concerning the use of Delphi in the water supply sector as a part of RIA process reducing bias in decision analysis.

The remainder of this Subchapter is organized as follows: the second Subsection presents the importance of RIA in the regulatory system. Subsection 3 outlines the Delphi theory. The Portugal case study is detailed in the fourth Subsection. Subsection 5 discusses the results. Concluding remarks are presented in Subsection 6.

3.1.2 RIA in brief

According to Alemanno (2016), RIA carries the possibility to render the policy process not only transparent and participatory, but also more rational, through the increased availability of evidence support policy initiatives enhancing the scrutiny of the preparatory process, leading to the adoption of the final rule.

Although RIA has become an important tool over the past few years, with evidence based on decisions made by policy-makers worldwide, the academic literature on RIA, as regards its processes and application, is still concentrated on central government’s agenda and on social sciences. Nowadays, debates around the world about RIA have intensified, not only on state capacity and governance, but also concerning its better understanding and applicability at different regulatory levels and in different sectors, as discussed in the Chapter 2.

Currently, the hybridization of RIA practices results also from the diffusion of several methods of policy appraisal (De Francesco, 2016) and their uses depending on the depth of the RIA and the complexity and the dimension of the problem.

Here, concerning the RIA framework, the ‘consultation step’, which involves the stakeholders to get more reliable information as the input of the analysis was the main focus. As for the RIA method, Delphi enable identification of criteria and similarly aid the analytical methods (mono, multicriteria and risk methods) in a different way.

Finally, implementing the Delphi technique as a useful method in the RIA (ex-post) approach in the PWS (Law no.194/2009) may qualify the construction of more robust and transparent links between this law’s objectives and may enable clear understanding concerning the weighting for each criterion in a more rational way. This proposal is innovative regarding the uses of a different perspective in eliciting weighting coefficients, either by customers’, municipalities’ or concessionaires’ representatives.

3.1.3 Delphi technique

The Delphi technique was developed during the 1950s by workers at the RAND Corporation (a research institution that initially focused on national security issues and later concentrated on scientific, educational, and charitable endeavors for public welfare) while involved in a U.S. Air Force sponsored project (von der Gracht, 2012).

Delphi is understood as a social research technique for structuring a group communication process that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem (Rowe & Wright, 1999). Nowadays, the Delphi technique is also used widely in the fields of public policy and strategic decision making in companies (Makkonen et al., 2016). Also, four key features may be regarded as necessary for defining a procedure as a ‘Delphi’, respectively: anonymity, iteration, controlled feedback and the statistical aggregation of group response (Rowe & Wright, 1999).

Furthermore, the comparative advantages of the Delphi technique as a consultation tool, especially in this case, are related to four aspects: (i) it allows a number of experts to be called upon to provide a broad range of views, (ii) it does not require face-to-face meetings, (iii) it helps keep attention directly on the issue, and (iv) it is inexpensive. On the other hand, Delphi requires adequate time and participant commitment and is also more time-consuming than group process methods, e.g., NGT, conference decision, public consultation and so on. Although there is no register of Delphi in RIA in the WS agenda, its use is prominent rule on this matter, because it can help decision makers to achieve consensus and also reduce cognitive and motivational bias.

Concerning Delphi designs, Hasson & Keeney (2011) identified ten main categories of Delphi, which are classical, modified, decision, policy, real time, e-Delphi, technological, online, argument and disagregative policy. Table 3.1 highlights the main types of Delphi design in policy problems.

Within each Delphi type, the features of the Delphi may also vary in terms of the number of rounds, the level of anonymity and feedback given, as well as the insertion criteria, sampling approach or method of scrutiny (Hasson & Keeney, 2011).

Traditionally, the Delphi application follows nine steps, i.e., (i) prepare the questionnaire and select the experts (hereafter, panelists), (ii) test the questionnaire, (iii) 1st round, (iv) analysis of the feedback, (v) check the convergence, (vi) prepare a new questionnaire, (vii) 2nd round, (viii) analysis of the new feedback and (ix) publish final descriptions (3rd round).
A number of authors claim that the Delphi approach enhances reliability and is a validity instrument, i.e., personal bias can also influence the accuracy of a policy decision aid application. Thus, to reduce the splitting bias, the analyst or decision maker ought to obtain objectives and attributes from multiple stakeholders, which offer different degrees of detail to different parts of the problem analyzed (Montibeller & von Winterfeldt, 2015).

In terms of stability, three rounds are optimal in Delphi. With two rounds, homogeneity cannot be established (Boulkedid et al., 2011). Also, many Delphi studies have used discretionary criteria or descriptive statistics for the determination of consensus and the quantification of its degree. The criteria have, however, sometimes been chosen rather arbitrarily. The literature review revealed that researchers have actually used all kinds of descriptive statistics in order to measure consensus. One can find applications of measures of association as well as measures of central tendency and dispersion (von der Gracht, 2012).

Table 3.1 – Delphi characteristic (Hasson & Keeney 2011, modified).

Design type	Aim	Target panelist	Administration	Rounds (no.)	Round 1 design
Classical	To elicit opinion and gain consensus	Experts selected based on aims of research	Traditionally postal	may employ fewer than 3 rounds	Open qualitative first round, to allow panelists to record responses
Modified	To vary according to project design to achieving consensus	Experts selected based on aims of research	Varies, postal, online etc.	may employ fewer than 3 rounds	Panelists provided with pre-selected items, drawn from various sources, within which they are asked to consider their responses.
Decision	To structure decision-making and create the future in reality rather than predicting it	Decision makers, selected according to hierarchical position and level of expertise	Varies	Varies	Can adopt similar process to classical Delphi
Policy	To generate opposing views on policy and potential resolutions	Policy makers selected to obtain divergent opinions	Can adopt a number of formats including bringing participants together in a group meeting	Varies	Can adopt similar process to classical Delphi
Argument	To develop relevant arguments and expose underlying reasons for different opinions on a specific single issue	Panelists should represent the research issue from different perspectives	Varies	Varies	Can adopt similar process to modified Delphi i.e. first round involves expert interview
Disaggregative policy	To construct future scenarios in which panelists are asked about their probable and the preferable future	Expert selection can vary depending on the aim of the research	Varies	Varies	Adoption of modified format using cluster analysis

Finally, the decision makers, very often find that they need to apply models or techniques which are required to be fed with data that cannot be obtained directly from present or past reality, data which do not exist, or data which are not reliable or that are insufficient (Landeta et al., 2008). In line with these authors and keeping in mind that joining individual judgments may lead to 'process gain', where groups may perform better than their best participants with some adaptation that can reduce bias, the Delphi applicability was justified in the RIA approach into the Portuguese case study.

3.1.4 Portugal case study

3.1.4.1 Big numbers, water management model and legal framework

In mainland Portugal, 12 operators in the bulk service and 299 operators in retail services are responsible for WS to approximately 10.1 million inhabitants and 95% of households served. The institutional model assumed in Portugal is based on the French regulatory and development model, i.e., the responsibility for WS belongs to the municipalities, which can delegate their operation to the private sector by public tender (Marques, 2008). Nevertheless, nowadays the scope of the regulation is broader (both in the number of regulated companies and in the intervention of regulation); initially its aim was only to supervise the quality of service of the private concessionaires and to provide some technical assistance to the contracting stage and when renegotiation of the contracts took place (Marques & Berg, 2010). The common model of bulk services are public concessions (73%) and are responsible for serving 71% of the population in Portugal.

Since 2009, and effective as of 2011, the water and waste services regulation authority (ERSAR) has been regulating all delivery models; however, this development needs an increased maturity and expertise. Indeed, an improved compliance and standardization in reporting is needed, "mainly by in-house models, related to the information requested by ERSAR, in order to enable prompt and efficient analyses, enhancing the regulatory procedure" (Pinto et al., 2015).

Usually the private investors involved in PPP arrangements at the local level consist of construction companies or specialized sub-holdings owned by them (Da Cruz & Marques, 2012). Private sector participation is involved in almost 25% of the retail market (ERSAR, 2015). It only had a slight increase in the last decade, but even so it can represent an opportunity to study this specific participation model in Portugal's water sector. According to ERSAR (2015), about 18% of the population are served by municipal companies, 29% by direct provision, 23% by direct provision but with some autonomy, and approximately 20% by concessions (Figure 3.1).

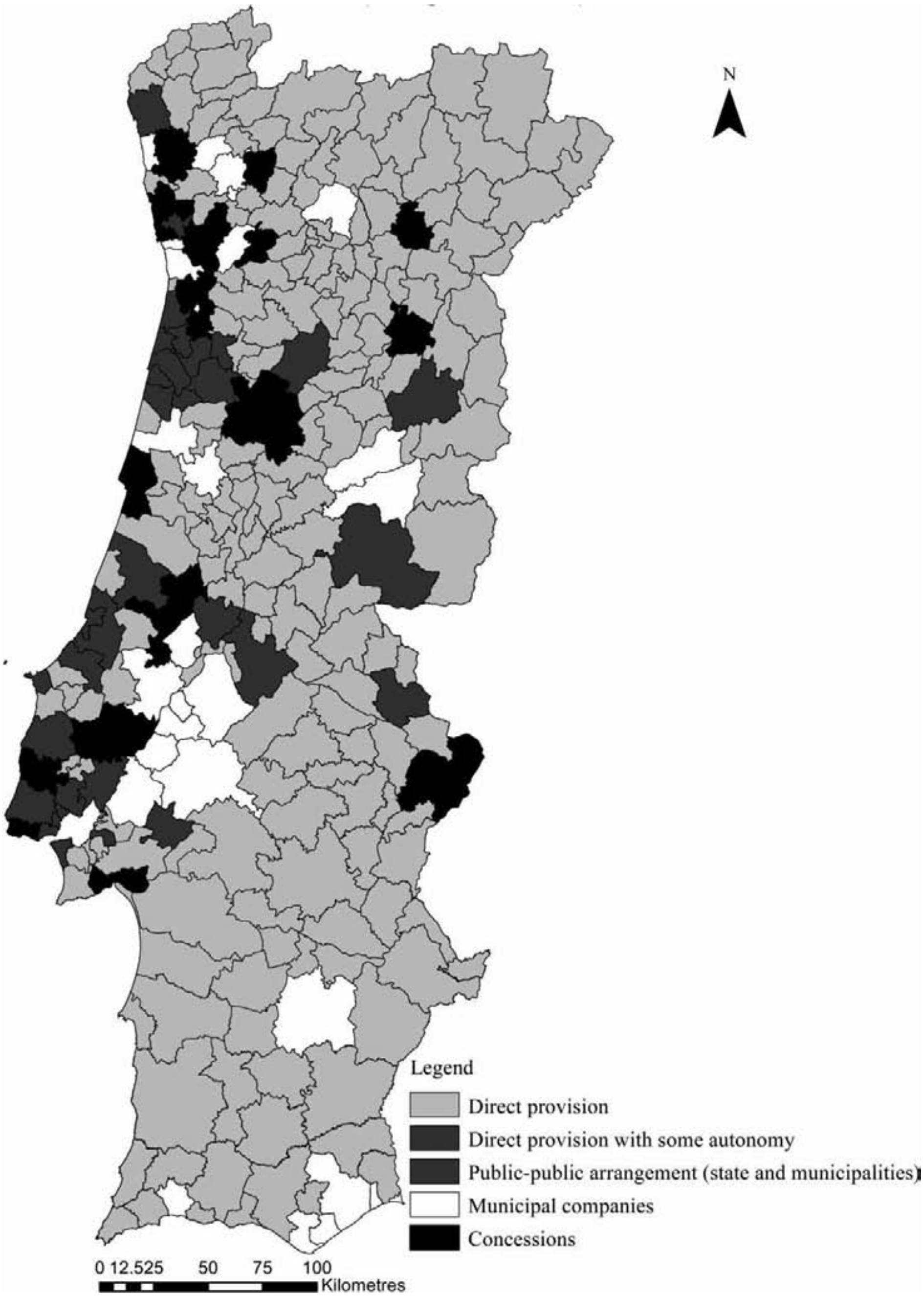


Figure 3.1 – Geographical distribution of WS providers (retail) in Portugal by management models (Source: ERSAR, 2015).

In terms of the legal framework in the PWS, Law no.194/2009 regulated these possible arrangements, ranging from fully private to fully public, the current legal and regulatory framework of the water sector in Portugal.

Nowadays, there are no clear issues concerning the impact of this law, whether positive or negative, regarding the performance of private sector participation in the PWS. This case provides a chance to build a link between the objectives of this law and selected criteria and also to evaluate the non-neutrality of SP in the RIA approach, which can result in greater public acceptance of decisions and a constructive dialogue (Mostert, 2003).

3.1.4.2 Methodology

In order to select criteria (1st stage) and check the non-neutrality of SP in the PWS (2nd stage), the proposed RIA approach (Figure 3.2) was carried out. Hence, such RIA framework considers only the 'consultation step'.

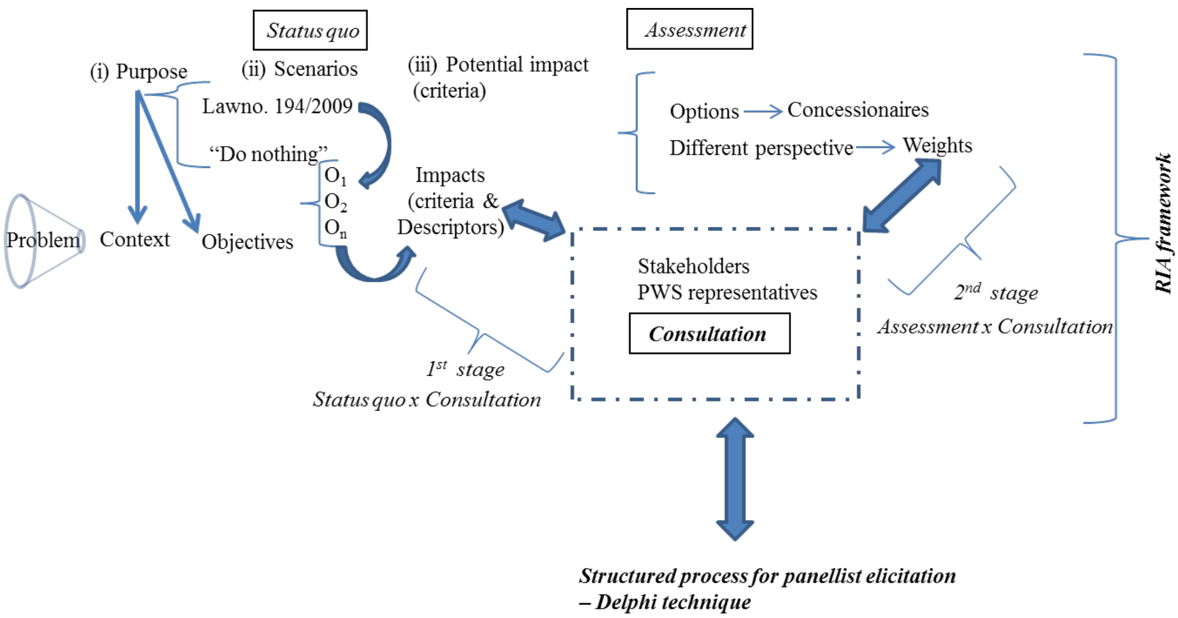


Figure 3.2 – RIA framework and consultation step.

Vital objectives must follow a set of properties: (i) value relevance – essential objectives involved in decision, (ii) understandability – clear mining, (iii) operationality – in terms of performance of strategic options, (iv) non-redundancy – should not measure a similar concern twice, (v) preferential independence – in terms of performance of strategic options on one objective disregarding their performance. For each essential objective placed at the bottom level, an associate criterion should be specified. Also, the criteria might have direct quantitative and indirect quantitative attributes, and qualitative attributes (Belton & Stewart, 2002). Independently, each criterion should have five properties (Keeney & Gregory, 2005) to be employed in a preference model, each criterion should be: (i) unambiguous, (ii) comprehensive, (iii) direct, (iv) operational and (v) understandable.

A total of 24 criteria were pre-selected based on data available and their capacity to measure the objectives from Law no.194/2009. These criteria and also their descriptors and indicators are available in Appendix V. Thus, in order to implement the RIA framework proposal 'status quo versus consultation', considering the PWS context, Figure 3.3 displays the potential relationship between the objectives of Law no.194/2009 and its potential representative criteria.

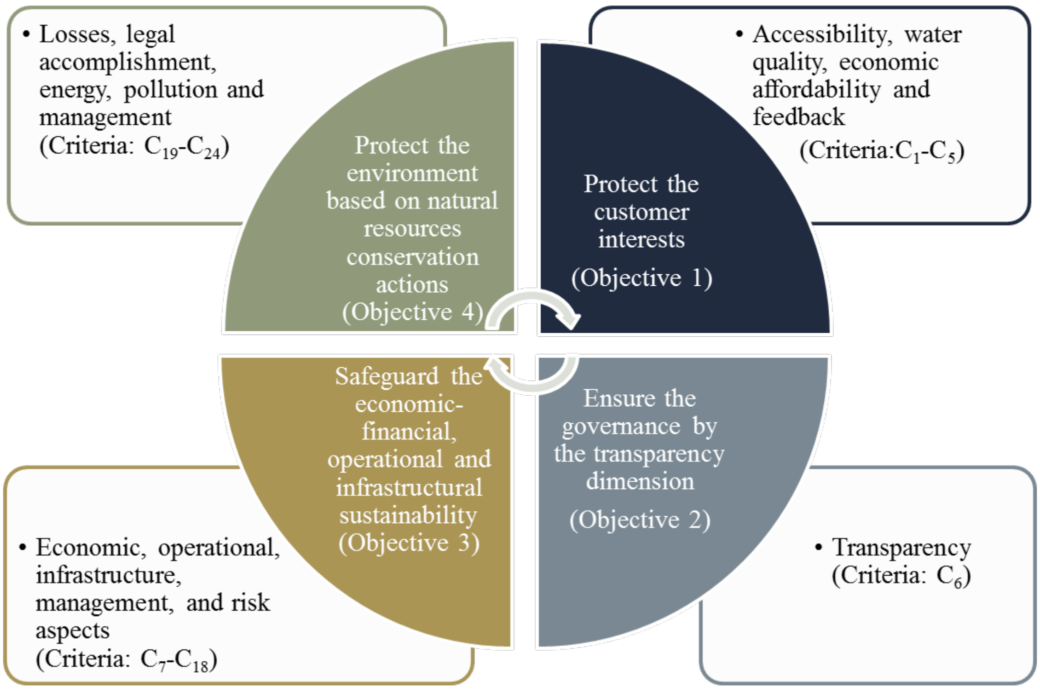


Figure 3.3 – Objectives and pre-selected criteria by Law no. 194/2009.

To build this first matrix (options versus impacts) the dimensions suggested by ERSAR and the data available (ERSAR's reports, concessionaires websites and concessions contracts) were considered.

To construct a reliable link between the objectives and pre-selected criteria (1st stage) as well as to check the SP in different perspectives, either customers, municipalities or concessionaires (2nd stage), nine steps were followed: (i) prepare the questionnaire and select the panelists, (ii) test the questionnaire, (iii) 1st round interaction, (iv) analysis of the feedback, (v) check the convergence (or new questions), (vi) prepare a new questionnaire, (vii) 2nd round interaction, (viii) analysis of the new feedback and (ix) 3rd round interaction (publish final descriptions). Finally, in each stage a different design of Delphi was used.

1st stage: Modified-Delphi design

The first stage analyzed the relation between the objectives of Law no.194/2009 and the impact through the criteria and their descriptors pre-selected by the data available. The questionnaire was developed by Google docs®. A total of 40 questions were allocated in four blocks: (i) introductory letter, (ii) data from the panelist, (iii) technique questions and (iv) additional comments. The questionnaire pre-test was carried out by members of the University of Lisbon, University of Brasília, concessionaires and water sector associations in Portugal.

The panelists were invited to categorize the pre-selected 24 criteria and objectives of Law no.194/ 2009 based on five levels: (i) indispensable, (ii) very important, (iii) important, (iv) low important and (v) unnecessary (Mendonça, 2009). The panelists were selected by their representativeness in the PWS, e.g., concessionaires, municipalities, regulatory authority, academics, consulting and consumers' associations. The analysis of the feedback was carried out by statistical assessment. More details regarding the first stage of the Delphi technique are provided in Appendix VI.

The number of rounds is one simple way of conducting consensus measurement and in many situations, it is sufficient. The interquartile range (IQR) is the measure of dispersion for the median and consists of the middle fifth of the observations. In fact, it is a frequently used measure in Delphi studies, and it is generally accepted as an objective and rigorous way of determining consensus (von der Gracht, 2012). Finally, the impacts were selected based on statistical parameters (mode, median and average).

2nd Stage: Argument-Delphi Design

In multicriteria decision analysis (MCDA), classically one of three weighting methods are used, the first two being direct rating and pairwise comparison (used in the analytical hierarchy process, in outranking methods such as preference ranking organization method for enrichment evaluations (PROMETHEE) and also in swing-weights). However, swing-weights has been used as a classical support with multiatribute utility theory (MAUT) methods (Belton & Stewart, 2002).

With this in mind, the use of these two objective methods were rejected because of their limited focus on variance from target and costs, respectively, and their complexity given the limited scope of this work. The third major approach, the weighting coefficient from panelist, includes a wide variety of methods, such as public opinion surveys, facilitated group consensus-based procedures (e.g., the Delphi technique) and various weighting procedures used in MCDA modeling methods.

However, there are many common mistakes in defining weights and several appropriate methods to elicit weight protocols (see Montibeller & von Winterfeldt, 2015). One innovative method that enables reduction of the splitting bias is swing-weights through the argument-Delphi design.

In line with Montibeller & von Winterfeldt (2015), the swing-weight approach was carried on, which refers to the variation of the weights as the value measure swings from the lowest value to highest value level in the scale (by the value function for each criterion). The swing steps were: (i) the panelist was asked which 'swing' from the worst to the best outcome would result in the largest, second largest, etc., improvement; (ii) the criterion with the most preferred swing is most important, and given 100 points; (iii) the magnitudes of all other swings are expressed as percentages of the largest swing; and (iv) again, the derived percentages are the raw weights that are normalized to yield final weights (Zardari et al., 2015). Appendix VII provided a detailed description of the value function for each criterion selected from the first stage used in a such approach.

The panelists were selected by their representativeness on PWS. The weight coefficients for each perspective, concerning the customers, the owner (municipality) and the water utilities (concessionaires) were obtained by the panelists and the normalization was calculated using Equation (3.1):

$$w_i = \sum_{j=1}^{m} \frac{w_{i,median}}{MAX(W_{median})} X\ 100 \qquad (3.1)$$

where, m corresponds to the number of panelist and w_i is the mean of each criterion and perspective. More details regarding the swing weighting by argument-Delphi technique are provided in Appendix VIII.

3.1.5 Results

3.1.5.1 Whole Delphi technique

In the test phase of the questionnaire, three panelists were invited to participate to evaluate and improve the form and content of the draft version. The feedback was 100% and a little change was made in terms of form. The Delphi technique (modified and argument design, i.e., 1st and 2nd stage) took 120 days although the total of 100 days was previously defined.

In the first stage (83 days), the period of 40 days initially granted for the '1st round' was extended by 10 days to obtain a greater adhesion of the panelists. However, the 2nd round was 'compensatory' concerning the time required. In the second stage 37 days were sufficient to complete the process.

3.1.5.2 Modified-Delphi

The 1st round feedback was from 42% of the panelists, i.e., from the total of 48 questionnaires sent, 20 were answered. In the 2nd round, the feedback was 70%, i.e., from a total of 20, there were 14 feedbacks. The total procedure participation was 29%. Wright & Giovinazzo (2000) and Gordon (1994) suggest levels (for non-feedback rate) of about 30–60% (1st round) and 20–30% (2nd round). According to those authors' parameters, the feedback was sufficient for this proposal. Nevertheless, some particularities should be pointed out: (i) the method was carried out via electronic contact, (ii) the difficulty of the matter, and (iii) the time required to answer the questionnaire was more than 10 minutes, which could contribute to the amount of 'no answer' responses. Figure 3.4(a) shows the participants' representativeness.

In terms of representatives, the main stakeholders identified in the whole modified-Delphi, involving about 80% of the total, were: (i) concessionaires, (ii) municipalities, and (iii) regulatory authorities (Figure 3.4(b) and 3.4(c)). The academic, consultation and water sector association maintained their participation during the process. In this way, one can conclude that the stakeholders who answered the questionnaire are representative of the PWS.

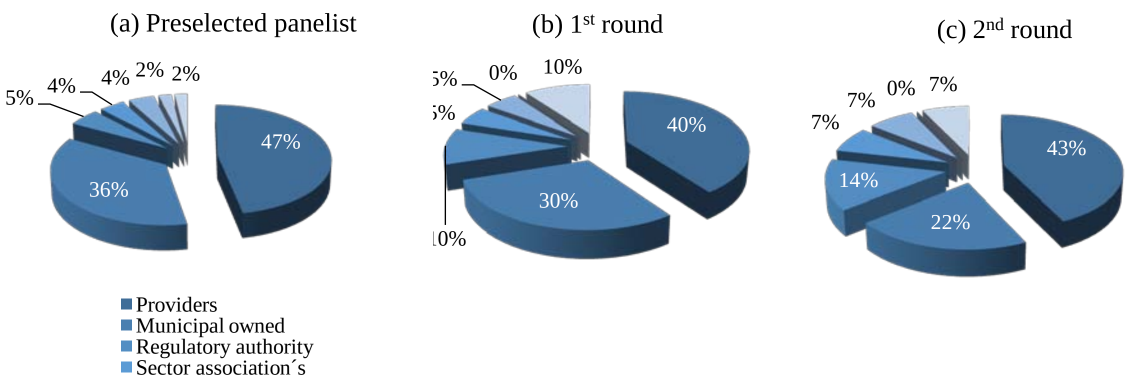


Figure 3.4 – (a) preselected panelist, (b) 1st round and (c) 2nd round.

In terms of convergence, the ‘number of rounds’ and IQR were considered. Three iterations are typically sufficient to identify points of consensus and also the IQR 1.5. Figure 3.5 shows the IQR (1st and 2nd interaction).

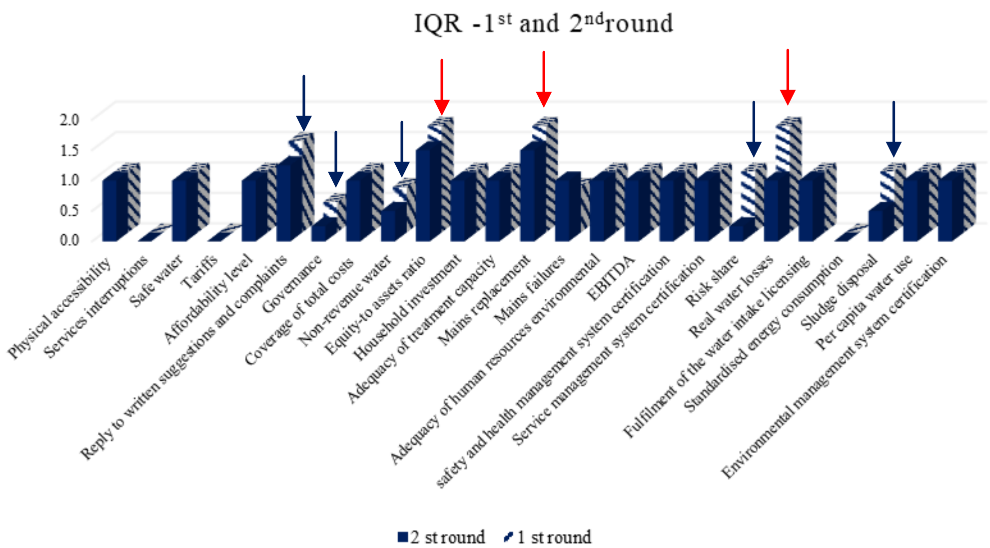


Figure 3.5 – IQR by the 1st and 2nd feedback.

In the 1st round only three criteria were superior to the pre-stablished limit (1.5) (red arrows) which forced to invest in the 2nd round in order to achieve the pre-established goal. However, five others (blue arrows) decreased in terms of IQR and the remainder kept at the same level as before. As a result, the measure of consensus was acceptable and reliable, which let to follow on to the next step in the direction of the most relevant criteria through statistical analysis. Based on the parameters presented in the modified Delphi Subsection, 13 criteria (black arrows, Figure 3.6) were selected from the total of 24. Figure 3.6 shows the average, mode and median as a final result of the modified Delphi. More information concerning all criteria are available in Appendix V and selected criteria in Appendix IX.

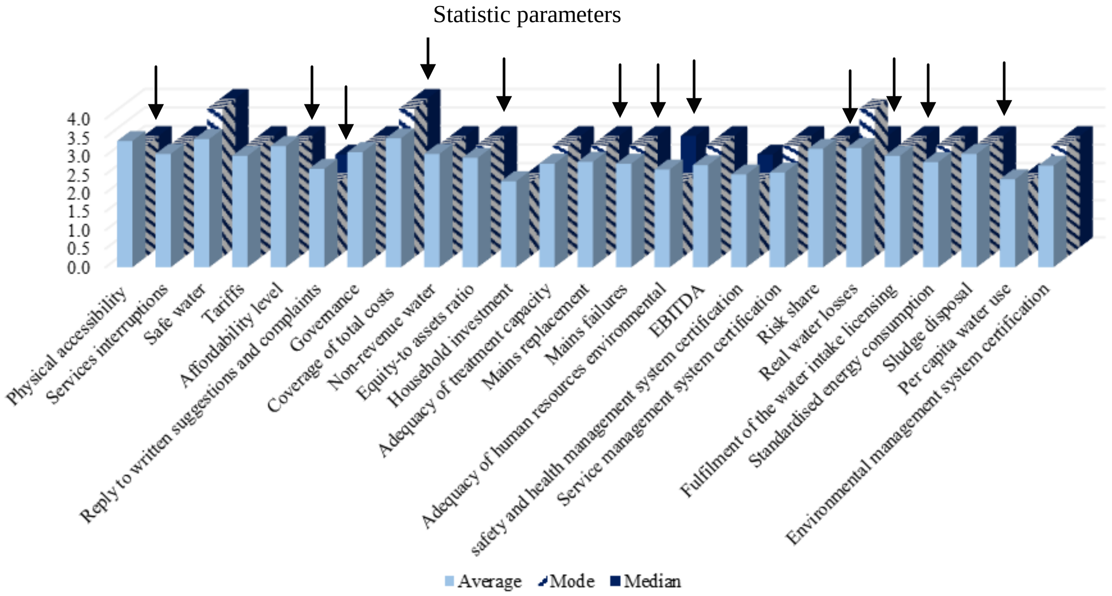


Figure 3.6 – Descriptive statistics of the criteria.

3.1.5.3 Argument-Delphi

The argument-Delphi was developed to allow evaluating the non-neutrality of SP in the PWS. Thus, the elicitation weights coefficient W_i, i = 1 to 13 associated with each $C_{i\text{-}th}$ criterion by swing-weights might be a convenient way for weighting. Indifference individual utility functions are assessed using the range of attribute values for the policy options being considered.

Feedback in the 1st round was received from 53% of the panelists, i.e., from the total of 15 questionnaires sent, eight were answered. In the 2nd round, the feedback was 88%, i.e., seven answered. The feedback in the total process was 40%. The representatives identified in the argument-Delphi (second part) were: (i) municipalities, (ii) customers, and (iii) concessionaires. Based on Wright & Giovinazzo (2000) and Gordon (1994) parameters, the feedback was sufficient for a such proposal. The 'number of rounds' were achieved in this analysis.

Figure 3.7 provides the median in terms of customers', municipalities' and concessionaires' perspectives (1st and 2nd round). The median was calculated by Equation (3.1).

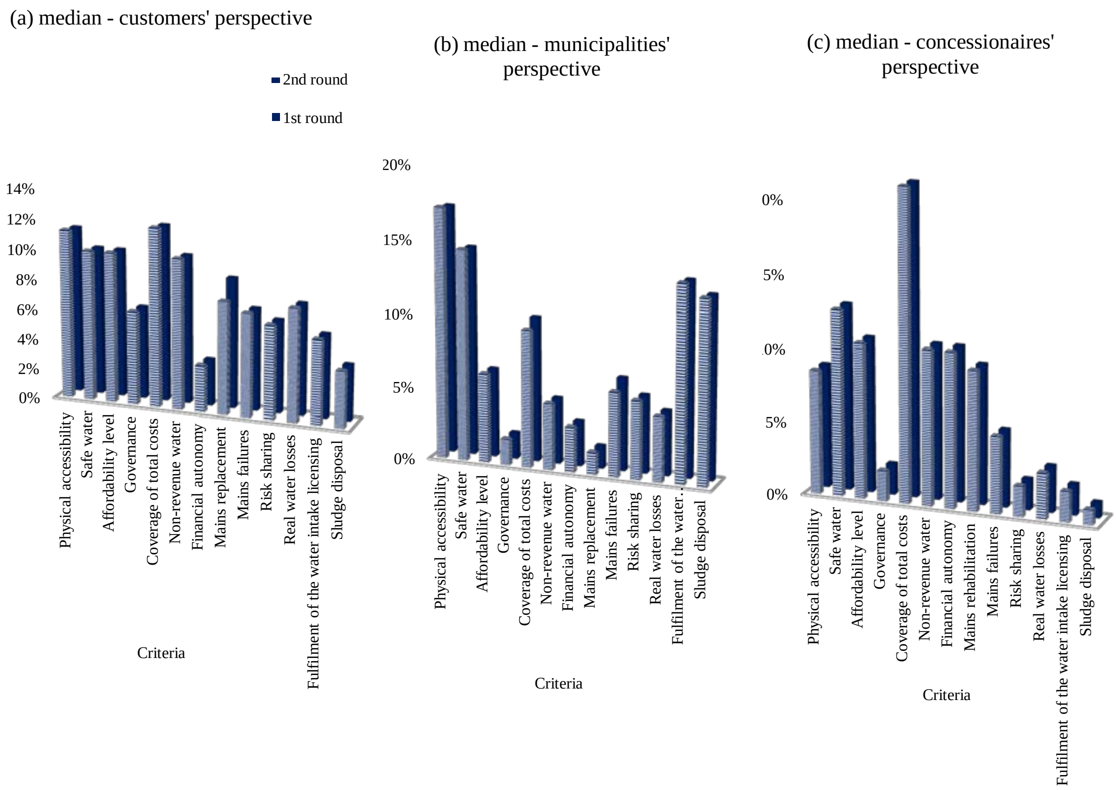


Figure 3.7 – Outputs (1st and 2nd round) from argument-Delphi in different perspective: (a) customers, (b) municipalities and (c) concessionaires.

First, the results show an interesting aspect of changing perspective. The 'concessionaires' perspective' was more reluctant in terms of modifying its answer between the rounds. In fact, it can be associated with the following hypothesis: (i) time to (re)valuate, and (ii) more conservative assumptions. The customers and municipalities' perspectives were more flexible in the round interaction. In a specific way, four criteria were not modified, these were financial autonomy, mains failure, real water losses, and sludge disposal from the customers' perspective, and affordability level, governance, non-revenue water, and risk sharing from the municipalities' perspective. Second, the group of graphics shows "how the preference is heterogeneous and unbalanced". From the customers' perspective, there is a smoother variation between criteria. On the other hand, the concessionaires' and municipalities' perspectives highlighted 'coverage of total costs, safe water, affordability level, non-revenue water and financial autonomy' and 'physical accessibility, safe water, fulfillment licensing and sludge disposal', respectively.

Additionally, based on the data analysis, from the customers' perspective, the following criteria were highlighted: coverage of total costs, physical accessibility and at the same level the affordability, safe water and coverage of total costs. From the municipalities' perspective, the following criteria were highlighted: physical accessibility, safe water and licensing. Finally, from the customers' perspective, the gap was stronger in coverage of total costs and safe water. In fact, this analysis shows in a clear way the trade-offs between stakeholders.

To summarize, this innovative approach allows to understand the different perspectives of each stakeholder, as well as the balance of preferences. Here, the non-neutrality of elicitation weights in a multicriteria problem is demonstrated. In fact, these results show how Law no. 194/2009 might be improved or reviewed regarding the water agenda. In this sense, this consult method can reinforce the need to check the potential distributive effects of any regulation act from the government.

3.1.6 Concluding remarks

Firstly, this research identified the potential use of RIA as a policy tool in an innovative and unprecedented case in the water agenda, showing the clear relation between the steps – objectives from Law no.194/2009, criteria and their descriptors, and also the preferences of stakeholders – and their contribution to the decision-making process.

Secondly, consult methods in this RIA approach become an exercise in sharing responsibility and social learning and can promote the governance of the water system. In this sense, by searching through and reviewing the literature, such analysis be able to confirm that the Delphi in the RIA approach could be used as a valid instrument for forecasting (Landeta, 2006) and supporting decision making providing, in this case study, crucial links between the objectives of this Law referred to and the perception of each representative studied.

Thirdly, the first part of Delphi (modified design) does not only allow to build the link between the objectives of Law no.194/2009 and 24 criteria pre-selected based on data available, but also to improve the reliability, the validity of such analysis and reduce some of the bias, e.g., myopic problem representation and omission bias. The second part of Delphi (argument design) highlighted how the perception changes, either under the customer, municipality or concessionaire perspectives. Here, while the customers' perspective is well distributed between the four objectives, municipalities focused on customers and environment protection, and providers focused on economic sustainability. The stability of the modified-Delphi was achieved in both parts according to the literature parameters.

Fourthly, in general the methods that are envisioned to pick up, improve and process the subjective information most relevant for a complex problem are a valuable complement for the application of techniques and construction of models mainly stemming from objective data. The experiences presented here provided with evidence that the Delphi method enhances the institutional participation and communication in the RIA approach. Moreover, this exercise presents not only the frame that can support policy decision, but also indispensable elements that need to be considered in Law no.194/2009. This is a typical academic exercise with clear contributions to policymaking circles.

However, the aforementioned experiences have allowed to learn certain lessons about effectively running Delphi exercises in the water agenda. Thus, some lessons deserve particular attention in both stages in order to support the RIA consultation step:

- being creative in order to encourage contribution and sending or requesting the feedback;
- giving simple and adequate information in the attendance of experts;
- giving the same level information in multicriteria problems to the stakeholders in order to reduce bias (first stage) and also trying to convince them to answer according to their perspective when possible (second stage);
- having institutional support facilitates, e.g., expert collaboration;
- looking for policy options that not only enable the reduction of bias from subjective judgements in support of decision policies, but also provide the analyst with more reliable information;
- putting oneself, and the test-team, in the place of the panelist, generally it is necessary to sacrifice questions and rounds in order to guarantee panel participation and continuity;

- selecting a panelist who can make effective contribution to knowledge area and sector, with his/her degree of motivation to take part of the research;
- the study must not finish for the panelist when the last completed questionnaire has been sent; the expert must be aware when the study has finally finished that his or her contribution has been of some use.

Finally, in the following lines there are some thoughts in terms of consultation methods for RIA that can improve the regulatory system:

- In PPP arrangements, which has been noteworthy worldwide, this approach enables the capture of the real perception of stakeholders in order to design or review laws or regulation in a more effective way.
- RIA consultation in the water agenda might enable more consistent decisions on the conditions that need to be met when accountability and more effectiveness actions of public policy are required by society.
- This type of qualitative technique, properly applied, may contribute to improving the efficiency of the quantitative techniques, e.g., MCDA modeling methods in RIA, by allowing them access to a new type of information, which is relevant for understanding, and modeling the problem studied.
- With consultation /participatory methods on RIA, relatively high levels of reliability and validity for a technique of these characteristics could be achieved.

3.2 REGULATORY IMPACT ASSESSMENT (RIA): AN EX-POST ANALYSIS OF WATER SERVICES BY THE LEGAL REVIEW IN PORTUGAL

Paper is published in Water Resources Management, B.E. de Carvalho, R.C. Marques and O.C. Netto

Abstract: This Subchapter adopts an ex-post regulatory impact assessment (RIA) to analyze the effects of Law no.194/2009 on public-private partnerships (PPP) in the water sector in Portugal. Although the water services have been improving concerning coverage and safety since 1990, any change in regulation can have both “positive and negative” consequences either for customers, providers or local governments. This context can provide the opportunity to observe a national experiment of regulatory reform and assess its outcomes based on the following multiple targets: (i) customer protection; (ii) governance; (iii) financial, infrastructure and operational sustainability; and (iv) environmental improvement. To evaluate the impact of this legal reform, three steps were considered: (i) the status quo, scenarios and perspective; (ii) assessment; and (iii) consultation. Additionally, two aid methods were used: (i) expert opinions (Delphi) and (ii) multicriteria decision modelling method (TOPSIS) based on similarity distance to ideal solution. In fact, Law no.194/2009 reduced the gap in terms of performance between the concessions, but amplified the contrasts when all perspectives are compared. Regarding policy objectives, the major gap to overcome in a possible review of this legal framework is linked to the “economic-financial, operational and infrastructural sustainability objective”. Failures in any of these aspects can result in an ongoing PPP not meeting customer, municipality and concessionaire’s expectations.

Key words: Legal Review; Multicriteria Decision Analysis; Portugal; Regulatory Impact Analysis; Water Sector.

3.2.1 Introduction

The water sector reform in Portugal, which started in the beginning of the 1990s, changed the combination of private and public partnership to promote a genuine “industry of water” and ensure the stability of policies. Law no.372/1993 allowed private participation in the water sector, although Law no.147/1995 also elaborated certain aspects of municipal concessions. Later, a legal reform was carried out by the enactment of Law no.194/2009, which nowadays is the basis of the regulatory framework of public water supply, wastewater collection and treatment and municipal waste management. This law aimed to ensure the protection of customer interests and to safeguard transparency, along with economic and environmental sustainable principles.

In Portugal, the State and the municipalities share the regional responsibility for water services. The State is responsible for the multimunicipal systems (bulk wholesale services), while the municipalities are responsible for municipal systems (retail services). The providers assigned with the provision of these services may decide among three different management models, namely: (i) direct management, (ii) delegation and (iii) concession, and are able to promote public-public partnerships or public-private partnerships.

In fact, the importance of private partners in the mainland PWS and the legal reform by Law no.194/2009 provides an opportunity to observe a nationwide multi-target experiment of regulatory review to make an overall assessment of its outcomes considering the data available focused on water retail services.

Unfortunately, ex-post multi-objective assessment is frequently neglected in the decision-making process. The main reason is the lack of qualitative-quantitative, consistent and systematic methodologies, although there are a few guidelines to change this type of problem. Notwithstanding this, the proposed aid methodology was based on RIA that could be a way to trigger innovation in “water agenda”. Such approach should link the performance gap and the regulatory intervention improving the domains of “regulatory-institutional, natural-physical environment and organizational characteristics” (Spiller et al., 2015).

Here, as mentioned in last Subchapter, RIA can be understood as a policy tool that allows the examination of selected potential impacts arising from government action (Carvalho et al., 2017b). Moreover, RIA can help the decision-makers by (i) reducing the uncertainty of public decisions, (ii) reducing the influence of providers of utilities sectors, (iii) making explicit the trade-offs of political actions and (iv) systematically organizing the scattered information (Lima, 2010). In fact, this approach links the governance and regulatory substance to boost the regulatory system (Brown et al., 2006).

By taking the potential benefits of RIA into account, this Subchapter tries to implement it in line with theory and a proposed framework developed by (Carvalho et al., 2017a). In this Subchapter, RIA approach considered three stages, i.e., (i) status quo, (ii) assessment and (iii) modified consultation. Two scenarios, “Law no.194/2009” and “do nothing or no policy change”, as well as the legal objectives, policy options and criteria were presented at stage (i). The scenario “do nothing” was developed by statistical influence regarding the PWS based on the data available. The “assessment stage” was dedicated to evaluate the alternatives (concessionaires), after and before Law no.194/2009 in each criterion, through the analytical methods selected by the guidelines formulated by Roy and Słowiński (2013) and (Greco et al., 2016), but also due to the ease of use, transparency, time and resource requirements. Here, multicriteria decision analysis (MCDA) provides an efficient means to develop strategies in the presence of different objectives and constraints to satisfy the broad objectives defined by the sociopolitical conditions which are sometimes non-commensurable and conflicting (Afshar et al., 2011).

As to the consultation step, the Delphi technique was used in two stages instead of public consultation because of the academic characteristics of this RIA exercise as discussed in details in Subsection 3 of the Subchapter 3.1. This step recognizes the need for an open government agenda in such ex-post analysis.

Based on the proposed RIA approach (Chapter 2), the present exercise contributes to the literature by proposing a consistent evaluation methodology, for which the case study of Portugal’s legal reform offers an excellent example. This proposal is innovative concerning the use of RIA in a non-traditional sector, i.e., water supply, where decision-makers often neglect the multiple targets. Further, combining consultation and analytical methods allow to get more reliable information before checking the ex-post analysis. In fact, this work represents the first known efforts to apply RIA in the water sector.

The remainder of this Subchapter is organized as follows. The second Subsection describes the water sector in Portugal, the legal review and its most distinctive outcomes. The RIA approach is briefly explained in the third Subsection. The methodology proposed is outlined in the fourth Subsection. Subsection 5 shows the results, and Subsection 6 provides the concluding remarks and policy implications.

3.2.2 Portugal water sector: from Law no.46/77 to Law no.194/2009

Law no.46/77 prevented the private companies from accessing economic activities in the water sector. However, at the beginning of the 1990s, (i) the poor coverage, (ii) the quality of service provided, (iii) the need for huge investments to universalize the water and wastewater services and (iv) the need to comply with the EU environmental standards led the government to the enactment of Law no.372/93, which opened the possibility for private capital participation in the water sector. Laws no.379/93 and no.147/95 regulated the private participation in the water sector by concession arrangements (contractual Public-private partnership - PPP), and Law no.58/98 (amended by Law no.50/2012) regulated the municipal companies, including the institutional PPP arrangements (mixed companies). Later, Law no.194/2009 replaced the existing legislation improving the regulatory rules of all possible arrangements, ranging from fully private to fully public in a single document. It configures the current legal and regulatory framework of the water sector in Portugal.

Although the enactment of this law had several aims, one of them, and perhaps the main one, was to improve the PPP model (including contractual and institutional approaches). This model was acknowledged as displaying problems and conflicts between the owner and the concessionaires that had not provided the intended value for money.

Currently, there are no clear indications of this law’s effects, whether positive or negative concerning private sector participation in the PWS. Thus, one strategy to check the effectiveness of Law no.194/2009 is building a prescriptive, systematic and consistent aid methodology based on its explicit objectives of customer protection, transparency, economic development and environmental preservation. Thus, RIA approach was implemented considering different perspectives of customers, municipalities and concessionaires.

3.2.3 Regulatory Impact Assessment

The idea of RIA is not recent. The exercise of analyzing policy impacts had emerged long before it became a topic on the agenda, beginning with system analysis, operations research and policy analysis in the 1950s and 1960s (Dunn, 1994; Miser & Quade, 1985). Currently, debates around the world about RIA have intensified, not only on state capacity and governance, but also concerning its better understanding and applicability in different regulatory levels and sectors.

For this Subchapter, RIA is a policy tool that systematically evaluates the potential impact arising from government regulation and allows broad collaboration with stakeholders following (i) status quo, (ii) assessment, (iii) consultation and (iv) review or final step (Carvalho et al., 2017a,b).

The first step, “status quo”, is composed of (i) the problem and context, (ii) purpose, (iii) scenarios and (iv) potential impact (criteria). The “assessment” comprises the analysis of scenarios, assumption of the level and analysis of the options in each impact (criterion) as to profits and losses. The “consultation” step is the recognition of the need for transparency and openness among stakeholders (EMF, 2008). The “final” step consists of periodically reviewing the regulations to evaluate the extent to which they are achieving the objectives/intended benefits.

In terms of tools, some methods can contribute to the development of the RIA process, e.g. (i) monocriterial, MCDA and risk methods that enable the impact assessment of policy options; (ii) Monte Carlo simulation and integrated sensitivity analysis; and (iii) conference panel, nominal group technique and Delphi as aid methods which allow the description of policy problems, identification of criteria, development of alternatives and scenarios, and assist the analytical methods (mono, multicriteria and risk methods) in a different way.

The use of each tool depends on the complexity of the problem. The combination of methods should be appropriate for cases involving social, economic and environmental aspects, uncertainties and significant representation of interested parties. In this sense, RIA can be applied to policies that typically have multiple targets, as in a such case, not only in ex-ante, but also ex-post analysis to identify the potential imbalance of ongoing regulations, e.g., Law no.194/2009.

Nowadays, a second-generation multidisciplinary research agenda on water governance, which integrates economics, politics and administration, pays more attention to incentive issues and has clear policy implications (Araral & Wang, 2013). Thus, RIA approach, as a new generation substance, can support a more robust, reliable and transparent decision-making process on the water sector and promote a good regulatory governance not only regarding regulatory quality, but also administrative capacity, open government (transparency and participation), accountability and rule of law.

3.2.4 Research methodology

3.2.4.1 Overview

To evaluate the outcomes of the legal review in the PWS, an assessment framework based on the RIA approach, shown in Figure 3.8, was carried out. Such framework considers the following steps: (i) status quo, (ii) assessment and (iii) stakeholders' group consultation.

In the context of ex-post analysis of regulatory alternatives, the decision-maker usually compares an existing situation to a set of potential scenarios including "do nothing" and tries to identify one or more viable policy option. In a such case, Law no.194/2009 was considered as a "purpose". Two scenarios were considered: (i) "the current" and "do nothing or no policy change". To develop the optional scenario, the data series of each concessionaire and criterion with the evolution of PWS excluding the concessions were combined. This approach allows to build a trend line composed of historical and projection adapted to each concessionaire being consistent with the evolution of the PWS.

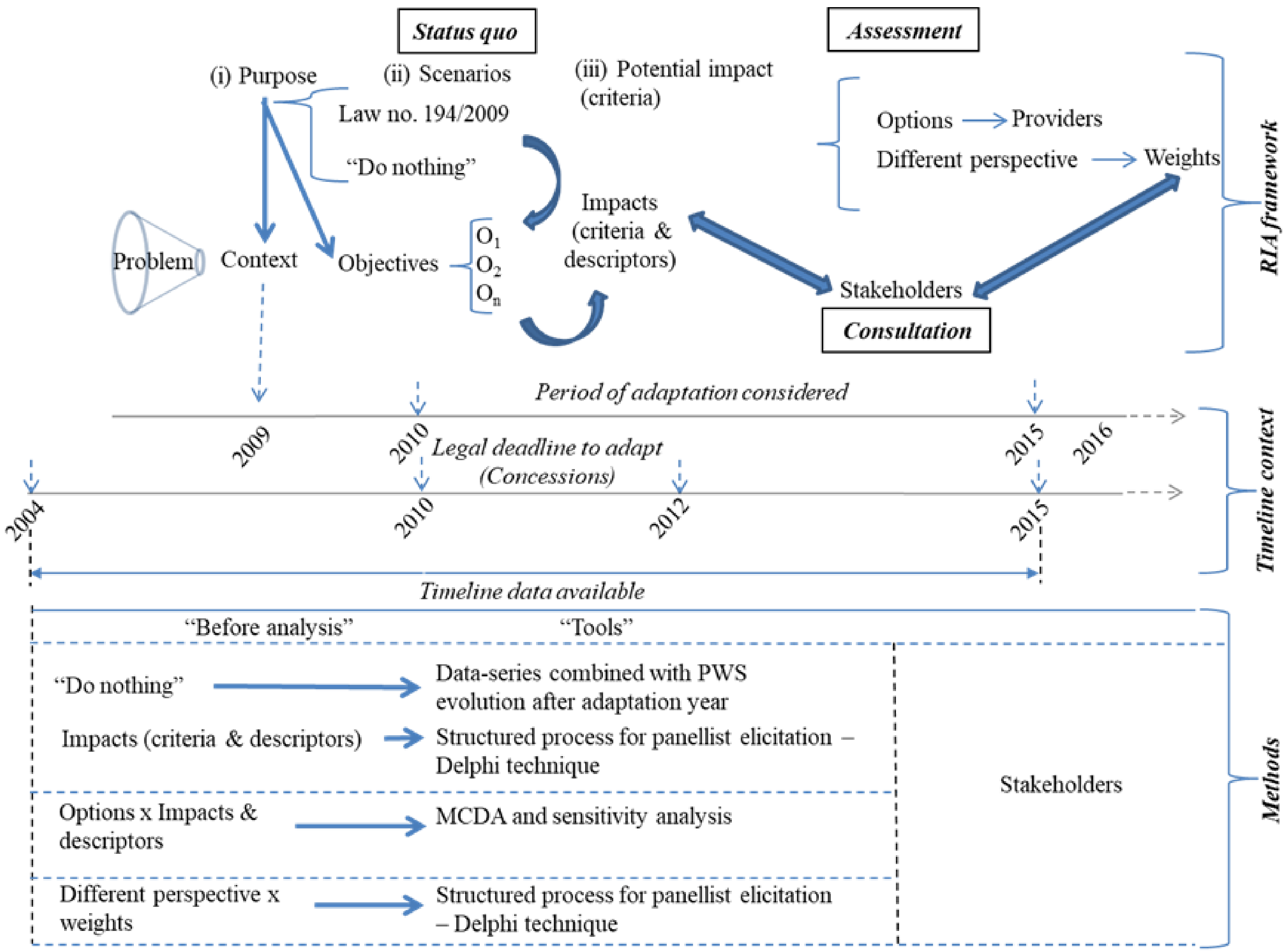


Figure 3.8 – Consolidating RIA framework.

3.2.4.2 Objectives from Law no.194/2009 and pre-selected criteria

Considering the Portuguese context for implementation of the RIA proposal, the potential relationship between the objectives of Law no.194/2009 and its potential representative criteria was developed (see Subchapter 3.1). These pre-selected criteria and their descriptions and indicators are available in Appendix V. To build the link between “options x impacts”, the dimensions recommended by ERSAR and the data available were considered.

3.2.4.3 Policy options

The selected policy options in a such proposal are directly linked to the data available, i.e., concessions created before 2010 and adapted (to the new law) until 2014. Considering this information, 11 concessionaires (Figure 3.1) were selected, representing over 42% of the total households covered by retail concessions.

3.2.4.4 Scenario “do nothing”

To evaluate the scenario “do nothing,” statistical influence (data-series and PWS evolution) was used for prediction. Algebraically, this stage were calculated by the Eq. 3.2:

$$P_{pc} = (p_t) x\ E_{pws} \qquad (3.2)$$

where P_{pc} is the performance after the adaptation year regarding *p* concessionaire and *c* criterion. In this case, p_t corresponds to the performance of the *p* concessionaire and *c* criterion in t adaptation year. Moreover, each impact (after the adaptation year) is correlated to the E_{pws}, which, was calculated by the data-series related to the direct management and delegation arrangements in PWS.

Finally, the results were validated by the focus group (composed of experts from ERSAR, academy, municipalities and providers). Then, the projection result was considered in a matrix of MCDA.

3.2.4.5 Selecting criteria

Typically, the decision-maker or decision-makers do not represent the group of experts, and the group of experts should not be considered responsible and accountable for the final decision (French, 2011). The literature review revealed that researchers have used all types of descriptive statistics (median, mode and interquartile range IQR) to measure consensus in a quantitative way and the number of interaction rounds according to some pre-defined levels. In a such proposal, the measure of consensus was done considering the number of rounds, which in many situations might also be sufficient (von der Gracht 2012), and IQR value, which is the measure of dispersion of the median and consists of 50% of the observations. Finally, the impacts were selected based on statistical parameters (mode, median and average). As the same case of Subsection 4 of this Subchapter, the details of "selecting criteria" area available in Subchapter 3.1.

3.2.4.6 Elicitation weights in a different perspective

In line with Montibeller and von Winterfeldt (2015), the swing-weighting method was adopted. It addresses the variation of the weighting coefficients as the value measure swings from the lowest to the highest value level in the scale. The value function for each attribute is available in Appendix VII. The weighting coefficients (w_i) for each perspective concerning the customers, the owner (municipality) and the water utilities (concessionaires) were obtained by the panelists through argument-Delphi design (Hasson & Keeney 2011), and the standardization was calculated using the following Equation 3.3:

$$w_{i,stand} = \sum_{j=1}^{m} \frac{w_{i,median}}{MAX(W_{median})} X\ 100 \qquad (3.3)$$

where, m corresponds to the number of panelists and w_i is the mean of each criterion and perspective. As the same case of Subsection 4 of this Subchpater, the details of "selecting criteria" area available in Subchapter 3.1.

3.2.4.6 Choosing the right method

To select the MCDA method (see more details in Greco et al., 2016), the analyst should start with reflecting on the best or even the only way of answering the following essential question, "what type(s) of results is the method expected to bring?" Consequently, in many cases, the answer to the above question may lead at this stage to a shortlist of more than one method. The final choice of a particular method will result from the answers to the questions formulated in "five other key questions to choose the right method" and "secondary questions" that can be found in Roy and Słowiński's (2013) work.

To evaluate Law no.194/2009 based on the problematic way (see Greco et al., 2016) and the guidelines by Roy and Słowiński (2013), the technique for order preference by similarity to the ideal solution (TOPSIS) model was chosen. To adapt TOPSIS in a such case, four category levels (very good, good, neutral and poor) were defined based on comparative trend performance between "before and after adaptation year" for each concessionaire.

In TOPSIS, the optimal policy option should have the shortest distance from the positive ideal solution (PIS) or, contrarily, the farthest from the negative ideal solution (NIS), for solving a multi-attribute decision-making problem. In brief, TOPSIS minimizes the measure of distance, provided that the closest solution should have the shortest distance from PIS and also the longest distance from NIS (Jadidi et al., 2009). This method is a distance-based approach, and its general procedure consists of the following steps (Shih et al., 2007):

(i) *Construct a performance matrix*: An $n \times q$ matrix contains the raw consequence data for all alternatives against all criteria;

(ii) *Define the ideal and anti-ideal point*: Set the ideal point $(v_j)\ a+$, and anti-ideal point,$(v_j)a-$, based on the normalized performance matrix. For positive function criterion, $c_{j,}$, (Equation 3.4):

$$v_j(a^+) \quad \text{and} \quad v_j(a^-) \quad ; \tag{3.4}$$

but for negative function criterion, $c_{k,}$ (Equation 3.5):

$$a^{+}) = min_{i=1}^{n} v_j^i \quad \text{and} \quad v_j(a^{-}) \quad ; \tag{3.5}$$

(iii) *Assign weights to criteria:* Set $w_{i,stand}$ ($w_i \in R+$) to represent the relative importance of criterion c_j (Equation 3.3).

(iv) *Calculate the distances* of a^i to the two ideal points, a^+ (Equation 3.6) and a^-(Equation 3.7): A commonly used distance definition is the p-norm distance function. Compute the distances of D(a^i) to a^+ and D(a^i) to a^- using p-norm distance functions.

$$D(a^i)^{+} = \left\{\sum_{j=1}^{q} w_i \middle| v_j(a^{+}) \right. \tag{3.6}$$

and

$$D(a^i)^{-} = \left\{\sum_{j=1}^{q} w_i \middle| v_j(a^{i}) \right. \tag{3.7}$$

where, p is a pre-defined distance usually set as 1 or 2 and $\left|v_j(a^{+}) - v_j(a^{i})\right|$ or $\left|v_j(a^{i}) - v_j(a^{-})\right|$ represents the absolute value of x. The distances of ai to the ideal and anti-ideal points have to be integrated to reach a result. One way to integrate these two distances into an overall distance of ai, D(ai), can be expressed as Equation 3.8.

$$D(a)^i = \frac{D\,(a^i)^{-}}{D\,(a^i)^{-} + D\,(a^i)^{+}} \tag{3.8}$$

where a larger value of $D(a^i)$ represents $D(a^i)$– better overall performance.

There are three common distances of Minkowski's metrics (p) to be recognized: Manhattan (city block) or linear distance p=1, Euclidean distance p=2, i.e., the length of the line segment connecting the q_i to the PIS and to the NIS (Equations 3.6 and 3.7) and Tchebycheff's distance p=∝, which involves the infinite root an infinite power minimizing the maximum criterion distance (Eq. 3.9 and 3.10). Appendix X provides all types of distance into TOPSIS modelling method.

$$L_{PIS} = MAX\{1 - v_j(a^i)\} \quad (3.9)$$

$$L_{NIS} = MAX\{v_j(a^i)\} \quad (3.10)$$

In general, p is a real number ≥ 1, but three positive integer values are common for Minkowski's p metric with p = 1, 2, and ∞ (Shih et al., 2007).

The first two seem to easily fit to the purpose, although the distance for all different values were calculated of p. In fact, the different distances in a such proposal are intended to check the sensitivity analysis for the model considering the distributions of weighting coefficients. In line with Mendonça (2009), the results were discussed based on Euclidian distance (p=2).

3.2.5 Results

Law no.194/2009

Figure 3.9 shows the performance of each concessionaire concerning the integral Euclidean distance (IED) of ideal and anti-ideal solutions in different perspectives based on the data surveyed, which could be translated into a heterogeneous distributive effect regarding policy achievement. Considering this research data, Law no.194/2009 was more effective in the municipalities' perspective (gap between 2010 and 2015) than in the customers and concessionaries' perspectives (black double arrow, Figure 3.9). To improve such analysis, Table 3.2 includes the effect level "after and before" Law no.194/2009 according to the perspective analyzed, whether that of the customers, municipalities or concessionaires.

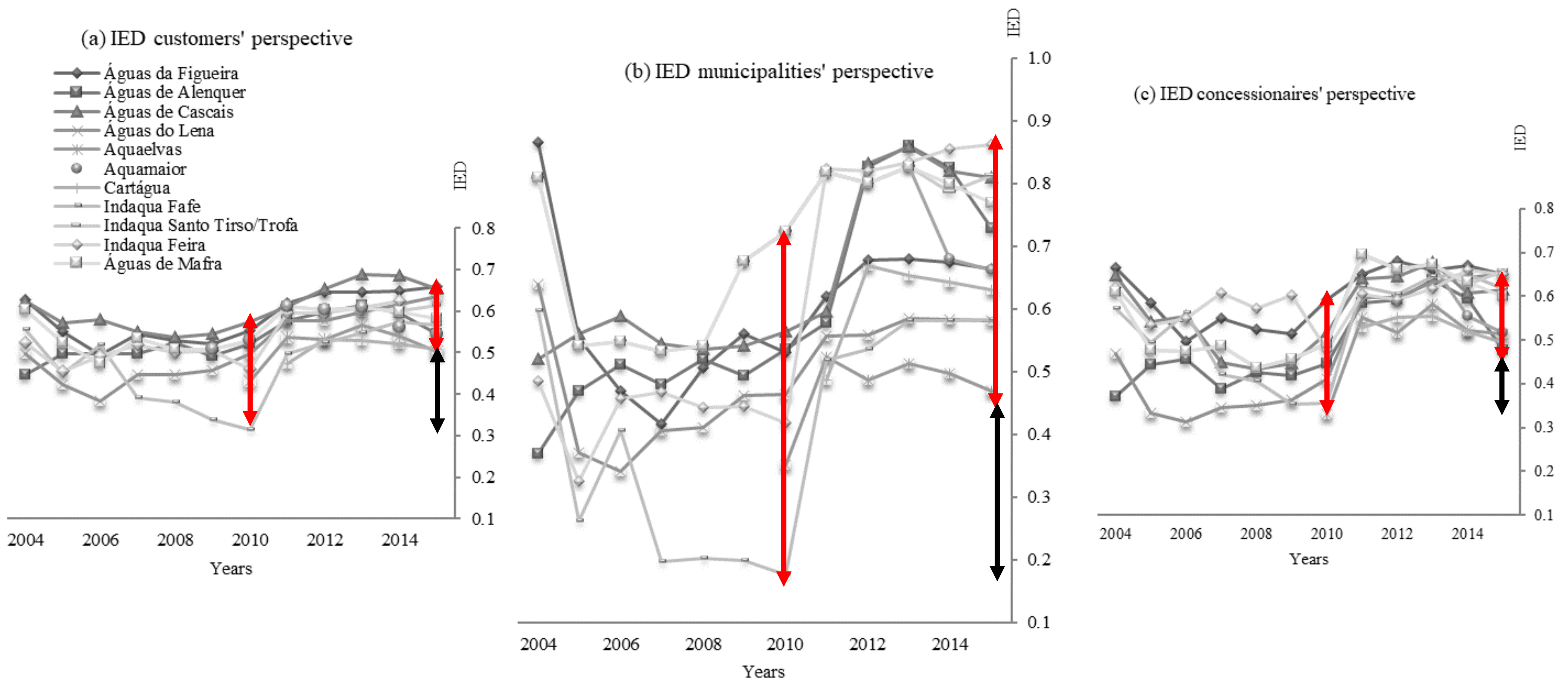


Figure 3.9 – Scenario Law no.194/2009 results of TOPSIS according to the different perspectives: (a) customers, (b) municipalities and (c) concessionaires.

Table 3.2 – Effect's level before and after Law no. 194/2009.

Concessionaires	Adaptation year	Level of effect		
		Customers' perspective	**Municipalities' perspective**	**Concessionaires' perspective**
Águas da Figueira (AdF)	2012	☺	☺☺	☹
Águas de Alenquer (AdA)	2011	☺	☺☺	☺
Águas de Cascais (AdC)	2012	☺	☺☺	☺
Águas do Lena (AdL)	2010	☺☺	☺☺	☺☺
Aquaelvas	2012	☺	☹	☹
Aquamaior	2011	☺	☹	☺
Cartágua	2012	☹	☺	☹
Indaqua Fafe	2010	☺☺	☺☺	☺☺
Indaqua Sto. Tirso/Trofa	2011	☺	☺	☺
Indaqua Feira	2010	☺☺	☺☺	☹
Águas de Mafra	2012	☹	☹	☹

Legend:
Very good☺☺,Good☺, Neutral😐, Poor☹
Scale in terms of IED: 1<☺≤20%; ☺☺>20%; -10%≤☹<0; -20%<☹☹<-10%; 😐 no variation.

An interesting point here is the performance disparities between the studied perspectives of some concessionaires, e.g., Águas da Figueira, Aquaelvas, Aquamaior and Cartágua. Negative performance in all perspectives was found in Águas de Mafra. Finally, positive performance in all perspectives was found in Águas de Alenquer, Águas de Cascais, Águas do Lena, Indaqua Fafe and Indaqua Sto Tirso. After 2013, a stabilization or slight decrease in performance in all perspectives was observed.

Concerning the objectives and criteria analysis, Figure 3.10 shows the average contribution for each criterion in terms of positive and negative values obtained with Equations 3.11 and 3.12. Here, if the gap between the positive (black stacked) and negative (gray stacked) is small, the policy presents satisfactory performance for that criterion. Such graphs show the opportunities for (re)considering the pre-defined objectives of ongoing and/or new regulations and policies.

$$Average(c^{1-13})^{+} \tag{3.11}$$

$$Average(c^{1-13})^{-} \tag{3.12}$$

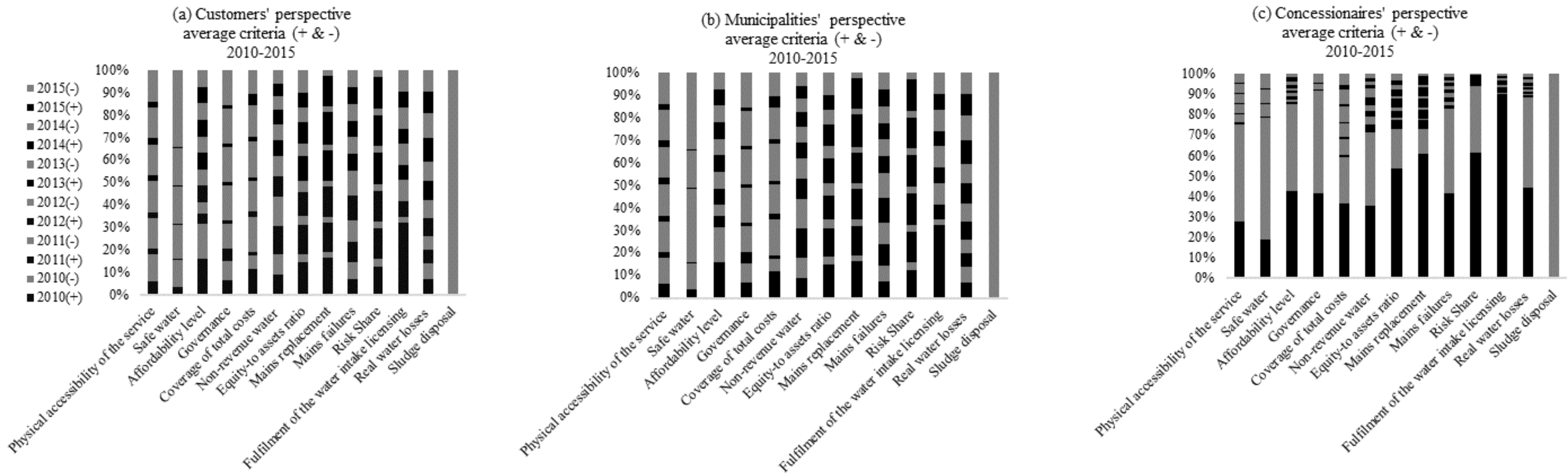


Figure 3.10 – Criteria's impact according to the different perspectives: (a) customers, (b) municipalities and (c) concessionaires.

From the first adaptation to Law no.194/2009 (2010) until 2015, the major gap to overcome was linked to the "the economic-financial, operational and infrastructural sustainability objective" irrespective of the perspective, whether that of customers, municipalities or concessionaires. Based on a such data analysis and according to the customers' perspective, the following criteria need more attention: mains replacement, non-revenue water and affordability level. In the municipalities' perspective, the following criteria were highlighted: physical accessibility and licensing. Finally, under the concessionaires' perspective, the gap was stronger regarding the coverage of total costs, equity to assets ratio and mains replacement.

Concerning TOPSIS' distance, Appendix XI shows the results (p=1, 2 and ∞) in each perspective. The different TOPSIS' integrated distances (ID) allows to understand not only the effects of global weighting coefficients, but also the sensitivity analysis. In a such case, the curves were well adjusted. The main reason is that the difference between the global weights coefficients was small. The short variation of ID relative to the different p values was confirmed by the weights.

Do nothing

The effect level of the "do nothing" scenario under the perspectives of the customers, municipalities and concessionaires showed worse performance than the scenario Law no.194/2009. Negative results were found in Águas de Alenquer and Águas de Cascais (customers' perspective). Neutral performance was found such as in Águas de Mafra (Municipalities' perspective). However, positive performance in specific perspectives were found in Águas da Figueira (concessionaires' perspective), Cartagua (customers' perspective) and Indaqua Feira (municipalities' perspective) without Law no.194/2009 (Appendix XII).

Concerning the TOPSIS' distance, the same trend was found in a comparative scenario. To summarize, the short variation of ID in terms of different *p* values was confirmed by the weighting coefficients.

3.2.6 Concluding remarks

As in the literature on RIA, this research shows that the availability and use of information derived from the RIA process leads to a better understanding of the following steps: (i) status quo, (ii) assessment and (iii) consultation, which can enhance law-making and improve the quality of government action.

The first part of Delphi allowed not only to build the link between the objectives from Law no.194/2009 and 24 criteria pre-selected based on data available (ERSAR, concessions contracts and the website of providers), but also to improve the reliability and validity of this analysis. The second part of Delphi (argument design), i.e., elicitation of swing-weights in different perspectives, highlighted how perception changes according to the corresponding perspective (if customers, municipalities or concessionaires). Although participation of more stakeholders makes the decision processes more credible, the process can be resource consuming if not well designed and carefully planned. The stability of Delphi was achieved in both parts in line with the literature parameters, as discussed in Subchapter 3.1.

The typical MCDA approaches in a such case focus on a set of policy options in each scenario (Law no.194/2009 and “do nothing”) and consider 13 criteria to determine the policy effects in PWS under different perspectives. The RIA assessment step using the TOPSIS technique provides an effective way to understand the impact of Law no. 194/2009. The sensitivity analysis based on different *p* values confirms the expectation regarding weights coefficients distribution.

The results were not completely conclusive concerning ‘all aspects’ of Law no.194/2009 because of (i) the type of sector, i.e., water services, (ii) the number of alternatives (the concessions adapted) and (iii) the objectives (not at all objectives identified can be directly linked with Law no.194/2009, even though they were mentioned). Furthermore, as mentioned in the first Subsection, although this exercise of RIA was done by consultation with some devising technique, the outcomes expected may not reflect the accurate impact of the mentioned law. In fact, in the policy appraisal, the analysis of sensitivity and uncertainty provides a formal way to cope with imperfect information, as this case.

This proposed RIA approach suggested that Law no.194/2009, especially concerning private sector participation, had better performance when compared with the scenario “do nothing”.

However, some constraints were considered. Here, some points are highlighted based on a such analysis:

- o as to the global impact, Law no.194/2009 reduced the gap regarding performance between the concessions in each perspective, but amplified the contrasts when all perspectives are compared at the same time;
- o as to the objectives, the most important challenge to overcome considering all perspectives was the “economic-financial, operational and infrastructural sustainability,” followed by “protecting the customers” and “protecting the environment regarding natural resources conservation and transparency;” and
- o as to criteria, the most important challenge to overcome considering all perspectives was the “coverage of total costs” followed by the “equity to assets ratio, mains replacement and non-revenue water.”

In terms of policy implications, such analysis can note that:

- Although Law no.194/2009 contributed to improvements of the PWS based on the evidence presented here, its future review or new proposal needs to be deeper and more structured, if possible, by a RIA ex-ante approach.
- RIA, based on literature review, should be understand as a central element in a better regulation agenda, promoting regulatory governance grounded on transparency and the trade-off between the social, economic and environmental objectives instead of the political objectives.
- The risk sharing in data analysis concerning legal aspects and the financial review need more attention to improve the ongoing contracts and the new possibilities. Failures in any of these areas can result in an ongoing PPP not meeting customer, municipality and concessionaire expectations.
- There was a stabilization or slight decrease in the trend of performance in all perspectives observed after 2013, which reinforces the need to (re)consider new actions regarding the future of the PWS.

Based on the proposed RIA approach and data analysis, the (in)efficiency of governmental actions, contrary to what might have been expected, can be better highlighted when decision-makers neglect prescriptive tools that can improve their understanding of the preliminary context and organize the most adequate options available, including “do nothing”. Furthermore, RIA framework model should be developed with clear, simplified rules, and exemptions, considering the (i) scope of application, (ii) personal responsibility of officials, (iii) flexibility, (iv) public participation and the (v) objective of the proposal to achieve declared multi-objective goals as explored in this Subchapter. In fact, with such framework of RIA in mind, decisions that are more reliable when the decision-makers face a complex problem and when more accountability, effectiveness and rational analysis based on evidence are required by society.

CHAPTER 4. REGULATORY IMPACT ASSESSMENT IN BRAZILIAN WATER AND WASTEWATER SERVICES

4.1 RETHINKING BRASILIA'S WATER SERVICES "NEW TARGETS" USING THE REGULATORY IMPACT ASSESSMENT (RIA) TOOL

Paper submitted to an ISI journal, B.E. de Carvalho, R.C. Marques and O.C. Netto

Abstract: This Subchapter suggests a regulatory impact assessment (RIA) as an innovative approach to rethink the potential effects of "new targets" for water service policies (WS) provided in Brasília considering different perspectives: the customers', the regulator and the service providers'. Currently, terms like political/rational and expert/politician are not considered integrated parts of the process, which could create a non-desirable impact on utility services. In this respect, by using the RIA policy tool, regulators would be able to develop a basis for making good decisions regarding the environment. From that point of view, the RIA was set in order to provide the necessary framework capable of considering the multiple dimensions of Regulation no.08/2016 into water services. The multicriteria decision analysis (MCDA) combined with participatory methods were used to support RIA and overcome eventual bias from judgments on the decision makers' part. The outcomes allowed to test an innovative RIA, and also to determine a suitable option for the current situation. Finally, the social and environmental aspects were more attractive in the customers' and regulator's perspectives while infrastructural dimension was suitable for the provider.

Keyword: Brasília Water Sector; Multicriteria Decision Analysis; Regulation; Regulatory Impact Assessment.

4.1.1 Introduction

Swyngedouw (2009) pointed out that the widely promoted market-oriented model of WS, that should be provided on an affordable and universal basis (Decker, 2016), was social and environmentally unsustainable and that achieving the WS targets envisaged in the sustainable development goals (SDGs) would not be possible without a proper embedding of these services within a public, social, financial and regulatory system backed by massive national and international public funding.

To fulfill the minimal efficiency considering the regulatory system (governance, substance, and utility) (see more details in Berg, 2013) RIA assumes an important role since it helps to improve the knowledge base (Meuleman, 2014), especially in WS. Any strategy or decision such as a primary law or a secondary regulation implemented by the government could have implications and change either the public or the private sector behaviors (Massarutto et al., 2013) with consequences for society under different points of view.

However, there is no register of RIA’s (ex-ante, extempore or ex-post) applicability worldwide in the WS agenda, although some partial evaluation of legal reforms in this matter was studied in Europe after fiscal crises of the states. Therefore, this process should require not only practices but also a comprehensive understanding of the RIA conceptual model, its framework, and support methods before decision-making. From that viewpoint, implementing a homogeneous RIA process in all regulated sectors improves its compliance and social knowledge (Castro, 2014).

Although the Brazilian regulatory system does not correspond to its economic importance, nor does it have the expected power, recent studies on utilities regulated by federal agencies identified some measurement activities that were not exactly taken into consideration by RIA but they included many of its phases. RIA responds to the urgent need to pursue a different approach towards a new regulatory system. Thus, regardless the instance where the service is being provided, to implement RIA in Brazil is necessary that regulatory agencies join efforts focusing on access to regulation and answerability, that is, it requires that the regulators produce information and address stakeholders about a variety of regulatory policy instruments.

Regarding WS, Brazil has always had a historical deficit in the provision of basic services (approximately 9.8 million households have no access to water supply), which fosters inequities and enhances actual social gaps. Brasilia, which is the capital of the country and has a population of 2.98 million people (estimated by IBGE, 2016), has over 98% of the physical accessibility in terms of water supply (SNIS, 2015). Although the performance of WS in Brasília does not represent the reality of Brazil, (ADASA, 2016) - the state regulatory agency – enacted an audacious and multiple dimensional target concerning this matter: Regulation no.08/2016 of July 4, which involves the social, economic, environmental and governance areas. This recent intervention represents an opportunity to verify RIA as a policy tool under an ex-tempore time viewpoint and a different attractiveness perspective.

This innovative and academic RIA approach allowed not only the evaluation of policy options but also the reduction of bias, e.g., myopic problem representation, anchoring bias and so on (Montibeller and von Winterfeldt, 2015). Basically, three steps were considered: (i) status quo, (ii) assessment and (iii) consultation. The policy options, titled 'short term for 2018 (ST)' and 'long-term for 2020 (LT),' were extracted by Resolution no.08/2016. In addition, other two options, 'NPC 2018' and 'NPC 2020,' were built based on statistical influence with a 95% confidence interval (CI).

The impacts of each option were assessed by attractiveness through a categorical-based evaluation technique (MACBETH) developed in a way that could adapt to a specified evaluating structure in order to appraise different possibilities (Pinto & Marques, 2016). The judgment of attractiveness difference was obtained by preference elicitation by decision makers (DMs) who represented the customer's, the regulator's and provider's points of view. Finally, the outputs were checked by a thorough and robust analysis.

Therefore, this Subchapter contributes to the literature by testing the RIA framework conceptual model in the water sector by using Brasilia's WS policy as an unprecedented and relevant example. Furthermore, combining analytic and participatory methods enhanced the quality of information collected during the whole decision-making process. In fact, this work represents the first known effort to apply RIA in the water sector in Brazil.

Subsection 2 presents a brief contextualization of the water sector in Brazil and Brasília. RIA is briefly described in Subsection 3. The methodology used in this study was developed as described in Subsection 4, and Subsection 5 brings an example of its application and its corresponding policy implications. Finally, Subsection 6 draws some concluding remarks.

4.1.2 Brasília water sector in brief

Brazil has always had a historical deficit in the provision of basic services, which fosters inequities and enhances current social gaps. With the enactment of Law no.11445 on January 5 of 2007 - the national law on water, wastewater, waste and drainage guidelines (LNSB) - a regulatory framework related to these essential public services was established for federal policies.

In a general way, the provision of WS is a responsibility of local governments (Pinto et al., 2015). According to a study published by the Ministry of Cities based on data collected from the SNIS – information system on water, wastewater, drainage and waste – by the end of 2013, the water supply coverage level in Brazil reached approximately 83% of its capacity; the wastewater collection came to 50%, whereas the wastewater treatment remained way below those levels. Compared to other regions in the country, this panorama showed a great difference since the indicators in the center and southern parts of Brazil were much better (89.6 and 89.4% respectively, for water supply and 50.2 and 41.4% for wastewater treatment), whereas, in the northern and northeastern regions, the reality was much worse (56.9 and 73.4% and 16.4 and 32.1%) (SNIS, 2015).

In terms, of policy, on November 20, 2013, a national plan for water, wastewater, drainage and urban waste sectors (PLANSAB) was approved by Decree-law no.8141 as a national strategic plan for the Brazilian water sector. This plan intends to invest 508 billion BRL (Brazilian real), encompassing 122 billion BRL to water supply, 181 billion BRL to wastewater collection and treatment to achieve universal service, around 98% of water supply and 88% in wastewater by 2033.

Regarding the structure, the water and wastewater market in Brazil consists of 28 state water utilities, 6 regional companies, and 1,474 local water utilities. In most of them - almost 1,000 - the water supply and wastewater collection and treatment are provided directly by the municipalities. These 28 state water utilities encompass 4,002 municipalities in the water sector and 1,292 in the wastewater sector (SNIS, 2015).

Although the index of water coverage differed between 40% and 98% around Brasília, its current situation does not reflect the real challenges on this matter. Brasília has been experiencing an increasing rate of water coverage (0.74) and a decrease of wastewater services (0.16) since 2000. In 2014, over 98% and 82% of physical accessibility in terms of water and wasteservices (WWS), respectively, were achieved (SNIS, 2015). This picture required a constant interaction among the water utility company of Brasília (CAESB) and the water, energy, and wastewater regulatory agency of the Federal District (ADASA), all regional governments and local associations to ensure and improve the quality of the provided services, safeguard economical and infrastructural sustainability and protect customer interests.

ADASA, which is linked to the SEMA, an environmental secretary of the Federal District was created through Law no.3365/04, and later had its competences improved by the Law no.4285/08. Currently, ADASA is responsible for simultaneous regulatory functions over water resources and water and wastewater services including solid waste and drainage. Besides, it has also been operating in sectors such as gas, petrol, and oil. Although ADASA achieved prominent aspects in terms of governance, regarding laws and processes followed by an agency, there is still a gap in regulatory substance, such as tools and rules available to regulators, which could be met by investing in RIA.

Recently, Resolution no.08/2016 was published concerning the methodology for evaluating the performance of water and wastewater services in Brasilia, as well as the general procedures between ADASA and the CAESB. Additionally, this secondary legislation established targets to comply with the good practices. A total of five dimensions: (i) customers' interest, (ii) infrastructural sustainability, (iii) economic and financial management, (iv) environmental sustainability and (v) governance were carried out by the legal action.

Thus, it's fair to say that the actual conditions of the water sector in Brasília enable a chance to observe an ex-tempore national experiment, which will provide the evidence base to assess how different policy options under distinct perspectives including several objectives and dimensions impact the water agenda in the capital of Brazil.

4.1.3 RIA approach

RIA may speed up, through the increased availability of evidence supported by policy initiatives, and enhanced scrutiny of the preparatory process, leading to the adoption of the final rule contributing to better regulation and better adjudication. However, the triumph of the decision depends on changing behaviors, and this is encapsulated in the term ‘compliance’, so that both the policy-makers at the design stage and the regulator at the delivery stage are seeking to promote the same thing.

Despite being a vital policy tool tested in some countries and quickly evolving, as governments continually refine its design and application, RIA’s problems are immense. One of these problems, maybe the main one, is the failure of implementation and the inability to thoroughly understand it (Jacobs, 2016).

Although there are several definitions regarding RIA, the same definition adopted in Subchapter 3.2 was adopted here. Given this academic approach, this Subchapter focused on (i) status quo, (ii) assessment and (iii) consultation steps within the MCDA modeling method and the participatory method (direct elicitation).

In a such case, multicriteria problems are the reality of research on the water agenda, and using the RIA approach can serve as a boost to enable the construction of a more robust, reliable and transparent decision-making process, as shown in detail in the next Subsection.

4.1.4 Methodology

An adapted RIA framework (Figure 4.1) was carried out to develop a methodology for evaluating the new targets proposed by Resolution no.08/2016.

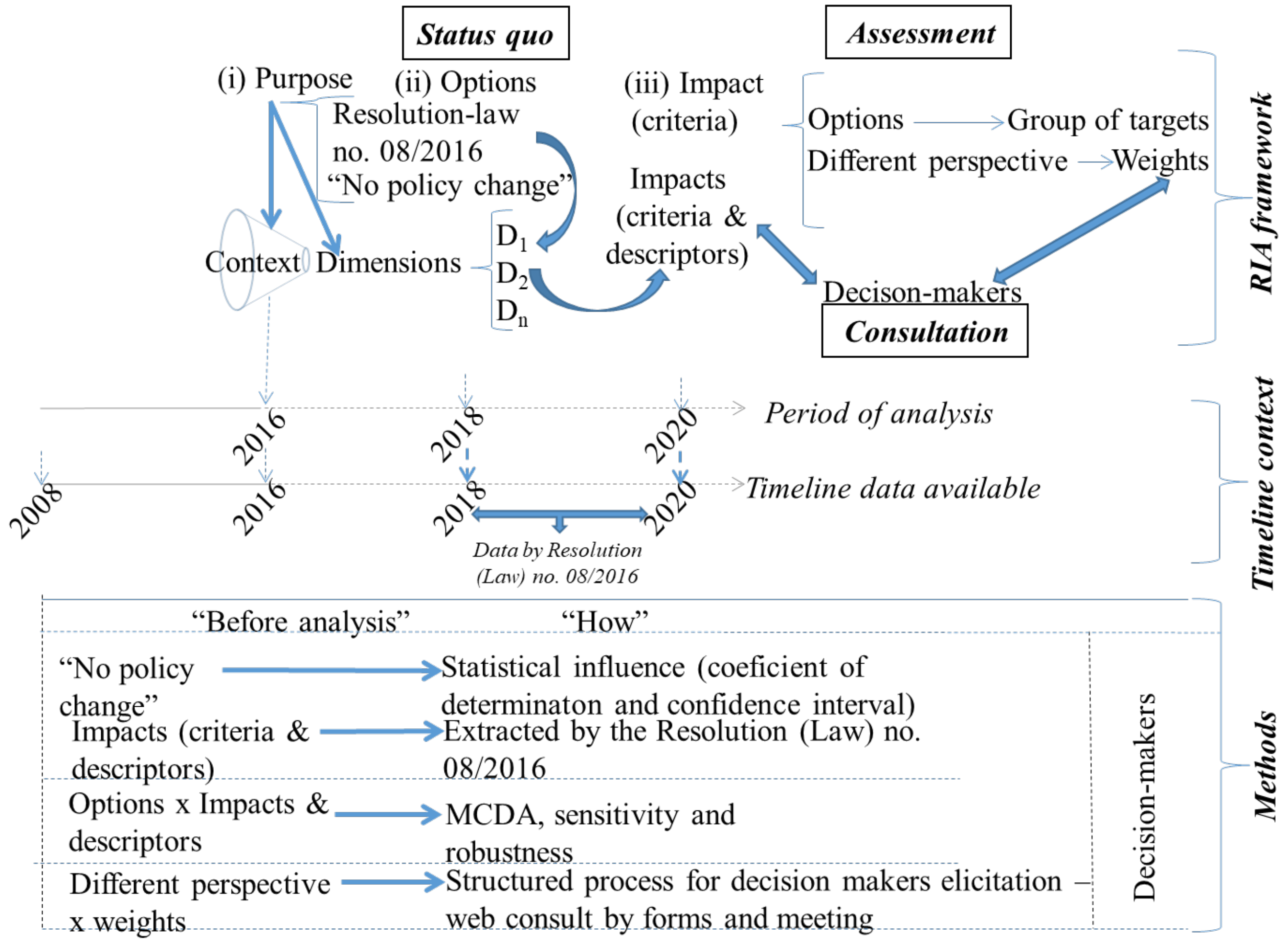


Figure 4.1 – RIA's framework adopted.

4.1.4.1 Status quo, options, criteria and descriptors

The ‘status quo’ step represents the situation extent and the problem’s complexity, which created the necessity to implement Resolution no.08/2016 to meet specific targets aiming to improve the water sector performance, based on the following dimensions (customer interest, infrastructural sustainability, economic and financial management, environmental sustainability and governance).

The Resolution no.08/2016 noted two policy options, i.e., ‘short-term (ST)' and ‘long-term (LT).' To complete the picture of options before the modeling, the statistical influence was used for forecasting. The linear regression model specifies that there is an underlying true relationship between EY and EX, expressed by a linear function. Algebraically, these ideas are represented as (Eq. 4.1):

$$Y = \beta_0 + \beta_1 X_i + \epsilon_i \tag{4.1}$$

Where ϵ_i i is the random error in Y for observation i and β_0 (the y-intercept, in a such case, the value for each criterion) and β_1 (the slope, that is, the correlation between the criteria’s value and time by the ratio of these variables) are constants to be estimated. In this study case, each criterion’s value was estimated by such regression, which was built by the historical data (2008-2015). The coefficient of determination (Eq. 4.2) and confidence interval, which reflects the uncertainty associated with each parameter value (Eq. 4.3), were adopted to verify the statistical influence.

$$R^2 = 1 - (SS_{res}/SS_{tot}) \tag{4.2}$$

where SS_{res} corresponds to the residual sum of squares and SS_{tot} means the total sum of squares.

$$\xi = t_{95\%} \sqrt{1 + \frac{1}{n} + \frac{(\bar{x} - x_0)^2}{\sum x_i^2 - n\bar{x}^2} \hat{\sigma}^2} \tag{4.3}$$

The variable t_{95} corresponds to the value of t-student’s distribution (with 2 degrees of freedom for the 95% confidence interval); n corresponds to the total of the sample; $\bar{x}$ means the average; x_i is the observed value, and x_0 is the estimated value. Finally, the value $\hat{\sigma}^2$ means the variance of a random variable. Then, the projection performed by MATLAB® software was considered as an input of each policy option, i.e., ‘no policy change (NPC) 2018’ and ‘NPC 2020.’ Furthermore, other two policy option were built during the MCDA process utilizing the preferences of DMs. Consequently, at the end, a total of six policy options were checked in this proposed RIA approach.

Following Resolution no.08/2016, ten criteria were grouped into three dimensions. These dimensions of providing WS helped meet the social, economic and security goals in an environmentally sustainable manner. The hierarchical structure used was developed from the concept of the decision at hand’s ultimate goal using a descending order of specificity, and it is highlighted in Appendix XIII.

According to Resolution no.08/2016, the ‘Service provider’ is supposed to protect the customer’s interests by providing accessibility and quality of service, often associated with its social sustainability. ‘Infrastructural sustainability’ promotes a suitable balance between resilience, robustness and system performance by evaluating the current practices on this matter, focusing on the services’ economic sustainability. The importance of ‘Environmental sustainability’ relies on avoiding or minimizing pressure on the natural resources through efficient and sustainable practices.

Since the criteria previously defined by Resolution no.08/2016 are value-oriented and need to be operationalized, descriptors and value functions have to be assigned considering that they are clearly not linear across their ‘scale’, depending on the condition itself. Those descriptors are an organized set of possible impact levels related to the fundamental points of view (criteria). Table 4.1 highlights the descriptors and the basis for comparison for each criterion in the corresponding dimension.

Table 4.1 – Performance descriptors for all criteria.

Dimension	Criteria	Descriptor	Basis for comparison
Service provider (customers' interest)	Physical accessibility (PA)	The comparison (ratio) between the total no. of inhabitants (%) and the no. of inhabitants with access to water service in urban area.	Quantitative
	Affordability level (AL)	The comparison (ratio) between the price paid for the amount of water necessary to cover basic needs and disposable income (minimum).	Quantitative
	Continuity of service (CS)	The (%) of households whose water services available is discontinuous (interruptions) during normal operation.	Quantitative
	Quality of supplied water (QSW)	The (%) of the total number of treated water tests performed that comply with the applicable standards or legislation.	Quantitative
	Complaints about W&WW services (CWWWS)	The (%) of the total number of W&WW complaints per year expressed as a percentage of the total number of W&WW connections.	Quantitative
Infrastructural sustainability	Adequacy of treatment capacity (AT)	The comparison (ratio) between the average inflow and the capacity of water treatment available.	Quantitative
Environmental sustainability	Standardized energy consumption (SEC)	The comparison (ratio) between the energy consumption for each m3 pumping.	Quantitative
	Water losses in the distribution system (WLDS)	The comparison (ratio) between the volume of water produced and the volume of water losses.	Quantitative
	Fulfillment of the water intake licensing (FFWIL)	The (ratio) between the volume of water produced per year which is licensing and the total volume extracted	Quantitative
	Sludge disposal (SL)	The comparison (ratio) between the volume of sludge produced as a result of treatment process with final disposal approved by environmental agencies and the total volume produced.	Quantitative

4.1.4.2 Assessment

The 'Assessment' step consists of the analysis of the options in each impact criterion concerning profit-and-loss value functions. Using decision-methods to support regulations should help regulator authorities to choose that best meet the policy objectives (Verbeek et al., 1999). There are several methods that can support this step and its choice represents the core of this RIA phase. The ability to choose the most appropriate method depends on the combination of the following: (i) problematic way (Greco et al., 2016), (ii) expected results and secondary questions (Roy & Słowiński, 2013), (iii) capacity to address bias (Montibeller & von Winterfeldt 2015) and (iv) time, analyst's familiarities and available resources.

The word problematic refers to the way in which decision aid (DA) is envisaged (Greco et al., 2016). (P. α) exposes the problem in terms of best choice. In (P. β), categories are designed prior to receiving actions, which will or might be processed in the same way during the following step. (P. γ) is oriented towards and relies on a partial or complete ordering (pre-order) on A that may be considered as a suitable instrument for comparing actions pairwise (Greco et al., 2016). Furthermore, to select the MCDA method, the analyst should, start with reflecting on the best and only way to answer the following essential question: “what type(s) of results is this method expected to produce?” In many cases, responding this question in this phase may lead to a shortlist of more than one method. Therefore, using the “five other key questions to choose the right method” as well as the “secondary questions” found in Roy & Słowiński's (2013) work, and analyzing their answers would enable to choose a particular method.

This exercise of RIA is particularly suitable for (P. α) providing the best policy option selection process, although there is no need for an option that is the best in all criteria. The options may differ in the extent, that is they may achieve several objectives, and no option will obviously be the best for achieving all objectives. Moreover, the following features such as utility score, performance scale properties, preference information required, imprecision, uncertainty, admitted compensation and robustness of the method were admitted to supporting the proposed decision method. Bearing those characteristics in mind, the evaluation technique (MACBETH) was selected to perform the RIA assessment step.

The MACBETH method is a particularly simple, well-known MCDA modeling method for the evaluation of options based on qualitative judgments regarding their attractiveness to a DM (Demesouka et al., 2016). Moreover, this model allows the processing of the difficult problem in a precise way and avoids the difficulties that are intrinsic in very ordinal aggregation. This method adopted the additive value aggregation model as the reference of DMs’ judgments. MACBETH will allow building an interval scale from the preference information provided by the DM. In this Subchapter, the scores were calculated for each judgment matrix, consisting of the solution to the linear program. The objective function of the problem was to maximize $PO\Phi(o_1)$, where $PO\Phi(o_1)$ is the score of the most attractive policy option o_1 (Ishizaka & Nemery, 2013). The specificities of such method in the RIA assessment step can be defined by the following equations (4.4 and 4.5) below.

Max $PO\Phi(o1)$ (4.4)

$$PO\ \Phi(o1) \le \sum_{j=1}^{n} c_j . s_j PO\Phi(o1)) \tag{4.5}$$

where c_j is the weighting coefficient of criterion j and $s_j\Phi(o1)$ is the score of each policy option Φ(o1) in a criterion j. The previous values were obtained through the M-MACBETH®software.

4.1.4.3 Consultation

To overcome some bias on the part of the decision makers and stakeholders in the policy decision process (see Montibeller & von Winterfeldt, 2015; Aslam et al., 2016), a consultation step was developed by direct elicitation techniques (Greco et al., 2016) from different DMs under their experience as customers, regulators and service providers.

This phase was divided into three stages: (i) structuring issues, (ii) scale transition, and (iii) weighting coefficient procedure. The first stage focuses on the reference levels. The second stage, perhaps the main one, represents a considerable increase in the amount of processed information. Also, the transition from ordinal to cardinal information in this stage revealed the origin of the notion of strength preference. The last stage refers to capturing the variation of the weight as the value measure swings (see Montibeller & von Winterfeldt, 2015) from the lowest to the highest value level on the scale (Parnell, 2009). The interaction between the facilitator and the DM was done through web survey and structure interviews[10].

4.1.5 Application and results achieved

The application of the RIA approach allows DMs to: (i) understand the scenario, (ii) the inherent dimension tradeoffs defined by Resolution no.08/2016, and (iii) how policy options have a different local score, as well as the impact of each criterion on the overall suitability

[10] The examples of each stage of interaction by the questionnaire are available at <https://goo.gl/xnytbR> (1st stage-customers' perspective); <https://goo.gl/eOAVCC> (2nd stage regulators perspective) and <https://goo.gl/J0k3pM> (3rd stage providers perspective).

score through their preference under customers', regulators' and services providers' perspectives.

4.1.5.1 Policy options performance profile and time required for the consultation step

Performance profiles for all of the options are presented in Appendix XIV. The difference between policy options from Resolution no.08/2016 and statistical influence (see the parameters in Table 4.2 for each criterion) with their respective characteristics was more emphasized in ATC – linked to the statistical influence – FWIL and SL – Regulation. The 'Neutral' and 'Good' reference levels, which were developed during the interaction modeling with DMs, had reference scores between 0 and 100.

Table 4.2 – "Do nothing" statistical influence parameters.

Criteria	$\boldsymbol{\beta_1}$	$\boldsymbol{\beta_0}$	$\mathbf{Y}_{NPC2018}$	$\mathbf{Y}_{NPC2020}$
PA	-0,25	606,78	97,23	96,73
AL	-0,04	95,75	4,46	4,37
CS	-0,33	777,9	95,14	94,47
QSW	-0,12	251,75	0,94	0,69
CWWWS	-0,05	101,26	0,36	0,26
ATC	0,91	-1751,11	86,94	88,76
SEC	-0,002	5,87	0,34	0,32
WLDS	0,53	-1035,8	34,69	35,30
FFWIL	1,30	-2545,84	84,03	71,94

It was appropriate to inform and detail the timeline of interaction with DMs before each stage of the consultation process. During the questionnaire test phase, two experts were invited to improve the form and content of the draft version according to the MCDA modeling method's requisites.

Although 60 days were defined to conclude the direct elicitation process, it took 85 days, of which 23 were required to develop the questionnaire, including the test phase. The frequency of interaction in each stage did not allow them to invest in a parallel consultation. The interval between the first stage with the regulators and the third stage with the service providers was influenced by the difficulty to identify other DMs that represented that viewpoint.

4.1.5.2 Structuring issues

After describing the criteria performance for each policy option, which is the keystone of a global additive appraisal model, it was required to create the definition of scales attractiveness or value functions for each criterion, which convert performance levels into a local score. First, the DMs were requested to point out the lower (‘neutral’) and upper (‘good’) reference level considering each criterion’s performance. The lower reference (‘0’) – the Neutral performance anchor – corresponds to the acceptance limit for each criterion. On the contrary, the upper reference (‘100’) – the good performance anchor – corresponds to the desired attainable performance for each criterion, or at least a good one. The innovative (de)biasing technique presented in this stage allows not only to overcome some bias, e.g., myopic problem representation, anchoring, etc. but also to easily understand how policies would affect stakeholders in different ways according to their preferences.

4.1.5.3 Scale transition

During this stage, the modeling of DM’s preferences was done to translate impacts into value scores, indicating the attractiveness of an impact when compared to the reference levels defined in the last Subsection. Some interaction between the facilitator and DMs to discuss and solve judgment inconsistency when necessary was allowed. Figure 4.2 shows the preference scale for the continuity of service criteria under customers’ perspective. The value reminder functions are available in Appendices O to Q (customers’, regulators’ and providers’ perspective).

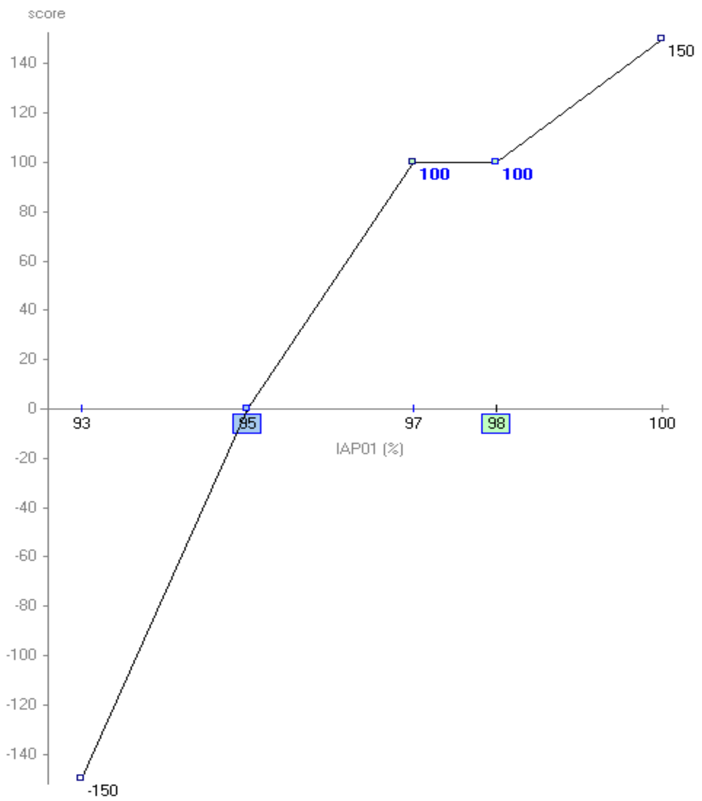


Figure 4.2 – Value function for each criterion under customers' perspective.

After this procedure, the consistency of data with the DM was checked to know whether reference levels had agreed or not with the value function obtained from him/her.

4.1.5.4 Weighting coefficient procedure

There are several procedures to assign weighting coefficients to the criteria, e.g., swing weighting method, trade-off, etc. (Greco et al., 2016). Moreover, Montibeller & von Winterfeldt (2015) identified a family of biases – some of them were previously mentioned in Subchapter 3.1 – that could affect the elicitation procedure in the decision analysis processes. According to these authors, using swing weighting with multiple stakeholders' opinions could provide different degrees of detail that could improve the quality of the decision (as confirmed in last Subsection by the difference between each perspective's value function, see Appendix XV-XVII). During the third stage of this Subchapter, the differences between neutral and good attractiveness for every pair of criteria were obtained from the most to the least attractive criteria swing.

The weighting matrix based on elicit qualitative judgments from DMs concerning the attractiveness difference between swings was repeated row-by-row until the matrix of judgments was completed. The DM was, in each perspective, asked to examine and confirm the weighting coefficients to validate the results (see all results in Appendix XVIII). To complete this stage (by an additive model), Figure 4.3 provides an overall score for each policy option under each perspective.

(a) Customers' perspective (b) Regulator's perspective (c) Provider's perspective

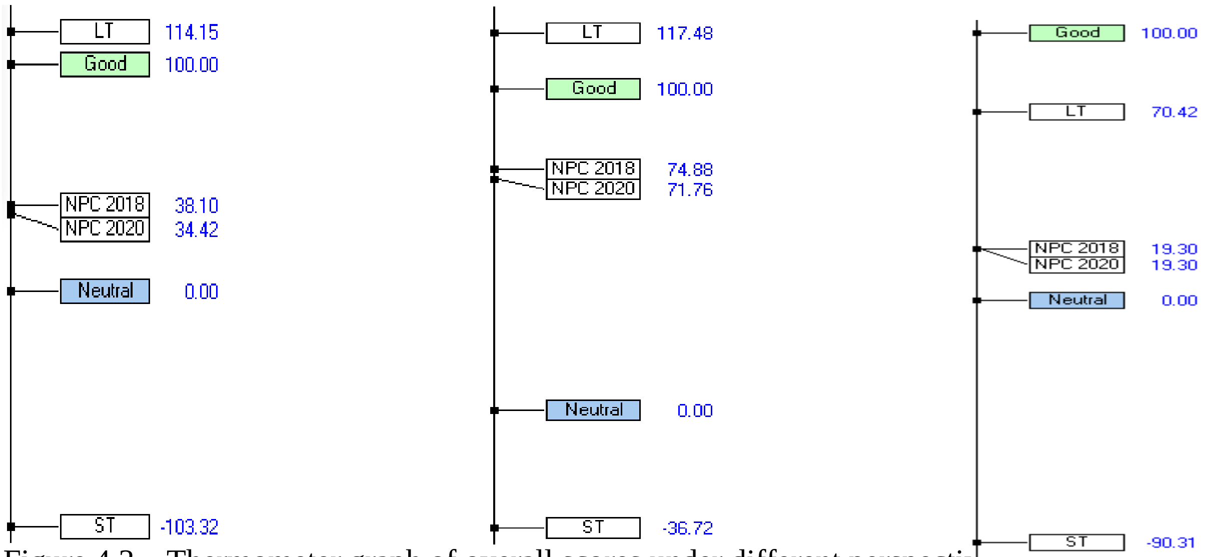
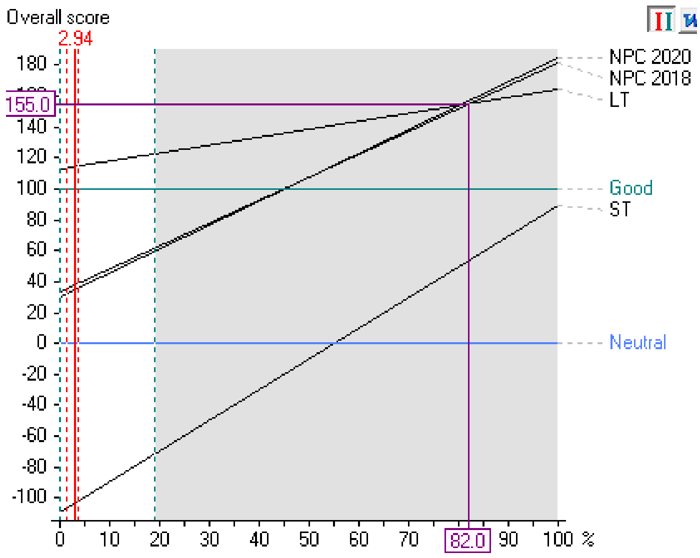


Figure 4.3 – Thermometer graph of overall scores under different perspective.

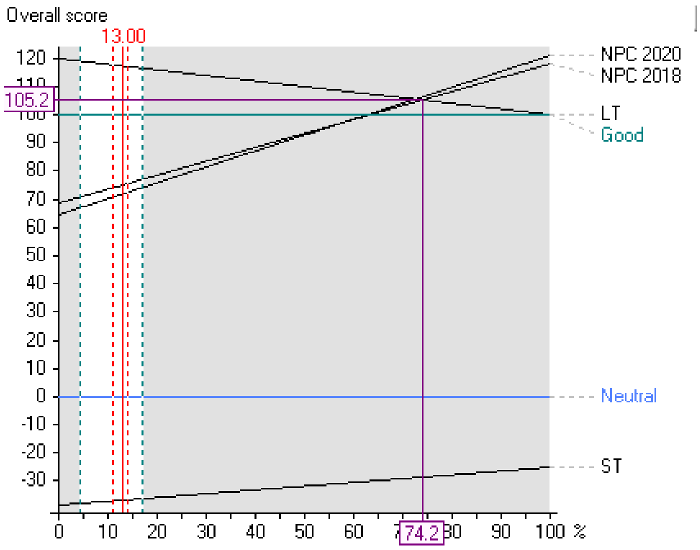
4.1.5.4 Additional analysis

The sensitivity analysis was conducted between the first and the second option in all of the perspectives, i.e., 'LT x NPC.' As an example, Figure 4.4 shows the sensitivity analysis on weight concerning the affordability level from a different perspective as to the 'affordability level' criterion. Table 4.3 summarize the analysis on weight.

(a)


Overall score
2.94
155.0
NPC 2020
NPC 2018
LT
Good
ST
Neutral
180
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
0
10
20
30
40
50
60
70
82.0
90
100 %

(b)


Overall score
13.00
105.2
NPC 2020
NPC 2018
LT
Good
Neutral
ST
120
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
0
10
20
30
40
50
60
74.2
90
100 %

(c)

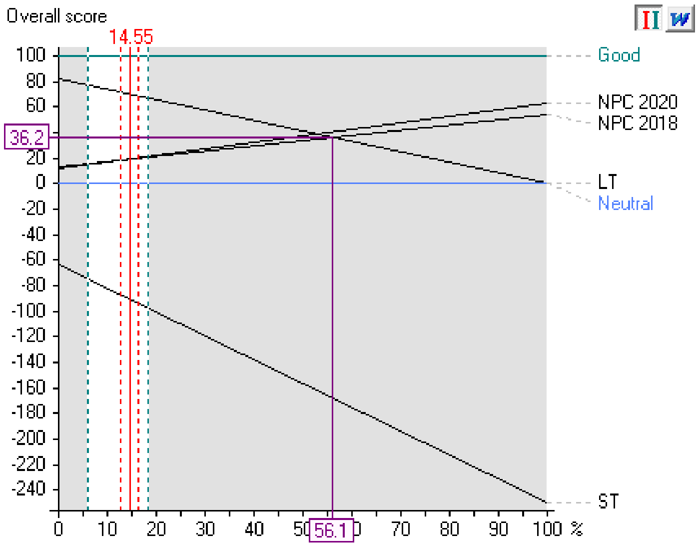


Figure 4.4 – Sensitivity analysis on weighting (affordability level): (a) customers', (b) regulator's and (c) provider's perspective.

From the regulator's perspective, over 74.2% of PA was needed to introduce changes in the final results. Regarding the provider's perspective, 56.1% was desirable to modify the portfolio of policy options. When 'LT x Good' policy options were compared in terms of 'adequacy of treatment capacity,' the variation of the final results would be achieved if this criterion increased to levels higher than 35.2%. If the same criterion surpassed 22.4% of the policy options, the list would change under the regulator's perspective.

Pragmatically, the requirements for changing the order of best option need a moderate modification of the weight criteria in all appraised transitions – showed in the blue sparkline.

Robustness is an important factor in the choice of scenarios (Bouyssou et al., 2009). A global comparisons table of the actions was integrated into the M-MACBETH® software. To explore the extent to which assumptions could be drawn due to varying amounts of differing degrees of imprecision or uncertainty, the robustness analysis proposed carries on the ordinal, MACBETH and cardinal information because of its capacity to represent not only the criteria's order but also the judgments and weighting coefficients.

When uncertainty is involved in the procedure of impact estimation, an impact table, for example, provides an overview of the options impact on the criteria extracted by Resolution no.08/2016 from the customer's perspective. 'LT' dominates (▲) 'ST' and is also globally more attractive (✚) than all of the other policy options (Figure 4.5). However, if researchers increase the imprecision of local cardinal information (97%), the model will no longer have enough information to determine if ‘Good’ is globally more attractive than ‘LT’ (or vice-versa). In other words, ‘Good’ dominated ‘Neutral.’ Pragmatically, these conditions presented on the “dominance table” proved that the ‘LT’ policy option was robust, i.e., a strong variation is needed to change its relation of dominance and attractiveness. From the regulator's perspective, ‘LT' dominated ‘Neutral' and was also globally more attractive than all of the other policy options. There was no change in the local cardinal information that modified the robustness of the final solution in this perspective. Regarding the provider's perspective, changing only 2% of the weight in each criterion (PA, SEC, and WLDS) only denoted incomparability between ‘NPC 2018' and ‘NPC 2020.' Moreover, by changing the weight of each criterion (CS, QSW, CWWWS, ATC, and FWIL) by at least ±1%, the composition of the final solution changed and denoted incomparability between ‘NPC 2018' and ‘NPC 2020'.

Table 4.3 – Sensitivity analysis.

Policy option interaction	Perspective	Variation (%) that introduces changes in the ranking of final results – Criteria									
		PA	AL	CS	QSW	CW&WWS	ATC	SEC	WLDS	FWIL	SL
LT x NPC 2018	Customer	No	>82	No	>93.5	100	>66.9	>86.2	No	No	100
											
	Regulator	No	>74.2	No	>98.5	>78.7	23.5	73.3	No	No	100
											
	Provider	No	>56.1	No	>91.2	No	>47.4	>85.2	No	No	100
											
LT x Good	Customer	No	No	<0.7	100	No	>35.2	No	>19.3	100	No
											
	Regulator	No	100	No	No	No	>22.4	>24.7	>50.5	No	No
											

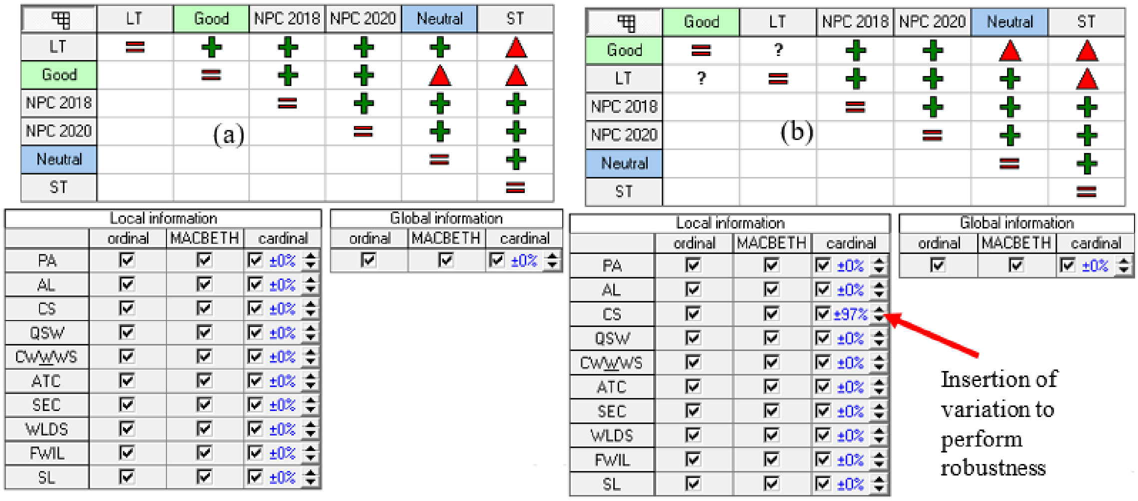


Figure 4.5 – (a) Robustness analysis under customer perspective studied (no local information change) and (b) local information change customers.

In addition, an analysis of the efficient borderline was made to check the locus of all possible policy options formed by the combination of the dimensions proposed by Resolution no.08/2016 (see graphs in Appendices XIX to XXI). Thus, regardless of strategy combination, 'LT' was overall well positioned, which allowed us to confirm the relative merit of this policy option.

To summarize the robustness analysis from the customer's and regulator's perspective, it's fair to say that 'LT' was a robust policy option, regarding the provider's perspective. Although the dominant conditions were not robust between the third and fourth policy options, 'LT' remained in the first position.

4.1.6 Policy implications and concluding remarks

The result achieved with the RIA approach exercise – based on a conceptual and framework model – was positive, since it recognized the practical application and experience of the whole process in an authentic context. That enabled DMs to have a better understanding of the status quo, the assessment, and consultation process and allowed them to go beyond the current policy decision practices on water services.

Using the coefficient of determination as well as the confidence interval to evaluate the stability of complementary 'NPC' policy options not only improved the analysis but also yielded reliable information before moving on to the assessment stage. Although the policy options were inserted prior to the assessment stage, the MCDA modeling method let the DMs create 'Neutral' and 'Good' references during the interaction process, which allowed them to make comparisons at the end of the process.

Furthermore, in order to overcome common bias in this work, different perspectives and (de)biasing techniques, such as structuring issues and swing weighting, were used to improve the quality of the model analysis.

As highlighted before, using MCDA modeling in the RIA 'assessment' step offers an ideal approach to evaluate problems shaped by several objectives and political context describing performances, e.g., social and environmental without forcing conversion to monetary units.
The use of the MACBETH method was helpful in designing a consistent valuation/selection criteria; the options and the analysis of sensitivity and robustness performed before making the final decision.

The weight sensitivity analysis supported the superiority of the first policy option, which would not affect the overall result of the model. The robustness analysis of the outputs denoted that as much as the authors varied the percentage of the local cardinal information, the best policy option never fell to the 3rd and 4th positions in the final portfolio.

As far as policy implications are concerned, the results of the RIA approach were not completely conclusive as to Regulation no.08/2016 because this analysis was restricted to water supply; certain classes of aspects and criteria descriptors; and the proposed targets. Thus, such analysis, if misinterpreted, would possibly lead to erroneous policy decisions.

Despite the limits of this exercise, this RIA approach suggested that policy options extracted from Resolution no.08/2016 could be reviewed in order to ensure successful implementation. Furthermore, based on the current analysis, the following could be considered:

- as for the global impact, from customer's and regulator's perspective, the 'LT' policy option was the first one chosen. 'Good', was the following option, based on decision-makers' preferences under that same perspective, which reinforces the importance of building solutions by means of DMs' interaction;

- from the provider's perspective, the 'Good' policy option stood out among all other alternatives, although a change of only ±1% in some criteria's weight did not promote a change in the first nor in the second policy options, reflecting the need to rethink the new targets proposed by this legal act/ Resolution no.08/2016;
- although the participation of more DMs made the decision processes more credible, it could be resource consuming if not well designed and carefully planned; and
- the DMs' preferences showed interesting features, i.e., the "service provider" aspect was common and predominant in all of the studied perspectives. Both customers´ and providers´ perspectives highlighted infrastructural sustainability. Finally, DMs who represented customers' and regulators' perspectives tended to emphasize environmental sustainability. In fact, the regulator does not adjust policy based on prior activity (Henze et al., 2012).

The considerations mentioned above reinforce the need to take into account more policy options and also different preferences in order to provide more efficient governmental action. Although the DMs had a certain difficulty understanding the RIA model used in this study, it is noticeable that the multi-methodological approach contributed to an inclusive learning process that promoted the legitimacy of the output as well as a solid justification of the analysis. Therefore, it was not surprising to hear from some DMs later interviewed that the RIA approach structure facilitated understanding the decision process of multiple objective problems.

The practical involvement in designing the RIA didactic capability policy tool, allowed DMs;

- to review targets in order to meet their perspective; and
- contributed to generating a supportive reference to justify more studies in this area, and consequently, to discuss solutions;

In addition, according to this Subchapter, when decision makers neglect prescriptive tools that: (i) could improve their understanding of the preliminary scenario; (ii) organize the adequate options, criteria and its descriptors; and (iii) the participatory process, governmental actions are inefficient or unable to solve complex problems.

4.2 ASSESSING THE IMPACT OF HOUSEHOLD CONNECTION TO PUBLIC NETWORKS WASTEWATER SYSTEMS

Paper submitted to an ISI journal, B.E. de Carvalho, S.B. Costa., R.C. Marques and O.C. Netto

Abstract: Brazil faces a severe lack of wastewater coverage. Even in urban areas, wastewater is directly disposed of in watercourses without any treatment for a large part of the population. Although the federal state and local governments have invested in WSS, the expected results have not been achieved. In order to help overcome this problem, the present Subchapter intends to provide the opportunity for observing a regional ex-ante regulatory impact assessment (RIA), as a policy tool, in the metropolitan region of Belo Horizonte. The regulatory policy options will be appraised through MCDA following objectives: (i) protect the customers concerning social aspects, (ii) safeguard the economic, operational and infrastructure sustainability and (iii) protect the environment. This Subchapter intends to promote RIA as a rational, robust and transparent decision framework that should be used by the regulatory agencies in worldwide. The results obtained indicate a need to develop: (a) mechanisms to enforce household connections in areas where wastewater services are available to the population; (b) tariff incentives focused on expanding investments to cover the gap in wastewater treatment services.

Keyword: M-MACBETH; Multicriteria Modelling Method; Regulatory Impact Assessment; Wastewater Services.

4.2.1 Introduction

Access to safe water and wastewater (in wider definition) is essential for health, security, livelihood, and quality of life. In 1977 during the United Nations Water Conference, the international community declared that the 1980’s were the "International Drinking Water Supply and Wastewater Decade”. The goal was that by the end of the decade all the people worldwide would have access to clean water and wastewater. However, more than 30 years later, almost 40 percent of the world’s population remain without improved wastewater (J-Pal, 2012).

In developing countries, (i) the lack of infrastructure for collection and treatment of wastewater, (ii) the great resistance from users to connect to public systems of wastewater services – because they understand it represents paying higher tariffs, and (iii) the indirect perception of the importance of those services are the cornerstones of many current development strategies (Vásquez, 2013). Such deficit has had a negative impact on people’s quality of life since it directly affects their health, the environment and the economic sustainability of the services in the medium and long-term.

In Brazil, despite the gap of water and wastewater coverage (16,7 and 49,7% respectively) (SNIS, 2015), the presence of: (i) national legal enforcement concerning the household’s connection (Law no.11445/2007, art.45), and (ii) regional legal norms of Minas Gerais State (MGS) (Law no.13317/1999, art. 48) have not contributed as expected in changing this situation. In fact, this challenge’s major concern is not only the investment but also the need to adopt good governance practices and regulatory substance such as the regulatory impact assessment (RIA).

According to (Berg, 2013), a substance is defined as tools and rules available to regulators. Here, RIA refers as an important substance to improve the knowledge basis and regulatory governance for public utilities (Berg, 2013; Meuleman, 2015; Carvalho et al., 2017a,b). The absence of RIA may contribute to an irrational decision process, especially in WSS. Any strategy taken by governments (primary law) or regulators (secondary law) could implicate behavior changes, either on public or private entities that act in the referred sector (Massarutto et al., 2013).

Although some academic RIA evaluation over Brazil's WSS (Subchapter 4.1) was noticed, to the best of knowledge none of the national regulators had used it in practice. From that viewpoint, the main objective of this Subchapter is to drive a case study - using RIA framework - able to support regulatory decision process. That approach could enrich research originality, besides offering an opportunity to ARSAE-MG advance its knowledge, power access of data and improve its regulatory function. The present research has started as a practical partnership between the water and wastewater regulatory agency from Minas Gerais State (ARSAE-MG in Portuguese) and the Technical Institute from the University of Lisbon (IST in Portuguese).

Based on the above discussion, one can believe that this scenario can provide the opportunity to observe an experiment of RIA following three steps: (i) status quo, (ii) assessment using a multicriteria decision analysis modeling method (MCDA) and (iii) consultancy. The reasons for both are that the WSS policy or regulation involves several objectives, which require (MCDA) combined with DM's judgments to enhance the quality of information in the whole decision-making process. In fact, this work represents the first known efforts to apply RIA in the Brazilian wastewater sector.

In this Subchapter, MCDA modeling method through MACBETH in which the impacts of each option were measured by attractiveness through a categorical-based evaluation Technique was implemented. Such method was developed by adopting a specified evaluating structure to appraise different possibilities (Pinto & Marques, 2016). The criteria and options were defined based on a focus group with experts from regional and local stakeholders. Conference panel and web survey were used to obtain value functions and weights for the criteria (follow the same logic as discussed in Subchapter 4.1).

The remainder of this Subchapter is organized as follows: Subsection 2 presents the current wastewater sector in Brazil and Minas Gerais, respectively. Subsection 3 describes the RIA framework as an innovative approach in a complementary way (Subchapter 4.1). The methodology is detailed in Subsection 4, followed by Subsection 5 that provides an example of its application and the corresponding policy implications. Finally, Subsection 6 draws some concluding remarks.

4.2.2 WATER AND WASTEWATER SERVICES: BRASIL

In terms of structure, WSS together with solid waste management and rainfall drainage are classified in a wider concept called “basic wastewater” in Brazil. Currently, the sector is decentralized into municipal jurisdictions in which local administrations are responsible for providing these services. A few regulatory agencies for water supply and wastewater services were created after 1997 and Law no.11445/2007 formalized their activities. Until 2014, 50 regulatory agencies were established for water and wastewater services, of which 22 are State agencies, 1 is a District agency, 24 are Municipal agencies and 3 are Municipal Consortiums (micro-regional) (ABAR, 2015).

Brazil faces a historic deficit in basic services, which fosters inequities and enhances the actual social gaps (Carvalho & Sampaio, 2015). Approximately 6.9% of the urban population has no access to the water supply network, while 42% has no access to the wastewater network. In Minas Gerais State (MGS), specifically, in Belo Horizonte metropolitan area (BHMA), nearly 30% and 46% of the urban population, respectively, have no access to the water supply neither to the wastewater network (SNIS, 2015). There are two main reasons for the wastewater treatment deficit in the MGS: (i) lack of coverage caused by investments below desired levels, and (ii) part of the population declines to connect to the public wastewater network in order to avoid paying for the service. As already mentioned, investment levels in Brazil and MGS are inferior to the ones required for the universalization of wastewater services. Nevertheless, when the investments are actually executed, the household connection occurs under expected levels.

Federal Law no.11445/2007 and state/regional Law no.13317/99 present legal safeguards to investments made by providers, defining obligatory connections to households in which public WSS network is currently available. However, these laws have not been effective to enforce connection to the public wastewater system requiring the regulator enforcement.

ARSAE-MG, the regulator involved in such analysis, was created by Minas Gerais State Law no.18309/2009 and has been responsible for regulating state (COPASA and COPANOR) and local companies (CESAMA-Juiz de Fora, SAAE-Itabira, SAAE-Passos). ARSAE-MG regulates about 3,5 million households through its mandatory law and specific agreements.

Due to its importance in the national background, such proposed exercise is a great opportunity to spread the use of RIA's framework as support for rational decision processes. ARSAE-MG is not legally allowed to inspect non-connected households and to compel the population to fulfill legal requirements; these mandates are exclusively given by municipal power. Nevertheless, the agency can play according to its rules, mainly through the design of tariff mechanisms truly able to promote desired outcomes that highlight the importance of such proposed analysis.

In fact, the WSS infrastructure deficit has negative impact on Brazilians' quality of life. It directly affects health, economy and environment, undermining sustainable development. Thus, the debate concerning investment and household connections reveals itself as a productive effort to overcome obstacles towards the universal access to WSS.

4.2.3 RIA framework

Among experts, RIA (definition adopted as the discussed in Chapter 2) is generally regarded as a means to improve regulatory quality (Carvalho et al., 2017b). Arguably, RIA would contribute to decision-processes by making them more rational, integrated, robust and transparent. Hence, the use of RIA can improve the regulator's human resources managerial and regulatory capacity, as well as the knowledge basis (Dunlop & Radaelli, 2016), particularly during periods of economic recession and crisis (Carvalho et al., 2017a,b; Tetlow & Hanusch, 2012). In this Subchapter, the adoption of RIA represents an important exercise where theory and practice are put side by side to support WSS as a driver of governance into decision making, improving regulatory principles from the administrative capacity and open government to accountability.

4.2.4 Methodology

To measure the impact assessment of "household connections", the Subchapter implements the RIA framework as a policy tool to improve regulatory decision-making in practice. A focus group made up of individuals who represented the stakeholders involved in the process was joined together to help with the discussion. MCDA was used as an assessment method to support the current analysis. Figure 4.6 shows RIA's framework in detail.

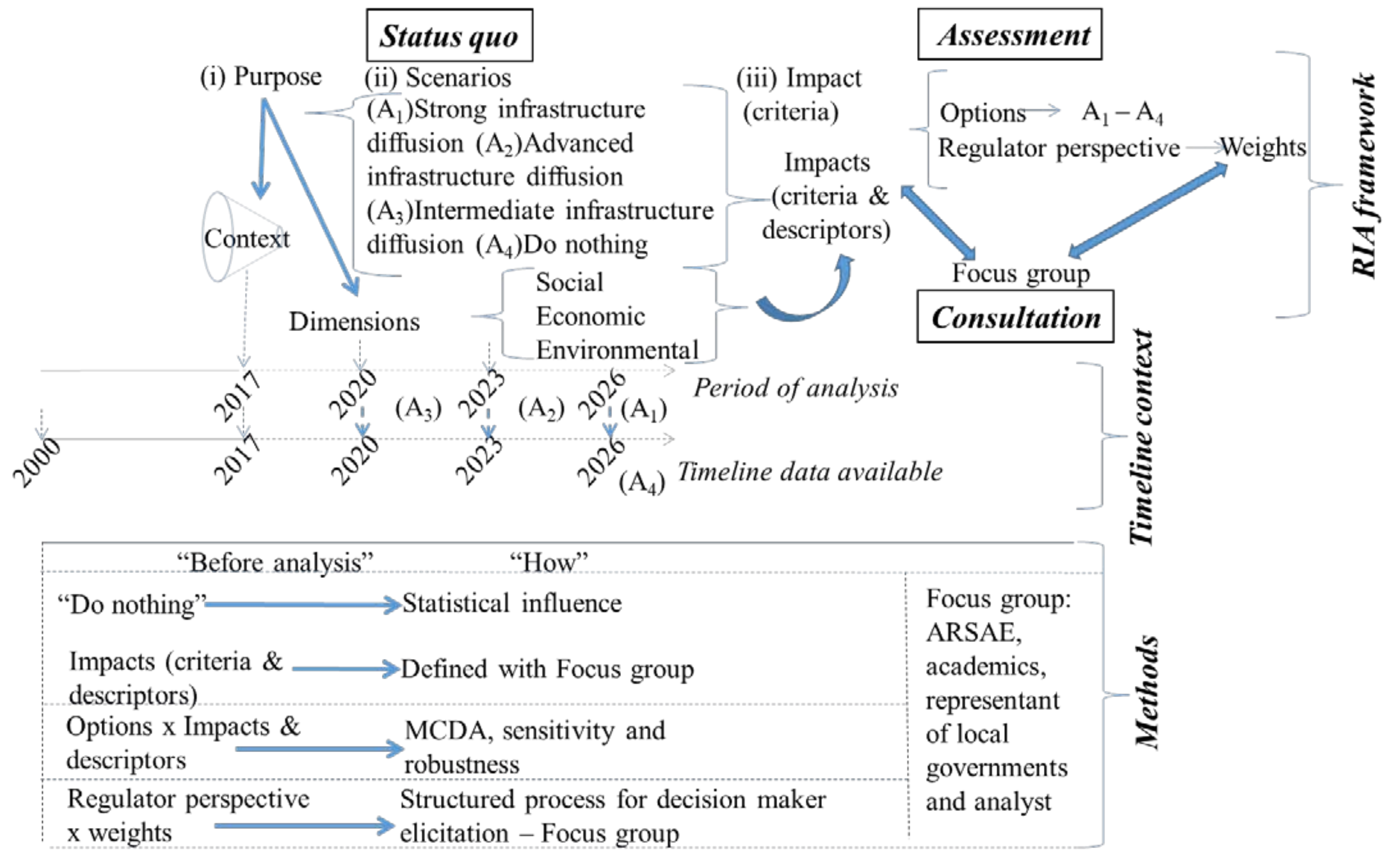


Figure 4.6 – RIA's framework to evaluate "household connections".

4.2.4.1 Status quo

Firstly, a ‘status quo’ was performed focusing on a small group of cities composed of Belo Horizonte, Betim, Contagem and Ribeirão das Neves (hereafter, BBCR) where approximately 3.85 million people have wastewater systems coverage (Instituto Trata Brasil, 2015). Moreover, the gap identified concerning non-connected households is of over 365,000 inhabitants.

At this stage, the objective was to identify regulatory “policy options” which allow DMs to deal with the current problem and formulate the criteria. The focus group (ARSAE-MG, academics, and local government members) discussed the following defining proposals: (i) strong infrastructure diffusion; (ii) advanced infrastructure diffusion; (iii) intermediate infrastructure diffusion, and (iv) do nothing, which were developed by a variety of functional forms including the linear ones (Reynaud, 2016). It was performed by Equation 4.1, where ϵ_i is the random error in Y for observation i and β_0 (the y-intercept, in such case, the value for each criterion) and β_1 (the slope, that is, the correlation between the criteria’s value and time by the ratio of these variables) are constants to be estimated. The coefficient of determination (Equation 4.2) and confidence interval, which reflect the uncertainty associated with each parameter value (Equation 4.3), were adopted to verify the statistical influence, where SS_{res} corresponds to the residual sum of squares and SS_{tot} means the total sum of squares.

For all hypothetical policy options, that the deployment cycle will occur in up to 7 years (2016-2023) were considered. To implement the MCDA modeling method, the core of RIA framework, some criteria were required. By doing so, the analyst, supported by ARSAE-MG, detailed the objectives for protecting customers’ interest, safeguarding the economic sustainability and protecting the environment in 7 criteria and descriptors. The focus group identified three dimensions of such analysis: (i) social, (ii) economic and (iii) environmental. Policy option and details of the proposed objectives were available in Table 4.4.

Under the social perspective, there is substantial literature establishing the harmful effects of the lack of wastewater on health outcomes, particularly in urban areas. Approximately 88% percent of all diarrhea infections worldwide are attributed to unsafe water supply, the lack of safe hygiene practices, and basic wastewater infrastructure (Evans, 2005). Safe hygiene practices and improved wastewater can have a large impact on health threats for children under five (Hutton & Haller, 2004; Waddington & Snilstveit, 2009). Indeed, there is a clear and fundamental relation between "non-connected household" (CSo_1) to the public wastewater system and a substantial impact on waterborne diseases avoidance (CSo_2) which requires a sensitivity analysis of the outcomes provided by the model.

Under the economic perspective, it is essential to guarantee the sustainability of the wastewater services by rational stimulus from the regulator. In this matter, the revenue (CEc_1) generated by the tariffs must be sufficient to cover capital and operational costs while providing adequate profits to remunerate shareholders (Infra[11]).

Table 4.4 – Policy option and criteria.

Ref	**Policy option**	**% coverage (in terms of current non-connected households)**	**Years period**
A_1	Strong infrastructure diffusion	100	
A_2	Advanced infrastructure diffusion	75	9 (2017-2026)
A_3	Intermediate infrastructure diffusion	50	
A_4	Do nothing	current	

Dimension	**Criteria**	**Basis for comparison.**	**Database**	**period**
Social	Household non-connected (CSo_1)	Quantitative	IBO-IBG CE COPASA IBGE	2007-2016
	Waterborne diseases avoidance (CSo2)	Quantitative	Trata Brasil IBO-IBG SNIS DATASUS	2003-2016
Economic	Incomes (CEc1)	Quantitative	CE COPASA ARSAE	2016
	Infrastructure (Infra)	Quantitative	Patrimonial data Network data IBO-IBG Open street map CE COPASA	2011-2016
Environmental	Sludge (CEn1)	Quantitative	ARSAE	2016

Finally, concerning the environmental perspective, all benefits from wastewater treatment are linked to improvements in water quality through the removal of different polluting substances. However, these benefits are less visible to individuals and harder to assess in monetary terms.

11 Infrastructure (Infra) contains the capital cost (investments and their remuneration), and operational costs (marginal costs) necessary to reach each of the alternatives given in the RIA process.

To deal with this challenge the option was to model the sludge amount (CEn_1) that could be driven out of the environment by connecting households to the public wastewater system.

4.2.4.2 Assessment

A review on MCDA modeling approaches led to distinguishing types of results that the analyst may wish to consider in relation to methods clearly associated with them (Roy & Słowiński 2013). Regarding RIA, the MACBETH (measuring attractiveness by a categorical-based evaluation technique) method was selected based on the following aspects (Greco et al., 2015, Roy & Słowiński 2013): (i) type of problematic way (P. α); (ii) acceptance of utility score; (iii) type of scale (non-original); (iv) preferences from decision maker and (v) resources required.

The MACBETH method is a particularly simple and well-known MCDA modeling way for evaluating options based on qualitative judgments regarding their attractiveness to a DM (Greco et al., 2016). The objective function of the problem was to maximize $RP\Phi(o_1)$, where $RPO\Phi(o_1)$ is the score of the most attractive regulation policy option o_1 (Ishizaka and Nemery, 2013) implemented by Equations 4.4 and 4.5 (Subchapter 4.1).

4.2.4.3 Consultation: Focus group

One of the core domains in RIA is "open government" in which regulators must adhere to principles of transparency and participation in the regulatory process to ensure that the regulation serves the public interest (OECD, 2012). The notion of such concern is central to evaluate household connections because it must provide more reliable information to the decision process (Montibeller & von Winterfeldt, 2015) and allow policymakers to understand all non-neutral stakeholders participation in the utility agenda (Carvalho et al., 2017a).

In this Subchapter, a consultation process was implemented based on three stages: (i) structuring issues; (ii) scale transition and (iii) weighting coefficient procedure. Initially, regulatory policy options were performed. For each criterion, reference levels were required. Secondly, the transition scale from ordinal to cardinal was performed to deal with the notion of strength preference. Finally, the M-MACBETH required the variation of the coefficient weights. Focus group meeting and web survey have supported all steps.

By doing so, the results were obtained with M-MACBETH and discussed regarding weighting references, sensitivity, performances, profiles, robustness and cost/benefit analysis.

4.2.5 Results achieved

The BBCR was chosen to apply RIA and evaluate the household connection gap taking into account social, economic and environmental aspects. Table 4.5 summarizes all aspects of each policy option. Figure 4.7 represents an example of how the gap of coverage was developed (the remainders of that are available in Appendix XXII).

Table 4.5 – Aspects of all policy options (2017-2026).

Policy options		A_1	A_2	A_3	**Do nothing**
Coverage (%), in terms of current non-connected households	***Criteria***	100	75	50	Current
Social (no. of household non-connected)	CSo_1	0	26768	53537	107074
Hospital stay/year	CSo_2	10.7	11,1	11.6	12.6
Economic	CEc_1	99	74	45	68
Average tariffs (Capex and Opex x 10^3)	Infra	352	264	166	157
Environmental (kg/year x 10^3)	CEn_1	38	40	47	73

For that purpose, the M-MACBETH® assess different possibilities of proposed policy options related to the gap. Thus, an interactive approach was adopted. It required several interactions among the focus group to evaluate criteria, assign value functions, and set their weights. Due to the characteristic of an ex-ante proposed analysis, caution must be taken in the use of proxy indicators (Pinto & Marques, 2016). In this Subchapter, the sensitivity and robustness analysis was done.

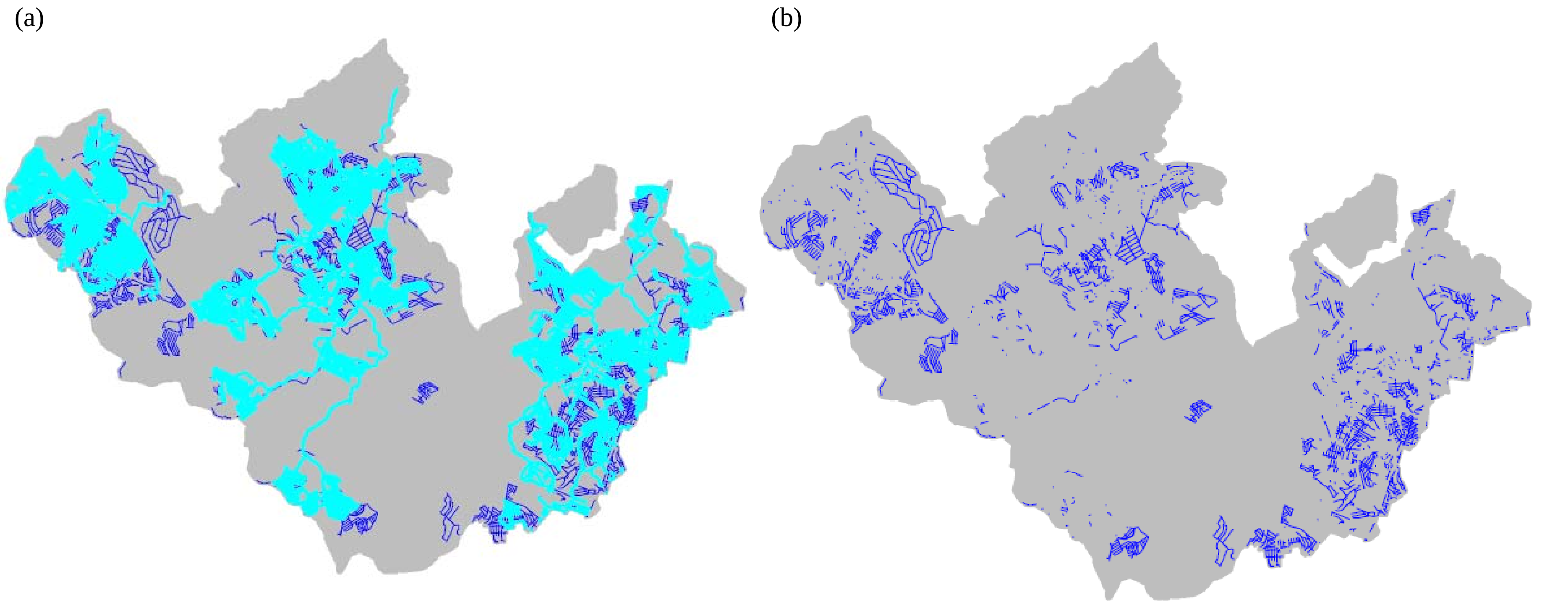


Figure 4.7 – Street map: (a) area covered (Ribeirão da Neves) by wastewater services and (b) area non-covered.

4.2.5.1 Structuring issues and scale transition

The first step was to create the definition of scale attractiveness (value functions) for each criterion, which convert performance levels into a local score, i.e., lower (neutral) and upper (good) reference considering each criterion's performance.

Thus, the modeling of DM's preferences was done to translate impacts into value scores, indicating the attractiveness of an impact when compared to the reference levels. Figure 4.8 shows the preference scale for the gap to overcome in terms of "household connection".

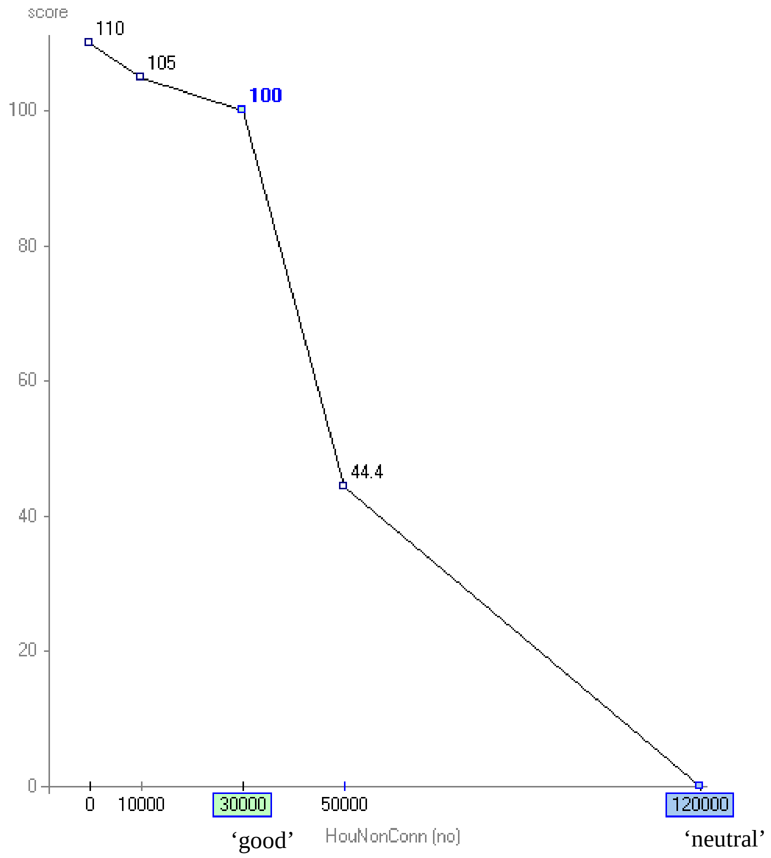


Figure 4.8 – Value function for household connection gap.

Note that the maximum score according to the focus group corresponds to reducing the gap from 120,000 to 30,000 connections. Each difference among good, neutral and intermediate levels reflects how difficult it is to cope with the gap in each criterion adopted in this analysis. The value reminder functions are available in Appendix XXIII. Although interaction among the focus group was frequent, it took 30 days to complete this stage, consisting of the introduction of such approach, analysis and validation step.

4.2.5.2 Weighting coefficients

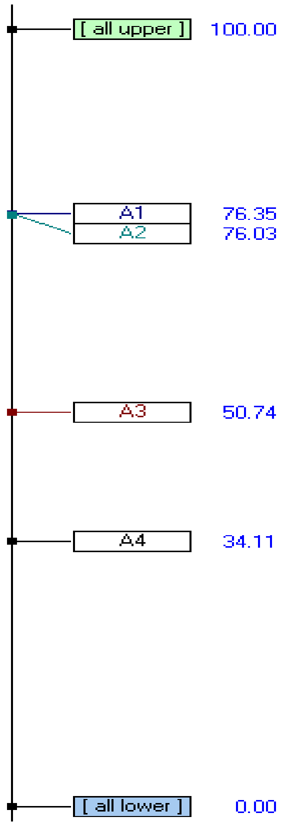
In each perspective, the focus group was asked to examine and confirm the weighting coefficients to validate the matrix (the same procedure was adopted as discussed in Subchapter 4.1). This stage took 15 days, and it included the reasoning of the proposed analysis and a validation period for the results achieved.

Based on such consensus, the goal to expand wastewater services access (CSo_1) is evident and in line with the main proposed idea of ARSAE's intervention. In this Subchapter, the externalities measured by health issues (CSo_2) and environmental (CEn_1) criteria are based on less relevant positions in relation to the Infrastructure (Infra) and its correspondent revenues (CEc_1). It shows the importance given to economic issues when the problem faces multiple challenges.

4.2.5.3 Policy options

Figure 4.9 provides an overall score for each policy option studied. Hence, researchers could see that there was no policy option considered "all upper" among the focus group alternatives. This finding is consistent, since overcoming household connection gap demands a substantial increase in costs (Infra). The marginal expansion of infrastructure tends to be widespread in peripheral areas that are frequently non-regulated by local public authorities. In addition, the revenue in these areas is not properly insured. People can still refuse connection even if it is provided by the public wastewater network.

According to this RIA frame, the overall score between alternatives "A_1" and "A_2" was similar, also in terms of CSo_1, CEc_1, and CEn_1. Such situation is not a problem because this approach showed two alternatives that could be better understood by additional analysis (sensitivity, robustness, and cost-benefits) supporting DMs to choose the best policy option.



Options	Overall	CSo1	CSo2	CEc1	Infra	CEn1
A1	76.35	110.00	38.18	108.86	13.48	94.00
A2	76.03	100.81	24.54	99.28	38.82	89.80
A3	50.74	42.16	8.18	58.85	71.63	82.40
A4	34.11	8.20	-16.36	0.00	120.00	5.76
[all upper]	100.00	100.00	100.00	100.00	100.00	100.00
[all lower]	0.00	0.00	0.00	0.00	0.00	0.00
Weights :		0.4333	0.1000	0.1667	0.2667	0.0333

Figure 4.9 – Overall thermometer and scores of each policy option.

The overall performance distance between (A_1 and A_2) and A_3 was significant concerning the social aspects, that shows its rejection in such analysis. Finally, all alternatives proposed have an overall score higher than “do nothing” (A_4). It encourages DM’s to act towards the other available alternatives, taking into account the current conditions of wastewater services in the surveyed region.

4.2.5.4 Additional analysis

A sensitivity analysis on weighting was conducted between the A_1 and A_2 concerning “non-connected household” (see Appendix XXIV).

By performing a sensitivity analysis on the weight of ‘CSo_1’ between the ‘A_1 x A_2’ policy options, it was observed that its variation – keeping identical proportions for the weights of the remaining criteria – only introduced changes in the ordering of the best option if it decreased to a level lower than 41%, as shown in Figure 4.10. When A_1 x A_2 policy options were compared regarding CSo_2, CEc_1, Infra, and CEn_1, the variation of final results would be achieved if CSo_2 and CEc_1 would decrease to levels lower than 7.8% and 13.7%, respectively.

Concerning the "Infra" criterion, the variation between final results would be achieved if the weighting of such criterion increased higher than 27.6%. In respect of CEn_1, the absence of intersection represents that A_1 is always more attractive than A_2, regardless of the weight of the mentioned criterion. Applying the same logic analysis between the other policy options "A_2 x A_3, A_2 x A_4 and A_3 x A_4", A_1 overcomes all alternatives as verified. A_2 was closer to A_1 and away from A_3. Here, A_2 appears as a potential alternative to be taken into account as a final intervention by ARSAE-MG.

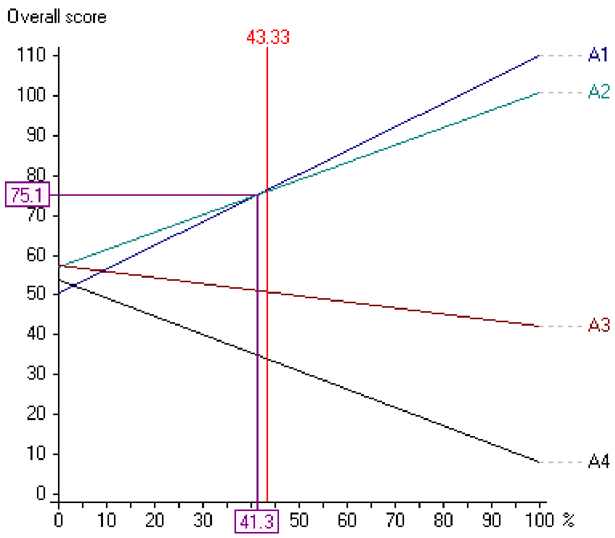


Figure 4.10 – Sensitivity analysis on weighting (CSo1).

Robustness is an important factor when choosing scenarios because of the previous expectation that customers with different behavioral characteristics are affected differently (Madani & Dinar, 2013). A global comparison table of the actions was integrated into the M-MACBETH® software. To explore the extent to which assumptions could be made due to varying amounts of different imprecision/uncertainty degrees, the robustness analysis proposed carries on the ordinal, MACBETH and cardinal information. When no uncertainty is involved in the procedure of impact estimation, an impact table, for example, provides an overview of the options impact on the criteria proposed, in such a case (Appendix XXV). As an example, in Figure 4.11, 'A_2' is also more attractive than 'A_3'. Considering cardinal of local information and global information, A_1 dominates ( )A_3 and A_1 is globally more attractive than ( )of all other policy options. However, changing only 1% in the cardinal or global scale is enough to denote incomparability between A_1 and A_2. This situation allowed to confirm that A_1 is sensitive on weights and it is not robust in terms of uncertainty.

	[all upper]	A2	A1	A4	A3	[all lower]
[all upper]	=	?	?	?	▲	▲
A2	?	=	?	?	+	▲
A1	?	?	=	?	?	▲
A4	?	?	?	=	?	+
A3			?	?	=	▲
[all lower]						=

Figure 4.11 – Robustness analysis regarding ordinal and MACBETH scale.

Such vagueness forces to invest in a cost-benefit analysis in which the proposed policy options were assessed through the groups of criteria. Here the cost of each intervention (only household connection) was contrasted with the benefits of all adopted aspects, i.e., social, economic, and environmental (Figure 4.12).

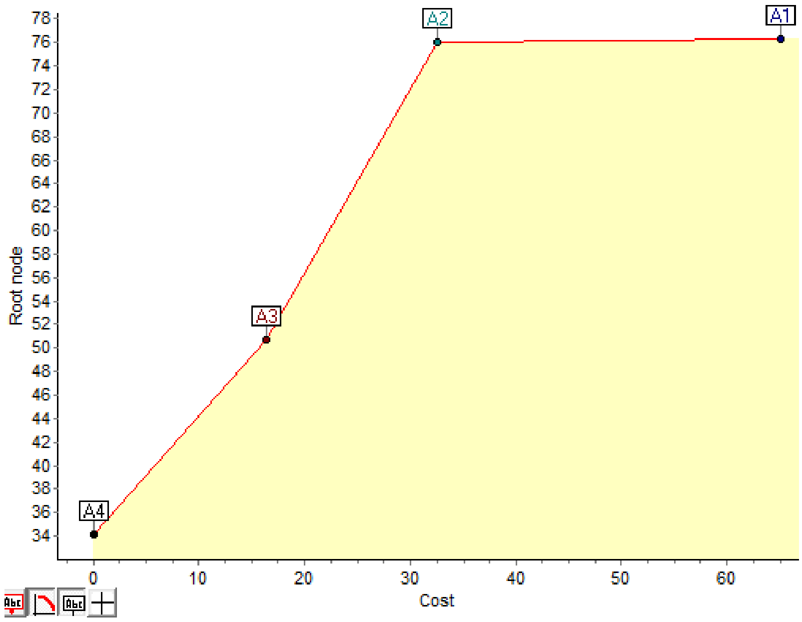


Figure 4.12 – Cost-benefit analysis.

All options are on the efficient frontier or are non-dominated. However, by focusing only on the comparison between A_1 and A_2, their benefits are similar, but with different costs. This situation confirms the expected additional analysis, which indicated A_2 as an adequate intervention based on the proposed portfolio's options. When extending such cost-benefit analysis to social and environmental objectives, the overall score between A_1 and A_2 and A_1, A_2 and A_3 remains low. Furthermore, such analysis – that takes into account the costs of an additional connection to the WSS public network – results in a higher distance between A_2 and A_1.

In summary, the cost-benefit analysis points A_2 as the best alternative. It represents the solution that has similar benefits such as strong infrastructure diffusion (A_1) WSS, but with substantially lower costs. During periods of financial crisis – as Brazil and MGS have been facing in the last years - this analysis is a fruitful and practical RIA outcome. The remainder of cost-benefit analysis graph is available in Appendix XXVI.

4.2.6 Concluding remarks

This Subchapter recognized a practical application of the RIA method in an authentic background. Findings empower ARSAE-MG with a better understanding - based on data evidence - to go beyond current policy decision practices.

As highlighted before, the use of the MCDA model in the RIA 'assessment' step offers an ideal approach to evaluate complex problems, mainly those shaped by a political background associated with several and, often conflictive, objectives such as social, economic and environmental aspects.

Even though the lack of infrastructure for collection and treatment of wastewater has been contributing to a gap of such services – concerning quantity and quality – better regulation should be the reasonable agenda to improve performance, especially in a background of economic constraints. From this perspective, RIA is central and should create the possibility to assess profits and losses of a future government intervention in that sector.

In terms of results analysis, the weight sensitivity analysis did not support the superiority of A_1, which reinforces the need to deal with incomplete, imprecise or uncertain information. The robustness analysis of the outputs denoted that any time there is a change in the local cardinal information percentage, the best policy option falls to the 2nd position in the final portfolio. Such additional analysis highlights the advanced infrastructure diffusion alternative (A_2). Cost-benefit analysis also reinforces A_2 as the best solution when costs of household connection is confronted with the benefits of all objectives proposed.

The results of this RIA approach are limited to the municipality of BBCR and to certain classes of aspects, criteria, and descriptors. Therefore, it is not possible to generalize or infer outcomes directly concerning other regions. If misinterpreted, such analysis would possibly lead to erroneous policy decisions. A good RIA practice must be tailor-made, observing specific political background and available data.

Despite the previously highlighted limits, this RIA approach suggested that:

- the universalization of services (only in that surveyed region) represented by A_1 has a high cost that would not be readily justified by the group of benefits assessed;
- A_2 corresponds to the reduction of the non-connected household gap in 75% along the period of analysis. This was the best available option, once its costs are almost 50% lower than A_1 and showed very similar benefits;
- A_3 (50% reduction of the mentioned gap) was considered a viable alternative given its costs and benefits. However, the focus group understood that A_3 is less desirable than the previous one;
- A_4 or “do nothing” is an option without costs, nonetheless, such situation configures a loss of potential revenue regarding the provider’s perspective. Additionally, it extends and intensifies social and environmental damages as a result of a non-provision of services to the customers who are currently outskirts of the public wastewater system.

This RIA exercise creates positive conditions and arguments to improve the discussion about ARSAE-MG regulatory function in terms of wastewater services diffusion. The study supports that the agency can play an important role in order to overcome the identified obstacles, mainly through designing tariff mechanisms that are able to promote the necessary investment to achieve the best alternative (A_2). Also, the institution should support local governments to enforce connection laws where the infrastructure is available. The intention is not to punish the reluctant population that refuses to adhere to the wastewater system, but to create incentives and conditions capable of reversing the current situation.

Moreover, it was possible to stimulate ARSAE-MG to invest in building a reliable database to reduce information asymmetry in comparison to other regulated companies.

In a scenario of fiscal constraints, choosing the best alternative is essential. Correct decisions present effective results saving time and resources. RIA is an excellent tool to provide accountability and effectiveness to the public decision process.

This ex-ante analysis allows the critical assessment of the household connection gap, though there is clear room for ex-post analyses. Furthermore, this Subchapter is considered as a start point to promote discussion and attract public interest on the RIA framework applied to the wastewater sector.

4.3 ADAPTING WATER TARIFFS TO CLIMATE CHANGE – AN IMPACT ASSESSMENT

Paper submitted to any ISI journal, F. Silva Pinto, B.E. de Carvalho and R.C. Marques

Abstract: Utilities face challenges that will most likely deepen in the future, and if left unattended, they may incur relevant net damage costs defying the society and environment. An ever more frequent impact is resource scarcity, where a water deficit can be brought upon due to an increasingly uncertain climate, overexploitation and contamination of resources, and also lack of infrastructure. Thus, in the water supply sector, the robustness and resilience of systems depends on drought preparedness measures able to establish a link between resources availability, utility costs, water tariffs (or other sources of revenue) and demand. In this Subchapter, the interplay regarding the instability of environmental phenomena, water supply and demand management is established. There is a focus on the role of tariffs, and its social, economic and environmental impacts are assessed related to costs, demand, and water resources availability. Possible tariff and operational adjustments are proposed on an 'ex-ante RIA time frame'. The São Paulo metropolitan area (Brazil) case-study is assessed, particularly the Cantareira reservoir system. This exercise providing a rationale to scarcity-related price changes avoiding random and arbitrary reasoning. Those solutions allow tariffs to avoid unnecessary constraints on utilities and customers, as well as on the remaining stakeholders, while considering the timing of adaptation, future growth in infrastructure, along with spatial and time-dependent changes in climate hazards.

Keyword: Water Tariffs; Climate Change; Regulatory Impact Assessment, Water Supply System, Water Resources.

4.3.1 Introduction

Weather and climate changes are modifying the water supply sector's panorama, due to their impact on the occurrence and severity of extreme events. Those challenges will most likely deepen in the future, increasing the net damage costs and defying our society and our environment (IPCC, 2014). One related case is resource scarcity due to both nature and man-made sources, where a water deficit can be brought upon due to an increasingly uncertain climate (e.g., precipitation patterns), resource overexploitation and pollution/contamination, as well as lack of infrastructure.

Indeed, in this assessment, water deficit (or in a similar perspective, 'water availability') is used in a broader definition including the relationship between competing uses, resource availability, and infrastructure requirements. Climate change added uncertainty raises additional difficulties to the management of supply and demand, constraining all stakeholders (Pereira et al., 2009). In fact, those issues related to different water uses (both consumptive and non-consumptive) are becoming increasingly complex, and therefore, calls are being made for a paradigm shift regarding water resources management (Richter, 2014).

A focus has to be made to understand and manage the transition from current management regimes to more adaptive regimes, including preparedness measures, at the ecosystem and resource level (e.g., stationary to non-stationary resource dynamics), as well as at the human systems level. In this case, preparedness covers 'monitoring and forecasting, vulnerability/resilience and impact assessments, and mitigation and response planning and measures' (Gutiérrez et al., 2014).

Therefore, for the water supply sector, such shift also requires a different approach regarding tariff design, to buffer against water challenges by allowing for an improved response to water availability changes, costs induced and demand management. The overall solution has to cover a broader perspective (at least at basin level, and including the utility, customers, governments, the 'environment' as well as other stakeholders regarding the different uses of water), and may require a connection between price adjustments and the instability of environmental phenomena.

4.3.2 The role of tariffs and possible structures

Tariff structures are an important link between utility and its community. Hence, it is important to consider all stakeholders objectives to promote a suitable equilibrium between supply and demand. The relation relies in sending customers/consumers the right message through a ‘selected’ tariff, meaning that once a decision is to be made, the price faced allows to achieve cost recovery as well as to support particular political, economic, social and environmental policies. However, under such rationale (i.e., tariff structures have to fulfill multiple objectives) arbitrary, discretionary, or ill-supported measures may be promoted.

The link between tariff design (mainly related to rate setting) and the utility’s costs is a key element, and has been widely discussed (Hanemann, 1998; Hirshleifer et al., 2005; AWWA, 2012). Such connection is centered on each tariff component’s level and the assumptions considered. In that context, the role of different time frames, that is, historical versus prospective perspectives, is paramount and defines a basis for setting prices under different marginal/average (historical; short-run or long-run) costs (EEA, 2013; Raftelis, 2014). Additionally, tariff structures require the support of accompanying policies/measures in order to achieve improved outcomes, e.g., customer ‘price responsiveness’ may depend on ‘billing price information’ (Binet et al., 2014).

To reach the desired objectives there are several possibilities at hand, being relevant to define the role of tariff structures, which ultimately, will be defined as a function of fixed, in CU/(customer month), and varying components, in CU/(volume customer month), that can include diversified adjustments (Pinto & Marques, 2015)[12]. Those adjustments are applied in order to differentiate tariffs based on a selected proxy. Those proxies are mainly selected based on:

- Customer characteristics - social, large families.
    - To differentiate based on customer characteristics, as in affordability with some wealth index, property value; and equity with household size and number of dependents.
- Time frame - seasonal, time of use, peak load.

[12] CU = Current Unit

    - Rates differ according to the relationship between demand and water availability, being usually adapted to peak hours, days, weeks, seasons.
- Spatial - urban/suburban rural, municipal, territorial characteristics.
    - Users pay considering spatial features, as with temperature, or the actual cost of supplying water to their region, or even their establishment.

4.3.3 The case of São Paulo: Cantareira reservoir system

Brazil is a federal republic with 26 states and a Federal District, with a total of 5570 municipalities, covering 8,514 million km^2, and a population of over 206 million inhabitants, with 84% living in urban areas (IBGE, 2016). In the last decade, water resources availability has been a topic of much discussion, and as a consequence, it has triggered relevant policy-making. In fact, surface water is unevenly distributed throughout the country, and unbalances between water availability and consumption in some regions are causing growing tensions, or even conflicts, among users. Regarding resource availability, the situation has worsened due to climate change effects in recent years (Coutinho et al., 2015).

As a matter of fact, since 2012, Brazil has been facing a severe drought in its Southeast Region, which has struck most harshly the State of São Paulo (Kelman, 2015). Specifically, the SPMA is inhabited by 20 million people, and it is responsible for 28% of national GDP as well as 83% of state GDP alone. As an important part of SPMA (up to 44% of its supply), the Cantareira reservoir system (CRS) is dealing with its most severe drought since 1930, directly and indirectly affecting the economy and society, with impact on electricity production, restrictions on navigation, as well as water supply constraints to domestic, industry and agriculture uses (see Figure 4.13)[13]. Due to its exposure, socio-economic and environmental impact on SPMA, this proposed exercise focus on the CRS.

The SPMA water and wastewater services are managed by SABESP, a mixed capital state utility (listed on the BM&F Bovespa and NY stock exchange markets), and is regulated by ARSESP, a state regulatory agency for water, wastewater, and energy sectors, as well as by ANA, a federal regulator for water resources. The first (ARSESP) enforces a price cap

[13] Figure 4.13 data sources: 1) ANA - http://mapas-hidro.ana.gov.br/Usuario/mapa.aspx; 2) DAEE (Water and Energy State Department) - http://www.daee.sp.gov.br/; and, 3) SABESP - http://site.sabesp.com.br/site/interna/

regulation which has an indexed adjustment mechanism covering non-manageable features (as input price changes, mostly, energy and chemicals, as well as the rate of inflation)[14].

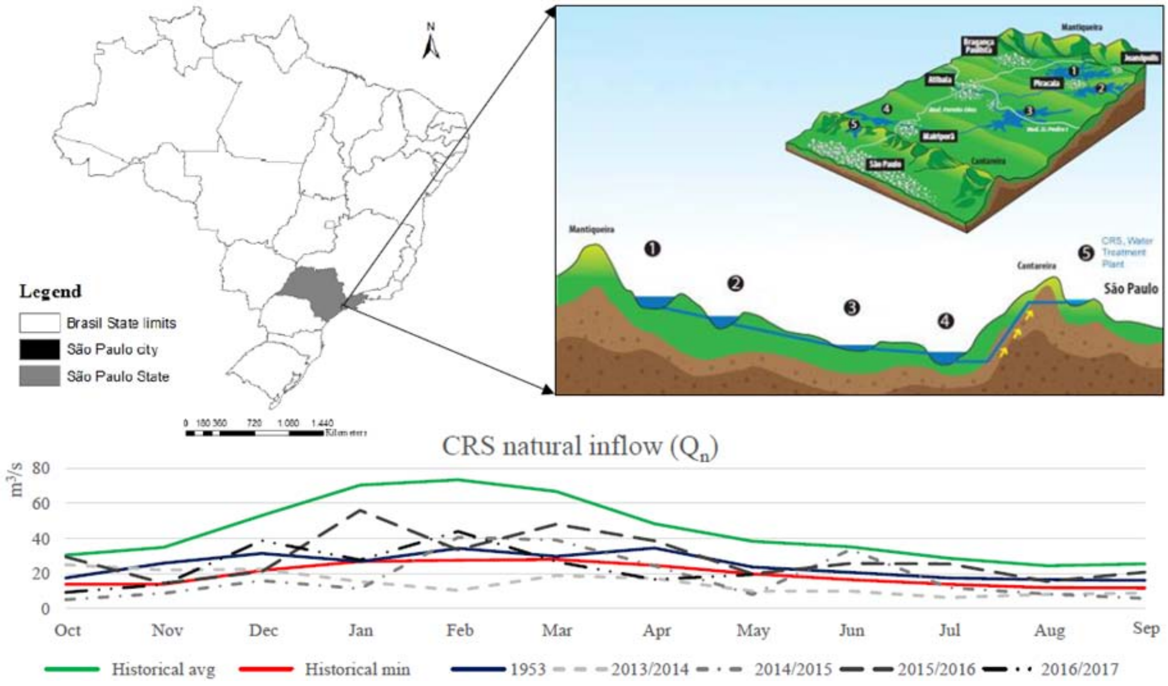
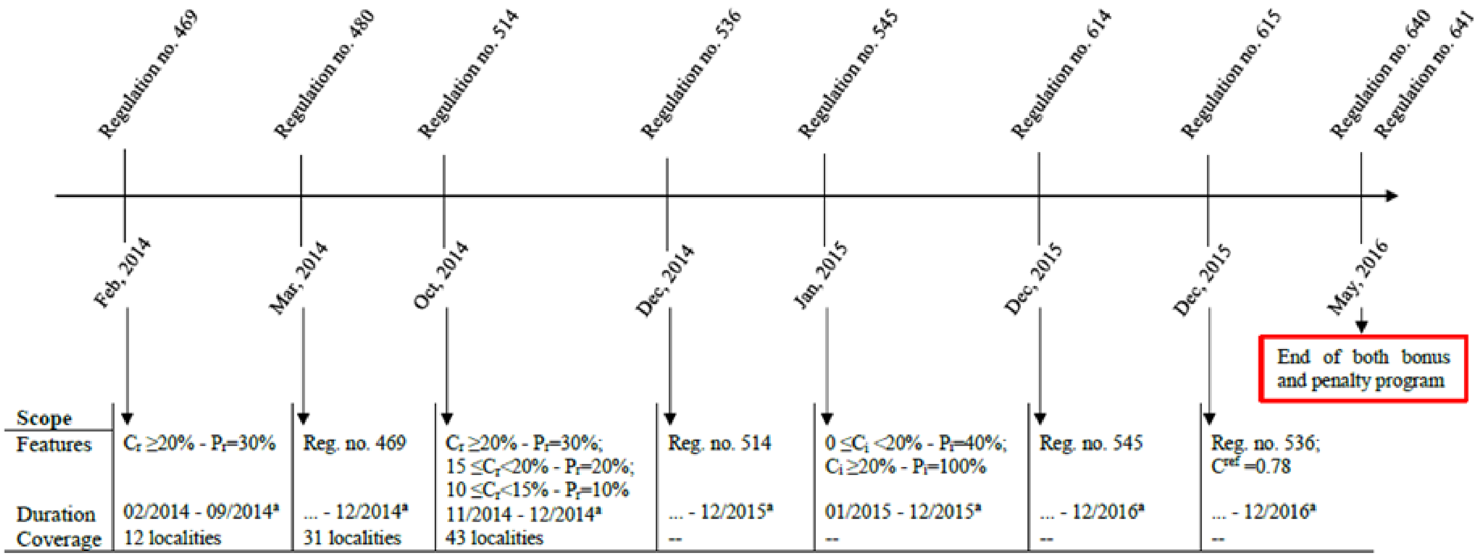


Figure 4.13 – Brazil, Sao Paulo and CRS (location and comparative natural inflow series) (ANA, 2013; DAEE, 2013; SABESP, 2017).

The second (ANA) grants water license entitlements. Under such institutional framework, this drought triggered a mix of policy measures mainly under regulations enacted by ARSESP to control demand (Figure 4.14). In the CRS, while the operational capacity of reservoirs had a sharp decrease from mid-2013 until depletion in July 2014 (pumping through the 'strategic reserve' or volume below the initial intake point requiring additional pumping). SABESP reduced withdrawals in January 2014, and by May 2015 the total outflow was 40% of the previous average values (Coutinho et al., 2015).

[14] For more information, please follow (SABESP - Operational and financial information - Tariff readjustments): http://www.sabesp.com.br/CalandraWeb/CalandraRedirect/?



Note: Cr (i) - Consumption reduction (increase) level range regarding a pre-defined level (costumer's average for the 02/2013 - 01/2014 period); Pr - Price reduction level on total bill (water and wastewater); Pi - Price increase level on water bill; Cref - Coefficient applied to costumer's consumption average. [a]- Or until the reservoir's level gets back to 'normal' standards.

Figure 4.14 – ARSESP's 'contingency plan' timeline (with time extensions and coverage expansions): bonus and penalty program-related regulations.

From a regulatory perspective, ARSESP enforced a bonus program (incentive through a discount on the final bill if customer's average consumption was reduced compared with the '02/2013 - 01/2014' period) and a penalty program (through an increase in the final bill if there was a raise in customer's average consumption). From an operational perspective, SABESP developed a few initiatives to decrease demand, raising awareness through media and stakeholder interaction, and supply augmentation, by promoting investments in key infrastructure in order to reduce the area (population) supplied by CRS as well as reduce water leakage. Thus, a mix of supply-side and demand-side measures were undertaken. The former to enlarge resource availability and increase redundancy, promoting possibilities for increased economic activity and becoming more resilient. The latter through awareness campaigns and 'price measures'. Still, to avoid social and political obstacles, water restrictions were not promoted, although the water pressure reduction initiative, to control leakage, sometimes led to actual water restrictions.

Through the whole process, further inherent flaws were noticeable, perhaps, reducing quality of service (Nobre et al., 2016), e.g., water license entitlements granted by ANA to the whole region, the delayed introduction of some solutions as changes in 'take-or pay' contracts covering high consumption levels, and the penalty program. Furthermore, there was no link established with the respective tariffs. Due to a significant share of fixed costs, unplanned investments, and reduced demand, the unitary cost (CU/m^3) increased while the unitary price did not follow up.

4.3.4 Knowledge gap and research focus

All around the world, governments have come up with weather and climate forecasting, gathering of water resources information, research projects, and emergency measures (e.g., contingency plans that include a significant raise in water tariff levels) to face acute resource scarcity. However, among others, there is a need to improve the interplay between those initiatives, as introducing climate change projections into RIA, not only to support planning and management for drought preparedness and climate resilience, but also to understand those impacts and increase their adaptive capacity (Gutiérrez et al., 2014; Wang et al., 2016). Thus, the current Subchapter focuses on the following points:

- link climate change outcomes, hydrologic information, utility costs, water demand and tariff design;
- provide a conceptual rationale for price changes that goes beyond 'demand control through the application of arbitrary coefficients', to also include resource availability considerations and infrastructure requirements (following point 1);
- propose a tariff adjustment model based on the previous rationale; and
- assess and compare the proposed model's impact with the CRS water shortage contingency plan.

There is a focus on providing a solution to scarcity-related price changes that would avoid random and arbitrary reasoning. Such policy should allow tariffs to avoid unnecessary constraints on utilities and customers, as well as on the remaining stakeholders.

The results achieved are then compared considering demand and resource management, as well as the impact on the utility's operational results. Nonetheless, the previous concept has to be supported with operational and stakeholder related initiatives. This 'adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities' (IPCC, 2014) will allow to include the required timing of adaptation, future growth in infrastructure, along with spatial and time-dependent changes in climate hazards (Stewart et al., 2015).

After this comprehensive introduction, the remainder of this Subchapter is organized as follows: Subsection 5 presents the modeling framework guidelines to reach the proposed focus. Subsection 6 outlines case-study modeling specifications, and discusses the results achieved under a suitable RIA framework presenting key policy implications. Subsection 7 provides concluding remarks.

4.3.5 Method

4.3.5.1 Modeling: general remarks

In a context of 'preparedness' and to accomplish the objectives mentioned in Subsection 1.4, there is a requirement to develop climate and hydrological models able to provide the required inputs to an RIA framework where tariff design takes place. In general, taking into account a defined time frame and climate variation patterns (as temperature, in ºC, and precipitation, in mm/day), scenarios are developed to assess future water availability, and thus, changes in operations and costs. By keeping the links through the whole cycle, instead of considering them separately (e.g., the impact of price on demand), data with increased relevance can be provided for decision making (Loubet et al., 2016). Therefore, this research unfolds under three specific steps (Figure 4.15):

- embed output values from climate models into the hydrological modeling, taking into account, preferably, temperature and precipitation parameters;
- run a Soil Moisture Accounting Procedure (SMAP) hydrological model; and,
- define the link between water resources available, utility cost variations, demand, infrastructure requirements, and tariff adjustments.

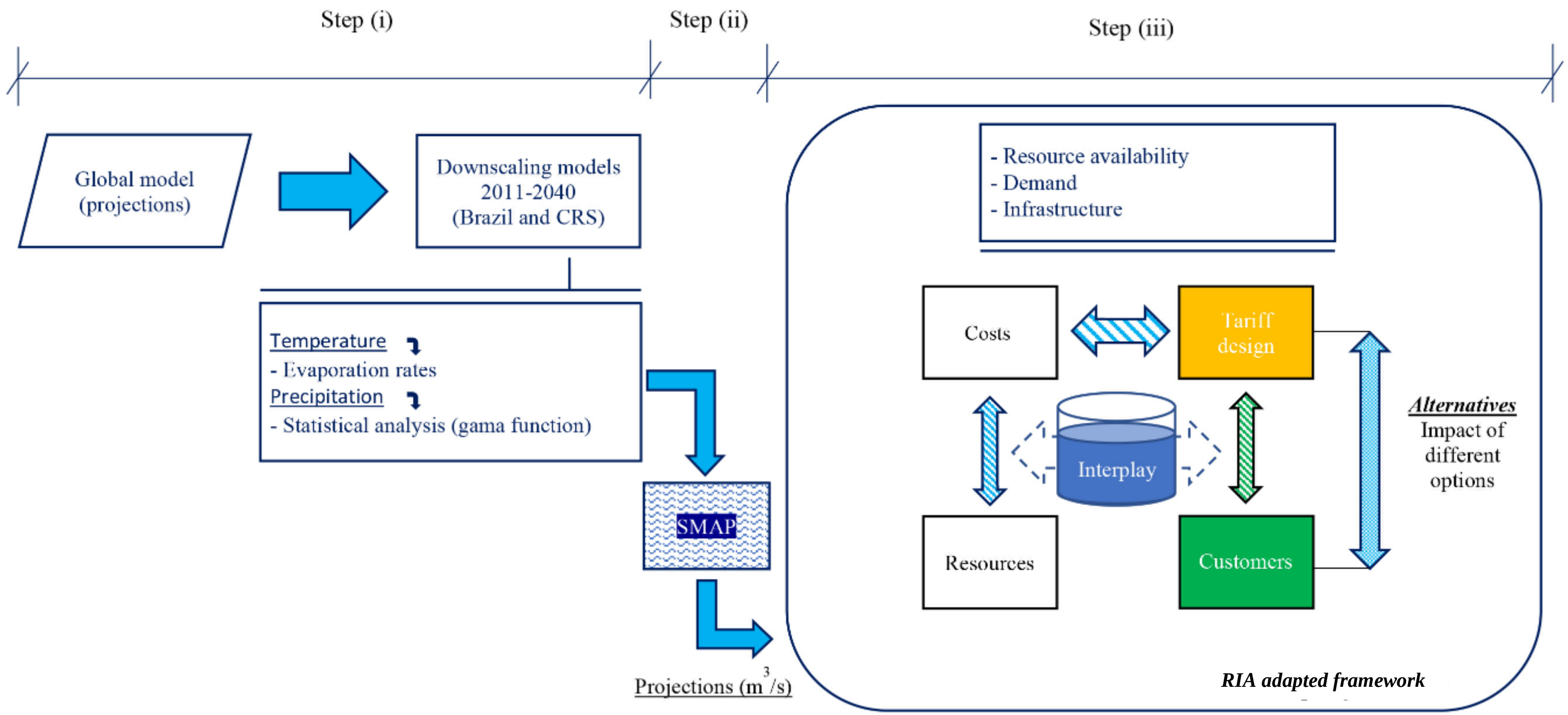


Figure 4.15 – Framework for setting tariff adjustments.

4.3.5.2 Steps (i) and (ii) – climate and hydrologic modelling: scenario development

The spatial resolution of global climate models hinder the development of local level assessments. A possible strategy is to degrade the global model simulations into regional climate models able to provide the desired detail.

Thus, there is a requirement to downscale from emission scenarios, which are simulated by global climate models, and to define projection timeslices (Chou et al., 2014). The evaluation of simulations regarding the downscaling model must consider a relevant period referred to as present climate.

Climate models are a critical feature to calculate input values for hydrological models. Thus, projections of temperature and precipitation variations are compared to a baseline period, for the defined timeslices, to calculate SMAP hydrologic model inputs (Lopes et al., 1982). The rainfall-runoff SMAP model is deterministic, conceptual and spatially dumped. The model has a simple structure and uses an exponential function which depends on the precipitation and soil moisture to estimate surface runoff (Kwon et al., 2012). The algorithm performs flow splitting by Soil Conservation Services (SCS) parameters (SCS-USDA, 1972). In accordance with usual hydrological taxonomy, in the SMAP monthly model, one can distinguish two reservoirs structure (subsurface, R_{soil}; and, groundwater, R_{sub}) and the splitting system (Figure 4.16), which represents balances in soil, groundwater and surface storage, besides other processes, as evapotranspiration and interception (Equations 4.6 – 4.15).

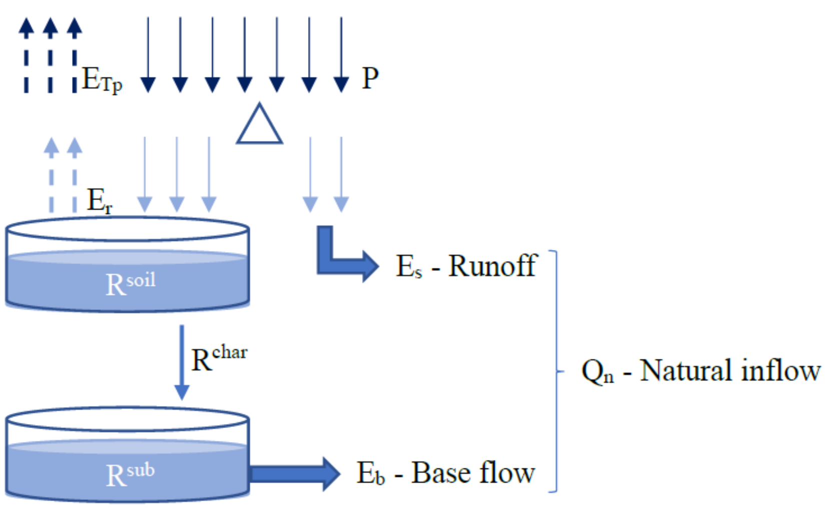


Figure 4.16 – Ilustrative SMAP model.

The evapotranspiration rates (ET_p) are calculated through the Hargreaves method due to its direct link with temperature parameter (Hargreaves, 1974). In brief, E_{Tp} is an estimated value between maximum and minimum temperature per day, as shown in Equation 4.6.

$$E_{T\,p} = 0.0023 \;\; \lambda/S0 \quad (T_a + 17.8)\,(Tmax - Tmin) \tag{4.6}$$,

where:

ET_p is the evapotranspiration rate (mm/day);

S_0 is the global solar radiation (kJ/m^2);

λ is the latent heat of vaporization (−);

T_a is the average temperature (ºC);

T_{max} is the maximum temperature (ºC); and,

T_{min} is the minimum temperature (ºC).

The remaining key equations, that cover the initialization procedure for both reservoirs, their successive stages, surface flow E_s, in $^{m3}/s$, as well as contributions for groundwater recharge R^{char} and base flow E_b, in $^{m3}/s$, can be defined as follows:

$$R_1^{soil} = h_0 \; x \; W \tag{4.7}$$

$$R_1^{sub} = 2630 \; x \; E_{b,\,0}/(1-k) \text{ x } A_b \tag{4.8}$$

$$R^{char} = R^{soil} \; x \; (R^{soil}/\, W^{c})^4 \; x \; C_{rec} \tag{4.9}$$

$$E_r = (R^{soil}/W^{c}) \; x \; E_{Tp} \tag{4.10}$$

$$E_s = (R^{soil}/W^{c})^{sa} \; x \; P \tag{4.11}$$

$$E_b = (1-k) \; x \; R_{sub} \tag{4.12}$$

$$R_i^{soil}{}_{+1} = R_i^{soil} + P - E_s + E_r + R^{char} \tag{4.13}$$

$$R_i^{sub}{}_{+1} = R_i^{sub} + R^{char} - E_b \tag{4.14}$$

where:

E_b, 0 is the initial base flow (m^3/s);

h_0 is the initial soil moisture state (*mm*);

W^c is the soil storage capacity (*mm*);

A_b is the basin area (*km*^{2});

s^a is a surface flow parameter (−);

E_r is the evaporation(mm);
k is a base flow recession coefficient $time^{-1}$; and,
C_{rec} is an underground recharge coefficient (−).

Lastly, the natural inflow (m^3/s) is computed as:

$$Q_n = (E_s + E_b) \times A_b/2630 \qquad (4.15)$$

Furthermore, the SMAP model has to be fine-tuned based on data available. The resulting outputs allow to define possible scenarios, i.e., considering different projections from climate change models. Important features to take into account are: (1) current climate period, (2) defined timeslices, (3) models definitions, and, (4) model outputs and their estimated anomalies.

4.3.5.3 Steps (iii) – tariff modelling: adjustments to target 'water availability'

Water utilities must be able to pay for their expenses in order to assure a continuous provision of services. The costs incurred range from those directly linked with the operations and maintenance (O&M), to capital charges. However, those are just direct supply costs, to understand the true costs entailed, opportunity costs and those related to externalities should be evaluated (Rogers et al., 2002). The downside factors of non 'direct supply costs' are estimation accuracy, adoption frequency and their degree of acceptance. Furthermore, consistently, the recovery of recurring operational costs alone is a demanding task for utilities. Nonetheless, all those revenue requirements have to be balanced to allow for their sustainable functioning. Generally, those requirements can be covered by different sources of revenue, still, the role of water tariffs is critical, mainly in resource stressed environments, where competing uses, resource availability and infrastructure constraints have to be assessed (not disregarding further opportunity costs and externalities). Indeed, it is relevant to understand how customers adjust their consumption behaviors when facing price, disposable income and household variations (for increased insights on elasticity of demand, see Sebri, 2014). This way, there is a possibility to relate price with inherent value (i.e., mostly benefits). An example is outlined in Figure 4.17, where theoretical costs incurred are specified (case adapted from Hall, 2009).

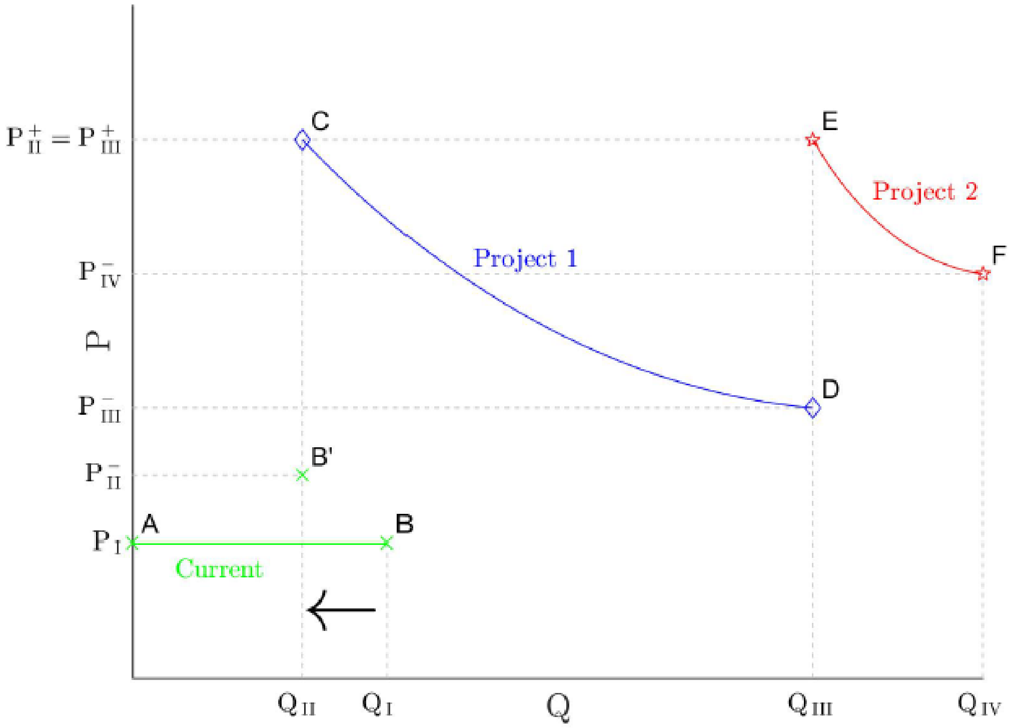


Figure 4.17 – Theoretical example of an utility supply costs.

The figure plot goes as follows: (i) an utility where the costs incurred are considered constant (e.g., previous capital costs considered sunk) has a capacity Q_I; (ii) The current source is an historically low-cost situation (e.g., freshwater source as groundwater), however, in such region, consumption is rising until point B, but due to exogenous variables (e.g., climate change) the availability went to B’, which has increased costs (as in increased pumping costs); and (iii) the utility has the opportunity to face demand by investing in further projects (alternatives) that would raise demand as wastewater reuse. The example highlighted in Figure 4.17 clearly depicts all three sources of scarcity. Those circumstances may require adjustments (under specific formats, e.g., surcharges) either in a shorter or longer time frame, depending on the alternatives selected, to target such water deficit. The main alternatives would fall under: water tanks; surface water sources; interbasin transfers; groundwater sources; desalination (brackish and seawater); and, reuse (wastewater and stormwater). Naturally, the price charged will have to range between possible alternatives (e.g., average costs, short run marginal costs, long run marginal costs as average incremental costs) and the customers’ willingness to pay.

This proposal assumes an adjustment covering possibilities related to stabilization (as in tariff levels), capital financing, or directly targeting changes in operational costs. Those adjustments under possible fixed/volumetric surcharges, or a percentage of total bill, will, most likely, affect the remaining objectives set (Pinto & Marques, 2016), namely: (i) financial sustainability - cost recovery and revenue stability; (ii) economic efficiency - allocative efficiency; (iii) social concerns - equity and affordability; (iv) environmental concerns - sustainable use; and, (v) governance - clarity and administrative simplicity, with a focus in implementation.

To operationalize those objectives and to keep the links mentioned in Figure 4.15, the model developed in Pinto and Marques (2017b) and add some valuable details (regarding the elasticity of demand) of the model developed in (Nauges et al., 2015) was adopted. Customers are grouped according to their consumption (integer intervals), each type of customer is charged following its respective block and has its own consumption behavioral adjustment patterns (elasticity of demand), which in this case are assumed to react to average price changes (without loss of generality). Please note that there are three types of water volume covering, first, consumption (benefit), and second, production (costs) and billing (revenue). The relation between them depends on water losses (both real and apparent) and tariff structure (e.g., guaranteed consumption). The key added features are:

- cost function dependent on proxies, e.g., reservoir capacity, water table elevation or pumping hydraulic head

$$c_\ell^a = c_\ell^c + \sum_{m \in M} b_{m\ell}^i c_{m\ell}^i + c_\ell^o + \sum_{\ell' \in L'} \sum_{s \in S} f_s^c\left(u_{\ell'\ell}\right) + \sum_{\ell' \in L'} \sum_{s \in S} f_s^e\left(u_{\ell'\ell}\right), \quad \ell \in L \quad (4.16)$$

- investment requirements to increase water availability

$$b_{m\ell}^i = \begin{cases} 1, & \sum\limits_{m' \in M : m' < m} u_{m'} + \min\limits_{\ell' \in L'} \left(u_{\ell'\ell}\right) \leq 0 \\ 0, & \sum\limits_{m' \in M : m' < m} u_{m'} + \min\limits_{\ell' \in L'} \left(u_{\ell'\ell}\right) > 0 \end{cases}, \quad m \in M;\ \ell \in L \quad (4.17)$$

- Water demand requirements with customer behavior adjustments

$$z_{i\ell'\ell} = z_{i\ell'\ell-1}\left(1 + \alpha_i \nabla_1 \left[g_i\right]\left(\ell'\ell\right)\right), \quad i \in I;\ \ell' \in L';\ \ell \in L$$

(4.18)

where:

$c_\ell^{\,a}$ is the total cost incurred by the utility to provide water supply services in year ℓ, for all $\ell \in L$;

$c_\ell^{\,c}$ is the capital (CAPEX) and financial cost (and possibly other related layouts) incurred by the utility to provide water supply services in year ℓ, for all $\ell \in L$;

$b_{m\ell}^{\,i}$ is a binary variable that detects the requirement of investment m, with an additional volume of water available u_m, in year ℓ, for all $m \in M$, and $\ell \in L$;

$c_{m\ell}^{\,i}$ is the cost of investment m in year ℓ, for all $m \in M$, and $\ell \in L$;

$c_\ell^{\,o}$ is the O&M cost (excluding chemicals and energy expenses) incurred by the utility to provide water supply services in year ℓ, for all $\ell \in L$;

$f_s^{\,c}(u_{\ell'\ell})$ is a function dependent on a proxy ($u_{\ell'\ell}$, volume in m^3 of water available) that covers chemical expenses (unitary cost x ratio of use x volume produced) incurred by the utility to provide water supply services in sub-system s, year ℓ, for all $s \in S$, and $\ell \in L$;

$f_s^{\,e}(u_{\ell'\ell})$ is a function dependent on a proxy ($u_{\ell'\ell}$, volume in m^3 of water available) that covers energy expenses (unitary cost x ratio of use x volume produced) incurred by the utility to provide water supply services in sub-system s, year ℓ, for all $s \in S$, and $\ell \in L$;

$z_{i\ell'\ell}$ is the water quantity per customer, ($^{m3}/_{(customer \cdot month)}$), demanded by customers i, in month ℓ', year ℓ, for all $i \in I$, $\ell' \in L'$, and $\ell \in L$;

α_i is the price elasticity of demand (coefficient) for customer type i, for all $i \in I$;

$g_i(\ell'\ell)$ is a function that relates each customer type i with the respective average price in month ℓ', year ℓ, for all $i \in I$, $\ell' \in L'$, and $\ell \in L$.

The general water shortage contingency plan has to include additional key features in order to effectively manage drought financing and water demand. The required steps cover an adequate dissemination and implementation (*e.g.*, deadlines - time frame) of tariff adjustments, as well as their rationale and additional non-pricing mechanisms. A suitable integration of those steps has to target specific policy issues to drive customer acceptance and media relations: timing for implementation, revenue adequacy, additional and/or deferred expenses, equity, bill presentation and accounting issues.

4.3.6 Empirical analysis

In terms of preparedness, despite their reduced application on RIA, Brazilian governmental and non-governmental agencies have been developing climate projections (quantitative information) to support discussion on prospective planning. In general, those scenarios are supposed to assess future water resource availability, considering a time frame (2011-2040), through observed data (1961-1990), taking into account temperature (ºC) and precipitation (mm/day) variation patterns. In order to obtain the required detail, the global model simulations were degraded into regional climate models able to provide simulations on the regions of interest. Therefore, in this analysis, two emission scenarios, Representative Concentration Pathways (RCP) 4.5 and 8.5 Wm^{-2}, simulated by global climate model HadGEM2-ES (Collins et al., 2011), through INPE's (Brazilian National Institute for Spatial Research) Eta model for a 2011-2040 timeslice (Chou et al., 2014) were downscaled, as highlighted in Appendix XXVII. The evaluation of Eta simulations considers a 30-year period (1961-1990), which is referred to as present climate period. Note that the selection of a representative climate model should follow specific rules to achieve the desired objectives (Lutz et al., 2016). For CRS, temperature and precipitation are both slightly underestimated in Eta simulations for the summer season (austral summer, December - January - February, DJF), the observed anomalies for temperature are positive in all scenarios, which implies an increase of evapotranspiration. On the other side, a decreasing trend was found for precipitation. The combination of both processes tends to project smaller inflows resulting in negative anomalies for both scenarios, although more aggressive in RCP 4.5 due to precipitation estimates (Figure 4.18). In those scenarios, the area and the anomalies of temperature increase from RCP 4.5 to RCP 8.5 (Chou et al., 2014). It is worth pointing out that in addition to these parameters, other variables can imply a significant change in surface water availability. Still, assuming that stages (i) and (ii) of the proposed framework do not need to completely encompass such detail (e.g., uncertainty), the projections for precipitation and temperature variations (compared to the baseline period for a 2011-2040 timeslice) can be properly introduced as SMAP inputs.

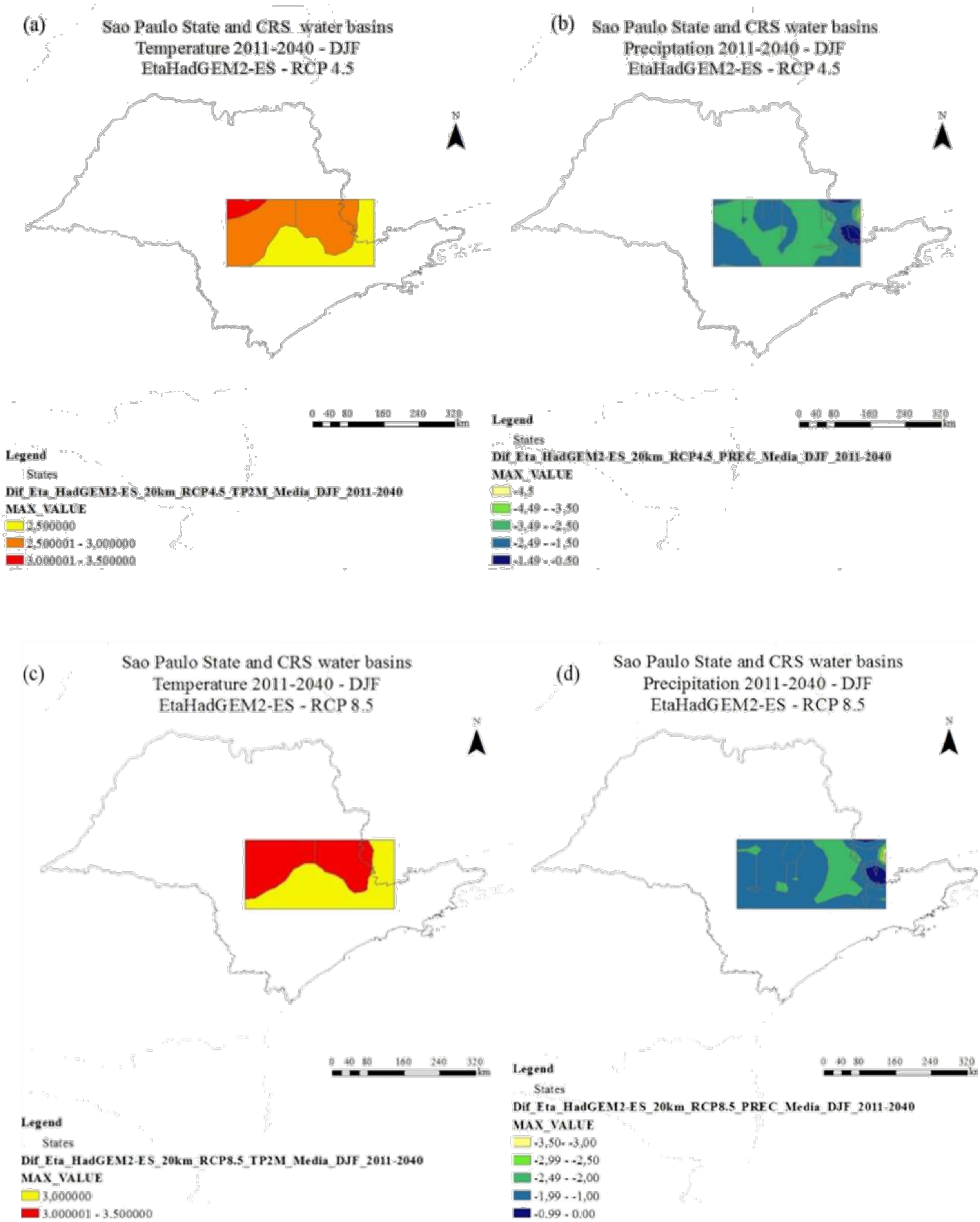


Figure 4.18 – CRS climate change projections (Eta HadGEM2-ES 4.5 and 8.5, 2011-2040): temperature, (a) and (c); and, precipitation, (b) and (d).

For hydrological simulations, in both scenarios 4.5 and 8.5, the frequency of negative natural inflow anomalies is predominant. Figure 4.19 outlines Q_n projections from three representative location points.

In this assessment, the SMAP model was fine-tuned based on data available (1997-2007), and its specific parameters were obtained considering data from the 20th century. The assumption to keep them for the 21st century is also made in the energy sector, for the Brazilian national interconnected system projections (Operador do Sistema Nacional, ONS in Portuguese). Further information was collected from the water services national database (SNIS), SABESP website (mostly for financial statements, sustainability reports and info on surface water sources)[15]. Therefore, this paper takes into account the following scenarios, which are summarized in Table 4.6, and highlight: present climate period; type of climate model; and, estimated anomalies.

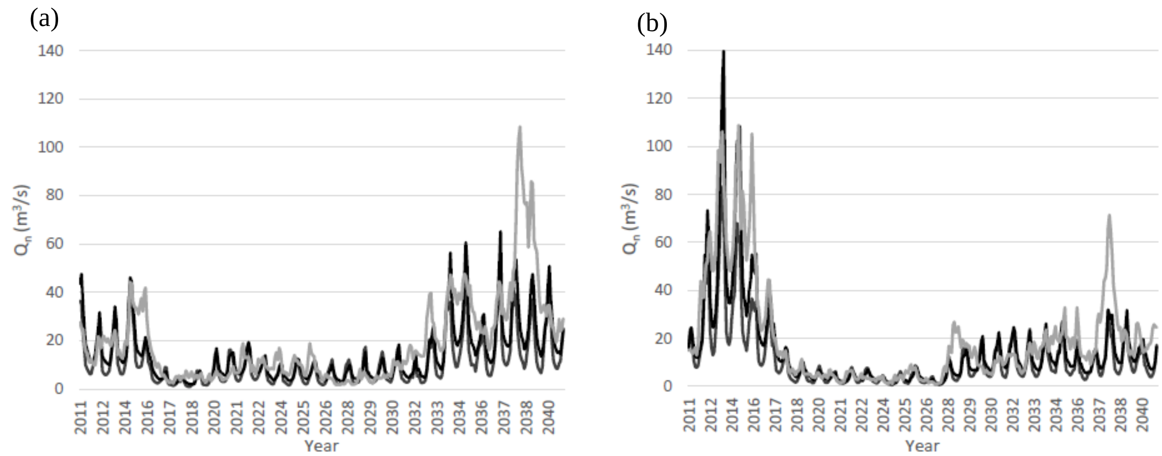


Figure 4.19 – Q_n projections from three representative location points, with inputs from Eta HadGEM2-ES: a) RCP 4.5; and, b) RCP 8.5.

Following the principles outlined in Subsection 4.3.5, there is a requirement to assess the prospective climate changes brought upon operational costs (e.g., energy and chemical costs) due to quality changes in surface water sources (for additional information, please check Gregor, 2013; and Mo et al., 2016).

[15]SNIS:http://app.cidades.gov.br/serieHistorica/.SABESP:http://www.sabesp.com.br/Calandraweb/CalandraRedirect/?temp=0&proj=investors new&pub=T&db= (Operational and financial information); www2.sabesp.com.br/mananciais/DivulgacaoSiteSabesp.aspx (CRS capacity); and, www2.sabesp.com.br/mananciais/divulgacaopcj.aspx (CRS reservoir operations).

Additionally, possible infrastructure investments, changes in reservoir operational rules, and water losses related initiatives must be planned (even if their impacts may require further assessment, see Pillot et al., 2016). In this study, unless otherwise stated, the operational and stakeholder related initiatives promoted by SABESP (Subsection 4.3.3) are considered for all scenarios to increase comparability.

Table 4.6 – Proposed scenarios and estimated anomalies (temperature, T; precipitation, P; and, natural inflow, Q_n).

Scenario	**Present climate period**	**Timeslice**	**Climate model**	**Outputs**	**Time perspective**	**Estimated anomalies (T, P, Qna)**
Sc #1	–	Current	–	Observed	Figure 4.14 (ex-post)	–
Sc #2	1961-1990	2011-2040	Eta HadGEM2-ES RCP 4.5 (DJF)	T, P, ETp, Q_n	ex-ante	(2:3.5, -4.5:0.5, -48: -40)
Sc #3	1961-1990	2011-2040	Eta HadGEM2-ES RCP 8.5 (DJF)	T, P, ETp, Q_n	ex-ante	(3:3.5, -2.9:0.0, -39: -29)

For tariff design, alternatives have to be identified, not to develop a detailed blueprint on the mix of supply-side measures required, but to enforce meaningful (representative) possibilities able to work as price level standards. In fact, the situation is far more complex than in Figure 4.17, however, as demand reaches system capacity, the reliance on other alternatives grows and therefore, the 'good' can be priced under such rationale. Please note that operational feasibility of alternatives does not require full 'complementarity', as there should be a mix of other initiatives. Thus, two options (Opt.) are considered:[16]

Opt 1. Technical reserve - the use of water below the initial intake point, has lower operational constraints, but higher (although conceivable) construction costs and lead time, as well as higher operational costs due to additional pumping plus a slight variation in the quantity of chemicals required; and,

Opt 2. Water tank - has no construction costs and lead time, but higher operational constraints (e.g., quantity, logistics and operational costs), other advantages and disadvantages may hold (Constantine et al., 2017).

[16] Regarding the use of possible alternatives, as a practical example, water reuse solutions can be reinforced, but should not be used as a price level standard, as the infrastructure and social acceptability demands, among others, are higher for those projects (Furlong et al., 2017). Furthermore, alternatives should be duly assessed prior to their implementation (Schoen et al., 2017).

The previous tariff structure (which renders the problem defined in Subsection 4.3.5, mono-objective) was kept, indexed adjustment mechanism, price cap constraints (although the costs used are in compliance with Eq. 4.16), and the current taxes charged (e.g., COFINS/PIS/PASEP), for simplicity and comparability, thus, the focus is on component price levels. Indeed, both options work as price levels for tariff structural components (mainly, third and fourth blocks). Due to their nature and cost level, see Table 4.7, **Opt. 1** refers to a component where consumption is deemed discretionary on average, over CRS's initial capacity and having to rely on its technical reserve. **Opt. 2** works as a stop block (Hanemann, 1993), that is, when CRS's capacity is very low, an economic incentive is provided to avoid overly discretionary consumption, please note that there are notable exceptions.

Table 4.7 – Tariff proposal considering climate change projections and alternative sources.

Volume m^3	**Unit**	**Price-level rule[a]**	**Rationale**
Domestic - Regular[b]			
[0, 10]	(^{CU}/month)	1st - Level that considers average affordability constraints	An amount of water priced at affordable level, while giving revenue stability
(10, 20]	($^{CU}/m^3$)	2nd - Level that balances cash-flows	Cost-recovery.
(20, 50]	($^{CU}/m^3$)	3rd - Opt. 1	Link between water resources, cost and demand.
(50, ∞)	($^{CU}/m^3$)	4th - Opt. 1 or 2	Same as Opt. 1, or level↑ to give a clearer sign.
Commercial / Industrial / Public - Regular			
[0, 10]	(^{CU}/month)	5th - CRS cost of service	To allow for a competitive setting and public health requirements.
(10, 20]	($^{CU}/m^3$)	Level that balances cash-flows	Cost-recovery.
(20, 50]	($^{CU}/m^3$)	Opt. 1	Link between water resources, cost and demand.
(50, ∞)	($^{CU}/m^3$)	Opt. 1 or 2	Same as Opt. 1, or level↑ to give a clearer sign.
Wholesale			
[0, ∞)		CRS cost of service	Under contract, requires re-negotiation.

[a] - Only considers production costs, afterwards, other costs are allocated in accordance with customer type.

[b] - SABESP has several tariff structures that cover particular situations (mainly social adjustments). Due to their nature, they were kept as defined by SABESP. For SABESP's tariff structure details, follow (Website - Regulation tab - Tariff revision): http://www.sabesp.com.br/Calandraweb/CalandraRedirect/?temp=0&proj=investorsnew&pub=T&db=.

In order to put price-level rules into practice, there is a need to specify what they entail. First, there is the case of average affordability constraints for regular domestic customers, that is, a specific amount of water should be priced below a share (e.g., 3~5%) of the regional (household) disposable income (Martins et al., 2013). From the second to the fifth, price-levels relate to inherent costs and requirements to achieve a 'null' net present value.

Particularly, the fourth depends on the requirement to impose a stop block to avoid consumption on that block, as soon as investments are expected to increase water resources the infrastructure related costs are triggered and operational rules change.

In this case, the possible investments are related to CRS technical reserve and reservoir/network operational rules. Furthermore, to account for customer behavioral adjustment, due to data availability, it consider the 'price elasticity of demand', the values were adapted from previous research (DAEE, 2004; Alves et al., 2009; Gonçalves, 2011) to the proposed time frame (2014-2016). Different values for that coefficient were used depending on the type of customer and its consumption block.

4.3.7 Results achieved

Historical values (sc. #1) are herein compared with the proposed tariff structure changes (sc. #2 and sc. #3), price levels in 2016 Brazilian R$, BRL.[17] In Figure 4.20, the tariff price levels was provided, historical demand and inflows (sc. #1) or the projected values (sc. #2 and sc. #3), the increase in water volume requirements projected by SABESP in 2013, for the 2014-2016 time frame, and bonus/penalty programs financial outcome.

Important details observable in Figures 4.20 (b) and (c) are: while the former, due to projections of low natural inflow to the CRS, a stop block (Opt. 2) was used, additionally, the reservoir and network operational rules (decrease in reliance of CRS to supply SPMA) adopted were the ones in Figure 4.20 (a). Since in mid-2015 there were no relevant improvements in terms of natural inflow projections, those rules were kept for the remaining time frame. From a different perspective, in sc. #3, Figure 4.20 (c), the natural inflow projections were very favorable, and thus, no changes in operational rules were required allowing to defer those investments to a more suitable 'time window'.
As highlighted in Figure 4.20 (d), the water requirements projected by SABESP were positive and independent from customer behavior, i.e., the values were based on fixed yearly projections for the number of customers and per customer consumption. As noticeable in Figures 4.20 (b) and (c), by considering customer behavior, the price can be adjusted to possible variations in demand. Furthermore, as seen in Figure 4.20 (d) the bonus and penalty

[17] The currency exchange rate monthly averages ranged in 2016 from (min - max): USD / BRL (3.196 - 4.043); and EUR / BRL (3.528 - 4.408).

(a)

programs used to control demand were significant financial hazards that could have been avoided with different initiatives 4.20 (b) and (c). The impact on the CRS capacity is also perceptible.

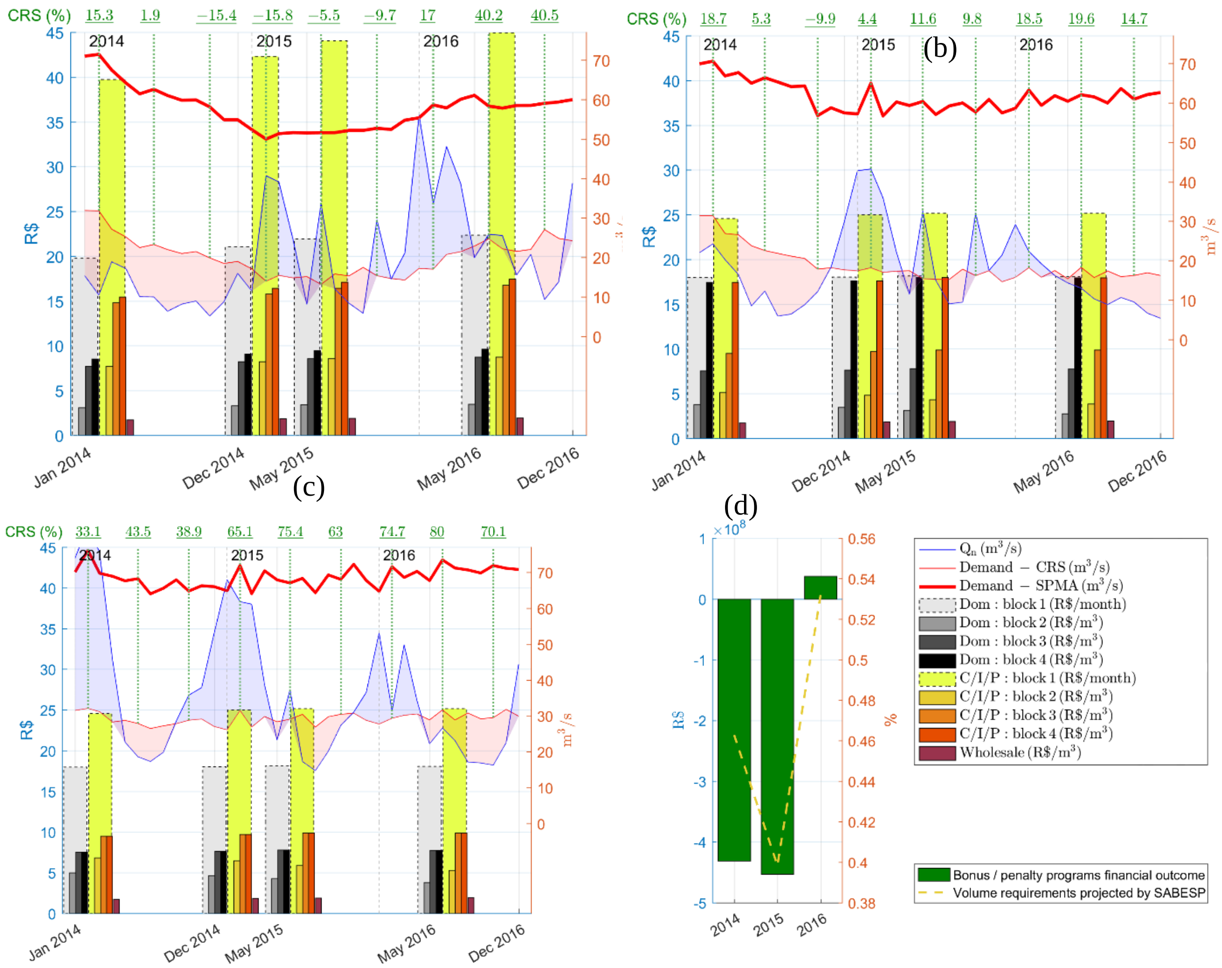


Figure 4.20 – Empirical results for domestic (dom), commercial/industry/public (C/I/P), and wholesale customers.

4.3.8 Dicussion and policy implications

As seen in Figure 4.20, if tariffs are set with proper links to demand, utility costs and climate/hydrological changes, negative outcomes at financial and environmental levels brought by extreme events (as droughts) may be controlled in an improved way. A balance in all dimensions (point 2, Subsection 4.3.4) has to be achieved, preferably in a preemptive fashion (planned), to reach sustainable adaptation measures. Proper preparedness covering planning, with a monitoring system able to detect anomalies and enforce counter measures is a key element for success. Naturally, if a water supply system is sufficiently resilient, a 'smoother' response will take place. However, it is important to highlight that in terms of investment, the focus does not usually go to infrastructure robustness / resilience, instead coverage expansion (mostly in developing countries) or 'quality' improvements are often prioritized (Marlow et al., 2013). Thus, investment, e.g., in water source redundancy, is usually deferred (such was the situation of the SABESP case-study).

The impact of SABESP and ARSESP's initiatives was significant, since, as seen in Figure 4.20 (a), there was an over 50% drop in water withdrawn (30% considering the whole SABESP system, i.e., some supply-side redundant measures, as supplying from other intakes besides CRS, accounted for the remaining). However, some initiatives had relevant issues. Inevitably, besides flawed planning and infrastructure resilience issues, there were stakeholder engagement and tariff structure related features that could had been improved.

The former related to political consensus in a wider perspective, at least at the basin level, to promote scarcity driven initiatives. The relevance to include not only the utilities and sector regulators, but also resource management (or environment) and customer related institutions is critical for a more participatory process. It would have improved media relations, increased customer acceptance, and thus, possibly reduced complaints, controlled private water tank prices as well as non-utility water intakes (usually in industry and irrigation sectors).

The latter connected to the tariff structure, the bonus and penalty programs. Even if a suitable price level adjustment was promoted, the structure per se has to be properly designed (see Pinto and Marques, 2017b). In the SABESP case-study the volume associated with each tariff block is not particularly related to SPMA customer characteristics.

For particular customers, a block with guaranteed volume or the existence of several blocks may imply a value judgment regarding how worthy different types of consumption are. In São Paulo, the 10 m^3 amount (1st block) may give incentives for over-consumption. Also, in commercial or industrial settings, higher uses do not mean discretionary or wasteful uses. This structural issue is also relevant for the bonus and penalty programs, as they are based on each customer average consumption level, which even if mentioned in AWWA (2012) as a possibility, it comes with several downsides. Since it does not consider the initial point from which each customer departs, previous mindful customers are harmed, giving to those who had a previous discretionary use the possibility to enjoy discounts and pay less than the others. That is why consumption constraints should be absolute and not relative, even if there are high customer management costs, in a short time frame it certainly offsets (due to possible complaints and hearings).

Also connected to tariffs, there is the case of ‘take-or-pay’ contracts, as the associated volumes were significantly high, and the solution came as a reaction to social unrest, being implemented not as soon as it should have. Therefore, triggers should be defined to adjust ‘take-or-pay’ contracts as well as other situations.

In general terms, for SABESP, the model considers that the remaining sources of revenue are kept constant, but changes in their role can be also included (to finance specific programs), although it may become data intensive. Related to cost and revenue, there is the exchange rate exposure on loans and financing, it is a very important risk for highly fluctuating currencies.

To conclude, several preparedness initiatives can be implemented to improve the resilience of water systems and communities, disaster response and recovery, as well as to decrease economic losses. Following this case-study key requirements are elicit: (i) stakeholder engagement, at institutional level between bodies linked to climate, planning, as well as resource management and use; (ii) strengthen social participation channels and training processes to avoid misinterpretation and confusion; (ii) knowledge/technology diffusion programs to reach a rational use of water; (iv) improve reservoir operational tools in order to incorporate uncertainties arising from climate variability; (v) increase resilience through redundancy of solutions, as in water storage capacity, e.g., integration of basins; (vi) development of climate related contingency plans; and, establish effective enforcement mechanisms and compliance.

4.3.9 Concluding remarks

To suitably aid the utilities in their decision-making process, there is a requirement to integrate supply, demand and asset management processes. Drawing from that concept, a feedback from tariff structures is required for several purposes, namely due to their role to finance and to manage demand levels, which is key to water resources management. In this study, in surface water dependent systems (without loss of generality), a tariff adjustment where inflow projections (influenced by climate models) are used as a component to an ‘operational cost’ proxy (as a share that depends on water withdrawn and recharge rates), which is linked to water demand and tariff levels allowing for a continuous adaptation. Such adjustment allows for improvements in timing of implementation, resource management and revenue adequacy in prior to, during, and post drought event time frames. It also gives important inputs for additional or deferred expenses (investment selection), and highlights requirements to assess equity, bill presentation and accounting issues.

The SABESP case-study, with a focus on CRS, highlights relevant details. The mix of regional importance, scale of hydrological problem, successful measures enacted and required improvements, allow to understand that a thorough link between sources of scarcity and solutions has to be made in an inclusive way. In this case-study, the main issues relied on the nonexistence of a link between tariffs, demand and operational solutions, disregarding the reactive nature of all initiatives implemented. The ad hoc relief and response initiatives are herein assessed, and proactive (preemptive) measures are proposed. Nonetheless, to develop a complete tariff adjustment policy, there is a need to consider resource availability in all sub-systems, this working example focus on the CRS (due to its importance to the whole system).

CHAPTER 5. GOVERNANCE & REGULATORY IMPACT ASSESSMENT

5.1 GOVERNANCE & REGULATORY IMPACT ASSESSMENT (RIA): HOW CLOSELY RELATED ARE THEY?

Paper submitted to an ISI journal, B.E. de Carvalho, Rondon, R., R.C. Marques and O.C. Netto

Abstract: The Subchapter aims to explain why the presence of regulatory impact assessment (RIA) may be a vehicle to improve regulatory governance and vice-versa. As a systemic policy tool, RIA is embedded in a governance environment that determines the condition under which RIA takes place. Here, one of the merits of RIA is that it may work as a regulatory driver to maximize the effects of good governance principles. Under the proposed analytical framework, the governance principles related to RIA were reviewed and used experts' opinion to understand the extent to which RIA may improve overall regulatory governance and also overcome RIA's own limiting factors. In conclusion, RIA could be an appropriate policy, even in poor governance environments, since it has a dimension that goes beyond regulatory quality "managerial dimension" contributing to improve the regulatory governance "institutional dimension".

Keyword: Core Regulatory Principles; Regulatory Governance; Regulatory Impact Assessment.

5.1.1 Introduction

Understanding why policies succeed in certain contexts and fail in others has become a major concern to the development community (World Bank, 2017). Institutional transplant is no solution (Dubash & Morgan, 2012). Such realization may help explain why RIA has become one of the most promoted regulatory policy tools by Organization for Economic Co-operation and Development (OECD) for the past 20 years (OECD, 2015). However, results of RIA in OECD countries - and elsewhere - remain uncertain (as briefly discussed in Chapter 2), and its effectiveness, one may argue, requires the compatibility of such innovation with the institutional setting. As noted in recent studies, governance systems establish the rules guiding the adoption of RIA but each element of the system affects RIA process itself (Berg, 2013; Meuleman, 2014).

Generally justified based on “better” and “smart” regulation rationale (OECD, 2012) achieving expected RIA’s results are sometimes challenging (Carvalho et al., 2017a; Jacobs, 2016; Tetlow & Hanusch, 2012; World Bank, 2010; Jacobs, 1997). RIA processes are quite long and complex, to say the least. In developing countries, the situation is even more critical because of several additional factors related to the so-called "poor governance" (Adelle et al., 2015). Nevertheless, the weakness of these regulatory systems may present itself as an opportunity to improve the governance of social infrastructure by means of regulatory reforms as mentioned by some authors (Da Cruz & Marques, 2012; Fukuyama, 2013).

This Subchapter discusses whether RIA allows regulators to understand the situation that they face, even in the absence of appropriate RIA conditions, and improve the regulatory governance. This is often the case of subnational regulation. As past research suggests (see, Berg, 2013; Marques et al., 2016) without a sound governance system, regulation cannot do much to improve services unless the governance of the utility focuses on performance. Here, there is a point in which RIA should be inserted embedding good governance into the rule-producing machinery of government in order to improve its decision-making quality (Adelle et al., 2015).

In this study, RIA has a broader governance dimension that may not just foster regulatory quality but also promote compliance with requirements of good governance. In this sense, the Subchapter takes a step further and suggests that the presence of RIA should be a measure of "good governance", particularly in precarious regulatory governance environments. According to (Rotberg, 2014), governance is “tangible” and the best way to measure governance performance can be by objective evaluation of the outputs. This situation highlights the need to build a linkage between Core Regulatory Principles (CRP) and RIA’s limiting factors (RLF) to perform the clear integration. Here, one can argue that RIA should contribute to regulatory governance beyond the internal managerial dimension of the administrative machinery.

This Subchapter is structured as follows. Subsection 2 provides the basic conceptual framework and reviews regarding fundamental theoretical contribution for the proposed analysis to establish links between regulatory governance and RIA while it suggests that RIA, as a regulatory mechanism, is deeply entrenched in the new governance trend. Subsection 3 explains the methodology which combines, firstly, a systematic review of reference literature about RIA to: (i) understand the relationship between RIA and regulatory governance and (ii) identify and analyse RLF’s ability to offset RIA’s expected benefits. The systematic review is combined with a consultation process in the form of questionnaire to capture whether there is expert consensus on whether, how and to what extent RIA may contribute to regulatory governance and if, based on experts’ opinion, RIA should be mandatory. The idea was to create a framework for future policy analysis that could explain the potential contribution of RIA to regulatory governance that would balance its potential benefits with its own limitations (RLF). Subsection 4 describes the findings and shows the results arising from the balance between RIA’s maximizing effects on CRPs and the offsetting ability of RLFs to impact RIA’s benefits. Finally, some concluding remarks about research limitations and its results were draw, and attempt to establish policy implications related to the presence of RIA and prospects for future research.

5.1.2 Governance & RIA: linkages and trends

5.1.2.1 Governance

There is no uniformity in the academic literature about both concepts of "governance" and "regulation" (Rotberg, 2014). However, the notion of regulatory governance tends to be associated with the style of governance of the so-called "regulatory state" (King, 2007; Scott, 2004; Majone, 1996). Such relevant governance approach encompasses rule making, monitoring, and enforcement of administrative rules and impartiality intervention (Heritier & Rhodes, 2011; Rothstein & Teorell, 2008; Scott, 2004). In fact, one can refer to regulatory governance as the governance of regulatory regimes (or, the "governance of regulation" as opposed to "governance by regulation" (Levi-Faur, 2011). References to regulatory governance are also found in national and international policy documents in a context that it affects beliefs and dilemmas (Kjær, 2011).

The 2017 World Bank Development Report on "Governance and Law" refers to governance as the "process through which state and non-state actors interact to design and implement policies within a given set of formal and informal rules that shape and are shaped by power" (World Bank, 2017). A related approach to regulatory governance appears in the OECD (2012, 2011, 2010, 2000) documents since the 2000s under which regulatory governance "is concerned with the design and implementation of regulation as well as ensuring compliance. It implies an integrated approach to the deployment of regulatory policies, tools and institutions" (OECD, 2010).

In this subchapter, regulatory governance refers as the process under which state and non-state actors interact to design and implement policies related to utility regulation (the policy) under a certain regulatory regime (formal and informal norms, principles and tools). Principles and norms provide the basic defining characteristic of a regime to the extent that, provided that principles (and norms) are unaltered, "changes in rules and decision-making procedures are changes within the regulatory regime" (Krasner, 1982). Furthermore, process institutional analysis tends to suffer from lack of a disciplined language, which makes it even harder to analyse, dissect, and propose better reforms (Ostrom et al., 1994). For that matter, in the construction of legal reasoning, both principles and rules are types of "legal norms" (the legal norm is a genre).

5.1.2.2 Governance & new governance: a path towards collaborative governance

The importance of regulatory governance in political science, economics, law and other social sciences can be measured by the uprising of academic writings about "new governance”. A relevant part of new governance writings has been focused on institutional design (and culture) for effective and legitimate regulation (Lobel, 2012). As part of the account of new governance, one also finds reference to various approaches, forms, and styles of governance suggesting a move beyond the hierarchical approach of the traditional form of regulation based on command-and-control (state law).

Current debate about new governance tend to take place in a higher level of analysis (or, multilevel). In new governance literature, references to governance (or meta-governance) tend to contrast mainstream styles of governance (i.e. hierarchical, market-driven and network-oriented) or even approach them in a complementary way (Meuleman, 2014; 2008).

For other authors, the notion of meta-governance entails any form of regulation (state law or other mechanisms) that regulates any other form of regulation (Parker, 2007). Or, as noted by Levi-Faur, it means one of several forms of hybrid regulations (co-regulation, self-regulation, meta-regulation and multi-level regulation) (Levi-Faur, 2011). As a matter of fact, new governance literature reflects, in a public-policy perspective, various concerns with current regulatory patterns associated with one or more of the following aspects:

- limitations of state law regulation (Scott, 2004);
- renewed emphasis on issues of accountability, legitimacy and transparency (Black, 2008; Lodge, 2004);
- growing importance of new modes of governance (Heritier & Rhodes, 2011);
- new approach to decision-making, which is now dependent on "non-hierarchical" and "mutually interdependent" relationships (Bartolini, 2011); and
- new approach to problem-solving based on efficiency, transparency, and consensus-building (Bartolini, 2011).

The common ground in the new governance literature is the need to improve regulatory governance to overcome the limitation of traditional regulation form. Indeed, the debate about limits of the command-and-control model has taken several angles. Regulation started to be regarded as inefficient, ineffective, and undemocratic (Solomon, 2008; Dorf & Sabel, 1998; Freeman, 1997). The diagnostic tends to be associate with the perception that compliance levels are disappointingly low; regulatory bodies are unable to persuade stakeholders of the way forward and find a collective solution for complex situations; and agencies lack resources to support private sector, and to monitor, enforce and revise regulations based on evidence (Solomon, 2008; Dorf & Sabel, 1998; Freeman, 1997).

In fact, as society becomes more complex, integrated and interdependent, public policy debate tend to focus on how to address issues of fragmented, disperse and lack of coordination in multisector regulation. At the same time, in another angle, the debate shifts on how to improve regulatory quality, tackle regulatory barriers and use regulation as lever to new public policies (e.g. innovation, environment and transition to circular economy). European Union innovation package is a good example of an attempt to support the transition to a new resource-efficient, green, and competitive low-carbon economy, a tremendous task that is only possible by means of collaborative governance (European Union, 2017). The path towards low carbon economy will have a profound impact on the traditional practice of public utility regulation globally (Boyd, 2014), and literature shows that collaborative governance is key to achieve such challenging goal.

5.1.2.3 Regulatory impact assessment (RIA) (additional view to the Chapters 2, 3 and 4)

According to a 2015 OECD survey, most of OECD countries already require RIA (OECD, 2015). Additionally, a World Bank data[18] shows that a group of 93 countries worldwide has conducted "some parts", e.g. (without public meeting) of RIA process regarding not yet adopted regulations. Indeed, there is a significant gap between its legal requirement (whole process, i.e. status quo, assessment, consultation and final review and publicized) and the actual practice of RIA, particularly in the case of subordinate regulation, which is the case of the regulations enacted by the executive branch. For instance, in the U.S., RIA is required by law and, in practice, it is conducted in major subordinate regulations.

As stated by West (2016), although RIA varies a great deal from one country to the next, the American system is effective because the core assessment (CBA) and its supervision is done by an office that is directly accountable to the president. However, the number of rules reviewed per year has been decreasing since 1981 (2365) to (612) in Obama ‘s period. In the European Commission, RIA has been used since 2002 to support the development of policies. Nowadays, the difference between planned and concluded RIA has stimulated a development of more specific techniques instead of CBA (Renda, 2016). In Australia, major regulations (primary or secondary) include RIA as a formal requirement. In the U.K., RIA is also applicable to all types of regulations. In Japan, RIA is required in case of major regulations.

[18] World bank data. Available at: http://rulemaking.worldbank.org/data/comparedata/assessment. Accessed in Jul.,2017.

Cost-benefits analysis (a partial RIA process) is also required in Chile for primary law and some regulations (OECD, 2015).

Out of the OECD countries, among emerging economies and developing countries, there are several examples of attempts to introduce RIA in new legislation or existing regulation (Renda, 2014). In these countries, RIA is based on the approach that was originally developed in the 1980s by OECD (Kirkpatrick, 2016). In many cases, RIA has also been adopted as part of donor-financed projects and programs as discussed in Chapter 2. In terms of assessment impacts by RIA, the main sectors are: (i) budget, (ii) public sector (utilities), (iii) environment, (iv) small business and (v) competition (OECD, 2017).

Much has been said about RIA’s ability to improve regulatory quality. Arguably, RIA would contribute to the decision-process by making it more rational, integrated, robust and transparent. Its adoption may also improve regulator’s managerial and regulatory capacity and expand the knowledge basis (Dunlop & Radaelli, 2016), particularly during economic crisis (Carvalho et al., 2017a; Tetlow & Hanusch, 2012). However, RIA has its limitations, which could explain and justify its modest application in practice.

5.1.3 Methodology

This Subchapter addresses the question regarding the benefits of RIA’s presence. First, RIA has been a highly promoted regulatory tool closely related to regulatory governance. Second, regulatory governance has achieved an overarching importance in the public policy literature, particularly in the critique of the "post-regulatory state", generally translating a new managerial approach to regulation concerned with limitations of the traditional command-control model to deal with the complexity of the regulatory issues (new governance). Third, the implementation of RIA is more challenging than it was expected. Based on such initial observation and based on a literature review of governance in general and, particularly, RIA, this research focus on evidence found in recent policy and academic literature about RIA’s merits and limitations. Such systematic review was conducted by the proposed approach showed in Figure 5.1. General regulatory governance literature was reviewed just to provide the conceptual framework and context for the proposed analysis.

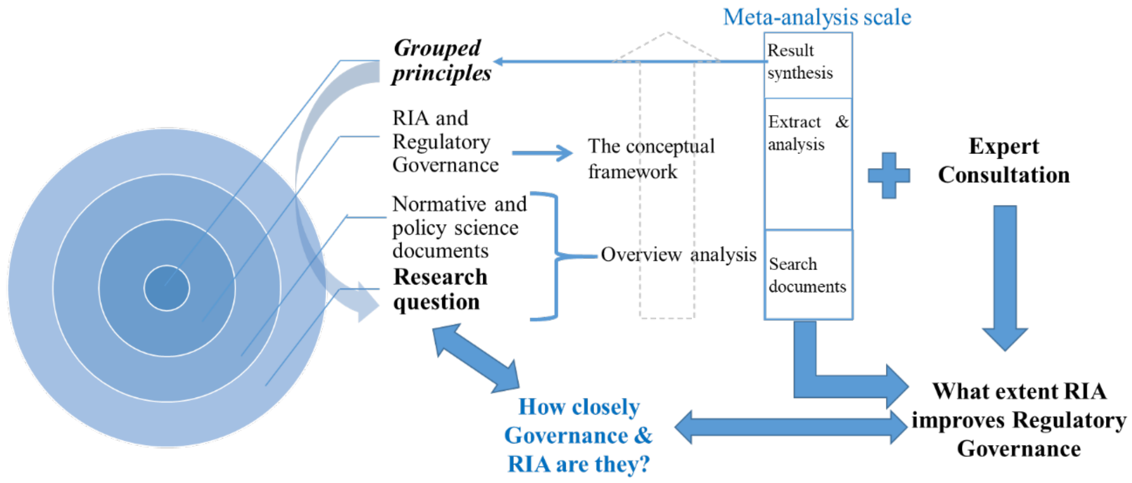


Figure 5.1 – Methodology.

A preliminary assessment of policy and academic literature starting in 2010 until 2017 has shown that governance principles are dispersed, recurrent and not properly defined in the literature. The lack of precise language - and a conceptual framework - can be explained by the fact that in public policy literature authors come from different backgrounds and adopt various approaches to the subject matter: that is, conceptual frameworks tend not to be rigorously treated as it would be in disciplinary studies. In fact, both governance and RIA are inherently multidisciplinary matters and the combination of these subjects is concentrated in both political science (included public management and administration) and Law. In line with the categories surveyed, based on the ISI Web of Knowledge categories, public administration and political science represent approximately 58% of the total of the studies surveyed (excluding studies on EIA).

Since rules vary in accordance with domestic legal systems, for focusing on governance "principles" which constitute core normative components of regulatory regimes was opted. Based on the principles' notorious character, recurrence, uniformity and the intensity that they appear in the academic literature and policy materials, 5 CRPs were clustered: (i) accountability, (ii) administrative capacity, (iii) open government, (iv) regulatory quality and (v) rule of law. The outcome of the literature review is presented per subject, period of studies, relevance, and source. A table of frequency on CRPs inter-connections and normative components was performed. A similar analysis was carried out to identify, analyse and classify RLF.

To obtain additional inputs on how RIA should contribute to regulatory governance (and vice-versa) and capture RIA's limitations, a consultation to experts worldwide about RIA's ability to improve regulatory governance and the feasibility of its mandatory adoption[19] was performed. Moreover, the idea of the survey was to improve the collection of data, because of the limits to access the law or other legal instrument of RIA. Here, the main concern is to evaluate, in a non-biased manner, the intensity under which RIA is associated with each CRP (Figure 5.1) and the perceptions of each one regarding the mandatory of RIA (MRIA, hereafter). The consultation was performed in six phases: (i) expert selection, (ii) survey test, (iii) 1st round of interaction, (iv) analysis of the feedback, (v) convergence check and (vi) 2nd round of interaction (published final descriptions). Experts were selected based on academic and professional experience with both, RIA and/or regulatory governance worldwide. A total of 90 experts were invited to evaluate and improve the form of the survey. The analysis of the feedback was carried out by statistical assessment. The final results were shared among all experts.

5.1.4 RIA: the way forward?

5.1.4.1 Narrative review and survey phase

In the past six years, there was a substantial increase in the academic and policy literature on both RIA and regulatory governance (see, Table 5.1 and Figure 5.2(a) and 5.2(b)). Several hypothesis may explain such trend: (i) moments of crisis and financial austerity offer the opportunity for improving regulatory governance (Meuleman, 2014), (ii) academic perception of the importance of institutional design to deal with the challenges of regulation in an increasingly complex society, (iii) perceived shortcomings of regulatory governance based on traditional regulatory regimes command-and-control style (new governance literature), (iv) increased interest in new managerial approaches to utility regulation (Bartolini, 2011); (v) recognition of RIA's potential to improve regulatory quality and its diffusion as transnational policy innovation by OECD and other international institutions (De Francesco, 2016) and (vi) the growing importance of regulation by unelected officials as a policy tool. To address the merits and limitations of RIA, the decision was, first, to approach the research question addressing to what extent RIA is "perceived" to contribute to regulatory governance based on

[19] Available at: https://goo.gl/cEKHqG

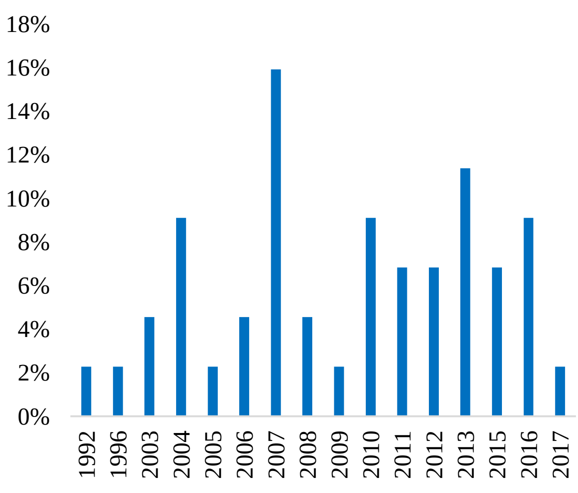
RIA's ability to maximize the effects of CRP and balance the potential benefits with RIA's own "perceived" limitations.

Table 5.1 – WOS and GS database.

Basic search	**Main categories**		**Type of document**	**Search**
	Topic results	**Title results**		
Regulatory governance	3479 studies (541 law, 492 political science, 426 economics, public administration 373, business finance 370, business 304) and so on.	140 studies (31 law, 27 political science, 26 public administration, 17 business, 11 management) and so on.	99 articles, 24 books review, 21 proceeding papers, 4 reviews, 2 editorial material	Web of Science (WOS)
	1,300,000	-	-	Google Scholar (GS)
Regulatory impact assessment	2604 studies (645 environmental sciences, 277 toxicology, 223 pharmacology pharmacy, 176 engineering environmental, 166 public environmental occupational health) and so on.	50 studies (18 public administration, 10 environmental sciences, 8 political science, 4 law, 3 social science interdisciplinary) and so on.	32 articles, 8 proceedings papers, 8 meeting abstracts, 5 editorial materials, 1 review and so on.	WOS
	2,190,000	-	-	GS
Governance and regulatory impact assessment (RIA)	84 studies (21 environmental studies, 15 environmental sciences, 12 public administration, 7 political science and 7 law) and so on.	2 studies (public administration).	2 articles	WOS
	918,000	-	-	GS

Total of studies selected based on relevance and access
89

(a)



(b)

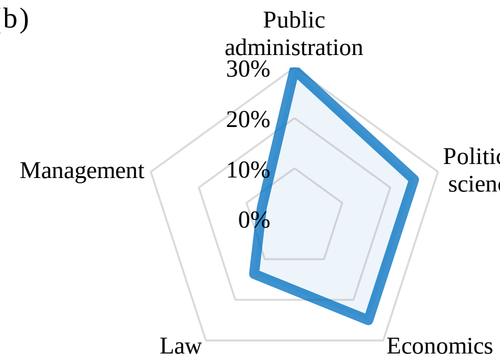


Figure 5.2 – (a) the no. of studies per year, (b) no. of studies per categories of the ISI web of knowledge SM[20].

Regarding the survey, the whole phase analysis took 30 days. From a total of 90 questionnaires sent, 39 were answered. The total procedure participation was 43% (see Carvalho et al., 2017b). According to those authors' parameters, the feedback was sufficient for the current proposal. Approximately 75% of sample surveyed have 5 years more in terms of experience regarding RIA (Figure 5.3), regulatory governance and both. Moreover, 92% of the experts are familiar with the concept of RIA.

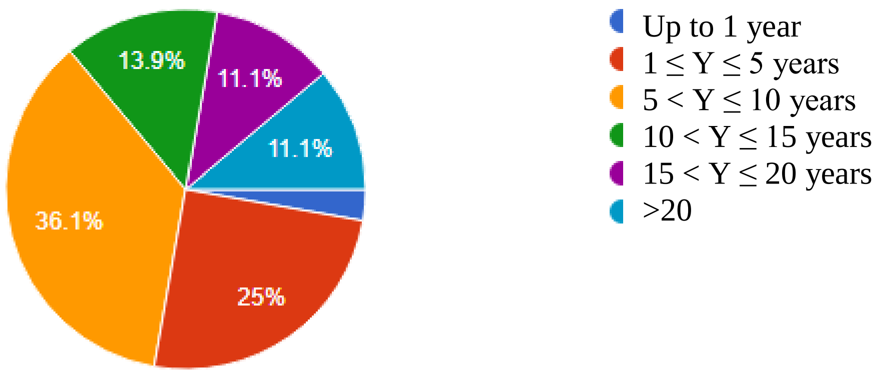


Figure 5.3 – Experience regarding RIA (answered by the experts' involved in a such study).

5.1.4.2 Balancing CRP and RLF

CRPs translate core normative values of a giving regulatory regime. From a legal perspective, CRPs provide the foundation of regimes and set their main characteristics. As they are general statements under the form of legal norms, CRPs may be enforceable. As a genre of legal norms, principles "set standard point to particular decisions about legal obligations in particular circumstances" (Dworkin, 1978). Although principles differ from rules as the latter is "applicable in the all-or-nothing fashion" (Dworkin, 1978), and they are used to solve

[20]. Available online at the following website: in: http://admin-apps.webofknowledge.com. Accessed in Feb. 2017.

conflicts based on their relative weight. In addition, principles have a different "normative character" due to their importance (usually hierarchical superior); they reveal, in a highly abstract form, important core values, which may be directly enforceable or enforceable through secondary rules. In any case, the notion of "principle" coincides in both Law and political science as core normative components of regulatory regimes. From a managerial perspective, CRPs translate the pillars under which regulatory governance is construed to direct the outcomes of a given regulatory regime. CRPs were identified based on bibliographic review and pre-selected per "recurrence criteria" (see Appendices XXVIII and XXIX). They were grouped based on the "thematic relevance" and importance. Table 5.2 shows the frequency (F) of CRP (or one of its normative component). Based on Equation 5.1, the frequency and their definition and connections was calculated.

$$F_{i\,.i} = \frac{\sum rc}{\Upsilon tc}, \text{ where:} \qquad (5.1)$$

rc=received connection; tc= amount of possible connections; i= number of principles and j=reference literature.

RLF are factors acknowledged in the literature that could explain limitations on RIA implementation that could justify not adopting RIA in general way. Accounts of RIA's limitations comprise the following aspects: (i) resources intensity, (ii) knowledge gap, (iii) decision maker bias, (iv) presence of corruption structure and (v) presence of poor regulatory governance. The frequency (F) of RLF also was calculated based on Equation 5.1 (see Table 5.3).

Table 5.2 – Principles, requisites, definition and source.

Principles	Frequency (F)	Normative components	Definition	Source
Regulatory quality	0.32	Targeting, evidence-base, rationality, flexibility, predictability, effectiveness and efficiency, consistency and coherence, clarification of the rules, proportionality, sustainable development	Regulation should be embedded in the planning and policy cycle, targeted, evidence-based, coherent, unbiased, comprehensive and proportionate	(EU Better Regulation Agenda)
Open government	0.27	Consultation, participation and transparency	Regulator must adhere to principles of open government, including transparency and participation in the regulatory	(OCDE Principles, 2012)

			process to ensure that regulation serves the public interest	
Accountability	0.20	Compliance, legal requirements, civic responsibility, participation and transparency	Regulator must be able to justify decisions, and be subject to public scrutiny and judicial review	(OCDE Principles, 2012)
Rule of law	0.14	Legal and constitutional requirements, equalities, compliance, fairness, clarification of the rule, proportionality and sustainable development	Regulator must ensure the effectiveness of systems for the review of the legality and procedural fairness of regulations	(OCDE Principles, 2012)
Administrative capacity	0.07	Autonomy, decentralization, financial self-sufficiency, human resources	Regulator should be appropriately resourced and organized to perform regulatory functions	(EU Better Regulation Agenda)

Table 5.3 – RIA: limits, frequency, definition and source.

Principles	Frequency (F)	Definition	Source
Resources intensity	0.38	RIA implementation demands qualified human resources, financial resources and infrastructure to elaborate the analysis	Zhang, 2010; OECD, 2012; Wiener, 2006; De Francesco, 2010
Knowledge gap	0.19	Insufficient or lack of primary and/or secondary data because of poor data collection or information asymmetry between regulator and utility	Zhang, 2010; Adelle et al., 2015; Staroňová et al., 2007
Decision makers bias	0.07	Decision maker limited comprehension or bias against RIA's rationale or justification	Wiener 2006
Corruption	0.19	RIA is a natural barrier to corruption limiting decision-maker's ability to justify policy decisions against the public interest	Adelle et al., 2015; Berg, 2013; Kirkpatrick, 2016; OECD, 2009; Carvalho et al., 2017
Poor regulatory governance	0.15	RIA tends not to be implemented in poor governance environments, which lacks accountability and administrative capacity, and disregards the rule of law or requirements of transparency and public participation	Staroňová et al., 2007; Berg, 2013

The research signaled a positive balance of RIA as a policy tool. Interestingly, the analyses suggest that the adoption of RIA tends to mitigate some of its own limitations. Based on available data, RIA is usually implemented in institutional settings where regulatory governance is already well developed. One of the reasons seems to be associated with a misleading perception that RIA is exclusively related to regulatory quality and should be employed at the discretion of the regulator, if deemed to be "feasible" (managerial dimension). Nevertheless, RIA could amplify the effect of other CRPs, which not just provides additional assurance that in the regulatory process the public interest is preserved, but also promotes a collaborative regulatory environment (institutional dimension). In this sense, a decision whether to adopt a RIA should consider its indirect and beneficial effects at the governance level should be inferred. To improve this discussion, Figure 5.4 shows the qualitative relation between CRP and RLF. The graph shows in axis (x) the intensity of each RIA-related CRP, in accordance with the frequency calculated. Axis (y) highlights the intensity of RLF varying in line with managerial and institutional scales based on the frequency calculated in Equation 5.1.

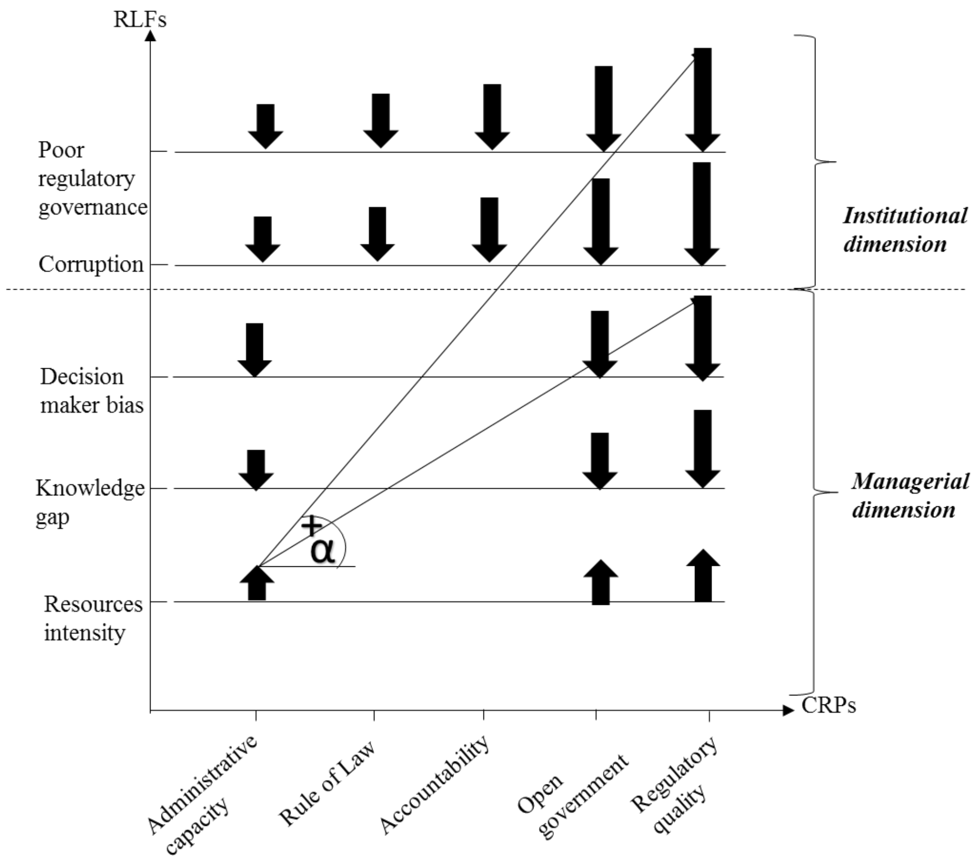


Figure 5.4 – CRP x RLF.

The graph represents RIA's potential to improve regulatory quality in both managerial and institutional dimensions. In theory at least, (i) the higher ability of RIA to boost CRPs into managerial dimension (α) and (ii) the higher and faster RIA's effect (α+) tend to reduce its limitations take into account both dimensions, which makes it a central question in the new governance debate, given the potential gain for regulatory governance. Indeed, the qualitative graph shows that RIA can produce external effects beyond agency capacitation. Therefore, RIA process should consider its indirect and beneficial institutional effects resulting from reinforcement of open government, accountability and rule of law. Based on the literature review and the proposed analytical framework, the following inferences from the relationship between CRP and RLF, which may serve as standpoint to clarify the impact of RIA on the regulatory governance were draw:

- RIA's full extension impacts on each CRP cannot be totally perceived in isolation (what it was referred here as "interplay"). Despite the research attempts to understand RIA's role in maximizing CRPs effects, individually there are potential efficiency gains to the governance of the system, which are well captured by the research. Experts have stressed this point. Further, the general perception of a lower ability of RIA in contributing to administrative capacity can be explained by the fact that RIA requires minimum resources to be properly implemented and, if these resources are not available, RIA's adoption could be jeopardized;
- RIA has a fundamental institutional dimension highlighted by the high frequency that *accountability* and *open government* appeared in this researched material (Figure 5.4). The literature revealed that there is a general perception that regulators are required, as a matter of good governance, to justify their decision and be responsible for their conduct in the regulatory process. On the other hand, RIA can also serve as a valuable tool for regulators who will be able to justify their decisions in a technical, rational, evidence-based and un-bias manner. It serves both the public sector and society limiting the personal responsibility of public officials (technical staff) and, securing public interest in decision making. *Accountability* gains may also be inferred as a result of the cultural and political drivers leading to the adoption of RIA as a matter of good governance;
- RIA is a collaborative tool that potentially maximizes *open government* principle of regulatory governance. The high frequency of open government reflects the generally accepted notion that, in the regulatory process, regulators should consider stakeholders' inputs in the decision-making. *Open government* tends to mitigate the alleged lack of legitimacy arising from the delegation of legislative powers to the agency, and due to the interplay of *open government*, *accountability* and *rule of law*, the pillars of good governance, RIA may be part of a policy strategy to tackle corruption and poor governance. New governance literature also stresses the importance of open governance as a matter of regulatory effectiveness. Based on expert consultation, RIA maximizes transparency if there is open participation in the regulatory procedure and if public consultation is embedded in the institutional setting

to the extent that its secured consultation outcome is a constitutive part of the regulatory decision;

- RIA is perceived to be more closely related to *regulatory quality*. The high frequency associated with regulatory quality in the bibliography is explained by the fact that most of the authors consider that RIA's main objective is to improve the quality of specific regulation, in a narrow understanding of regulatory quality (Figure 5.3). The components concerning the *regulatory quality* are numerous and recurrent in the literature (Appendix XXIX). The reason why such a broad and encompassing approach to the notion of *regulatory quality* lies on the assumption that the fundamental purpose of governance is to assure maximum effectiveness and quality in the regulatory impact, which allows to perceive *regulatory quality* in both managerial (α) and institutional dimensions (α+). In fact, regulation is a primary function of the government and governments should provide resources to secure agency's minimum. Moreover, among the experts (by the survey), there is a support to argue that RIA tend to be perceived, primarily, as a policy tool that add *regulatory quality* to the normative function of the government, in a narrow perspective; and
- RIA contributes to the *rule of law* in various way, but such understanding is not well captured in the literature and questionnaire. In short, RIA helps validate the fact that regulators have acted within the legal boundaries of their technical discretion and have complied with legal and constitutional requirements as determined in the domestic legal system. In RIA's processes, decision-makers should manifestly express that they have assessed and complied with substantive requirements of the law, including sustainable development requirements, if such is incorporated in the legal system (compliance). *Rule of law* has also a procedural dimension, which requires the regulator to observe due process in rule making processes (fairness and equality). Therefore, *rule of law* is closely related to the normative components of *open government* (consultation, participation, and transparency) and *accountability* (compliance, legal requirements, civic responsibility, participation, and transparency). In both its substantive and procedural dimensions, the adoption of RIA, as part of the regulatory regime, may serve as both a vehicle and an opportunity to review the legality of the regulation. Attempts to find alternatives to traditional command-and control regulation do not mean a move away from the *rule of law*; on the contrary, collaborative governance strengthens rule of law. *Accountability* and *open governance*

are intrinsically connected to rule of law due to the open character of substantive due process clause, a key normative dimension of the *rule of law*.

5.1.4.3 A mandatory RIA: preliminary evaluation

The research has shown that RIA processes have a high propensity to disseminate quality data and reduce decision makers' bias. In addition to the usual bias of every decision-making process, utility regulation processes generally suffer from poor quality data and information asymmetry commonly found in regulated markets. In that sense, a mandatory RIA may put additional pressure to the regulator to improve the overall quality of the regulatory function by defining default and mandatory rules for its implementation, particularly on; (ii) data collection and dissemination; (ii) stakeholder participation and information sharing; (iii) decision-making processes; and (iv) requirements for risk and scenario assessment.

A MRIA may force the government to re-allocate resources to the core government activity (finance, human resources, and infrastructure) and be a contributing factor in the regulator's organization culture. In this context, there is a cultural process associated with RIA, which requires that its implementation becomes part of the organizations' routine. Obviously, such cultural process is only possible when there are minimum resources. Under this perspective, if potential gains are perceived - or RIA is mandatory -, the required investment in the formation of human resources and additional infrastructure are not only justifiable but should be included in the budget as part of the agency cost, as required by Law. In fact, it may foster reallocation and\or rationalization of resources when they are not apparently available. Additionally, to this review approach, the survey shows that 74.3% of the participating experts have agreed that RIA should be mandatory. On the other hand, experts have pointed that MRIA is not equally suitable in all regulatory cases and should not be applied if: (i) cost of RIA overweight benefits and (ii) regulatory effect is below the "minimum economic impact" threshold. According to the survey a full RIA should be mandatory for laws and decrees, and a simplified RIA should be adopted in case of other administrative acts.

A MRIA may seem an enthusiast not long ago, voluntary EIAs was a novelty. The development of EIA may enlighten the possible path of RIA. Since its debut in the U.S. National Environmental Policy Act (NEPA) in 1981, EIA has become an institutionalized and enforceable mechanism adopted in treaties (Convention on Transboundary EIA; the

Convention on Wetlands of International Importance; the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters; the United Nations Framework Convention on Climate Change; the United Nations Convention on the Law of the Sea; the Protocol on Environmental Protection to the Antarctic Treaty), and in more than 180 domestic legislations, being mandatory in several countries and in the World Bank's Safeguard Policies for major projects. As a matter of fact, if RIA is to be mandatory, stakeholders will have a vested right to participate in the regulatory processes and will be better equipped to challenge arbitrary, discriminatory, unreasonable and disproportionate decisions and regulation "ex-ante". From both collaborative and adversarial perspectives, a MRIA could be an important step towards a culture of good regulatory practices. However, it is important to point out that such discussion is limited, because there is some voluntary adoption (full or partial) of RIA that improves governance environment. There is a lack of literature that opposes MRIA and voluntary RIA as a process that improves regulatory governance.

5.1.5 Concluding remarks

5.1.5.1 Limitations

Based on the reviewed literature and on the results explained in last Subsection, the Subchapter shows evidence that "theory" and "perception" seems to converge on the adoption of RIA (mandatory and why not voluntary). Despite the limitations on the reach of the consultation and on the availability of RIA's pilot studies, the support to assert that there is a tendency towards consensus in the adoption of RIA was found, but with important exceptions yet to be discussed in future research. In any case, the results, even if broad and preliminary, intend to contribute to the debate on the merits of RIA to (i) improve regulatory governance and (ii) mitigate perceived limitations associated with its implementation (RLF).

5.1.5.2 Advantages

The research showed that the adoption of RIA is supported in "new governance" literature and "better regulation" policies as a mechanism to promote collaborative governance. Here, the implementation of RIA processes increases CRPs effectiveness and improves overall regulatory governance. Ultimately, adoption of RIA will determine that regulatory decisions with significant impact in relevant areas are supported by technical analysis and comply with legal requirements improving regulatory substance. RIA is even more critical in countries with poor governance systems, where decision-making processes tend to give room for the advancement of corruption due to lack of both transparency and participation of multi-stakeholders. According to the policy and academic materials reviewed, RIA contributes to overall regulatory quality, but it also has a fundamental legal dimension not often stressed in the literature. That is, if regulatory decisions are supported by RIA's outcomes and formally address legal requirements, they become easier to be scrutinized and reviewed by administrative and/or judicial bodies, which, at least in theory, improves the substantive due process. Just like EIA, now well established around the world in both domestic and international law, RIA often attracts criticism about the poor information quality, and is also under constant threat because of government impetus to promote growth policies in response to economic crisis. In any case, RIA requires commitment and must be culturally incorporated to promote the expected results. Indeed, one can argue that RIA has the potential to reduce institutional failure, particularly in poor governance environments.

5.1.5.3 Policy implications

Although the history of RIA can be tracked down to the 1970s, literature on the subject is still limited to a few scholars, policy experts and multilateral agencies, and segregated between theory and practice (as discussed in Chapter 2). The research methodology was developed to address such gap and showed that RIA is more than a policy tool but a decision-making procedure that produces far-reaching effects beyond regulatory quality of a single proposal as it affects the overall regulatory governance (institutional dimension).

Literature review and consultation stage support that RIA has the potential ability to improve decision making process, even in precarious regulatory governance environments. Thus, diffusion of RIA should be based on the rationale that RIA is not simply a way to justify a decision but rather an integrated part of the legal/regulatory procedure under which a public policy lays down its foundation, which shall be internalized in the administrative culture of the government or the agency.

In this context, RIA framework model should be developed with clear rules on (i) determination of RIA and exemptions – rules should clearly define cases for RIA, simplified RIA and exemptions; (ii) scope of application – whether RIA should apply to primary and secondary legislation varying according to the regulatory model and whether normative authority is delegated to agency or other subnational authorities; (iii) personal responsibility of officials – such rules should operate as driver for the implementation of RIA creating incentives for officials to seek exemption from personal responsibility by aligning with public interest through RIA procedures and, as a consequence, creating a learning culture for its implementation in practice; (iv) flexibility – rules should provide room for certain flexibility in accordance with the complexity of the proposed government intervention; (v) public participation – rules should provide rights of participation to stakeholders allowing transparency, effective participation and social control over government officials during RIA's procedures (vi) objective of the proposal – as a condition precedent to RIA, there should be a clear and objective identification of the objectives (economic, social, and environmental, among others) to allow stakeholders to provide inputs and support its adoption or challenge government premises or means to achieve declared goals.

5.1.5.4 Future developments

As the Subchapter suggests, RIA literature lacks empirical analysis on the adoption of RIA that systematically assesses its effects - potential gains and limitations – in the regulatory governance beyond risk assessment, cost benefit analysis, multicriteria modelling and so on. It seems that the cost of performing a full RIA (including structure of the context, data collection, consultation and evaluation to support decision-making) is not clear yet, but it would allow adaptations, determination of exceptions and application of simplified RIA. Still, there is room in the literature for studies that compare institutional designs and legal aspects in the details of RIA (mandatory or/and voluntary) in different countries and contexts to support the crafting of legislation proposals in specific contexts.

5.2 THE PRESENCE OF GOVERNANCE: AN ASSESSMENT BASED ON INNOVATIVE CORE REGULATORY PRINCIPLES FOR BRAZILIAN REGULATORS

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Abstract: State governance is considered as a new era in the state's intervention, and it is vital to cultivate both a qualitative and quantitative understanding of this development. Here, one can argue that the absence of governance principles allows regulators to justify the adoption of instruments to improve it. Thus, this Subchapter evaluates the level of regulatory governance based on five core values: (i) accountability, (ii) administrative capacity, (iii) open government, (iv) regulatory quality and (v) rule of law. To conduct the assessment, a multicriteria decision analysis model (ELECTRE TRI-nC) that considers the opinions of legitimate stakeholders was adopted in order to categorize Brazilian subnational regulators regarding the presence of governance. By doing so, this Subchapter intends to support researchers and policy makers by providing some determinants of good governance, which could be stimulated by RIA, as a policy tool, improving institutional environments..

Keyword: Multicriteria Decision Analysis; ELECTRE TRI-nC; Policy; Regulatory Governance; Regulatory Impact Assessment.

5.2.1 Introduction

Measuring processes and how they relate to institutions are major concerns for academics and managers (Boly et al., 2014). Although a non-normative perspective can be used to consider the institutions and processes of regulatory governance, it may be beneficial to use RIA, which is a driver of CRP and vice-versa (as discussed in Subchapter 5.1). In both RIA and governance, the institutional environment and its relationship with citizens, along with private and nonprofit sectors, are determinant to design and implement formal or informal rules.

Therefore, quantitatively analyzing governance allows policy and decision makers not only to measure the presence of governance in the regulators' environment but also to identify their strengths and limits. In fact, the process of constructing innovative system approaches highlights the importance of improving government capabilities in different levels and ways (Weber & Rohracher, 2012).

According to Kirkpatrick and Parker (2004), the underlying rationale for using RIA for policy makers is to contribute to outcomes and processes by improving governments' institutional abilities. According to these authors, such a process can be referred to as principles of good governance or CRP (adopted in this Chapter). In line with this research, (Kirkpatrick, 2016) argues that RIA has the potential to significantly improve regulatory governance in developing countries and thereby promote private investment and economic growth, as in the case of Brazil.

In the Brazilian regulatory environment, since 2007, when the program for strengthening the institutional capacity of regulatory management (PRO-REG in Portuguese) was created, some federal agencies have already been involved in the process of implementing RIA and some of its procedures (Castro, 2014). However, PRO-REG was later discontinued, and its changing locus has not promoted the debate regarding RIA at the federal level. In early 2017, PRO-REG was reinstated by the Chief of Staff of the Presidency of the Republic, which reignited the debate of this issue. Moreover, since 2015, the Bill of Law no.1539/2015, which will require "mandatory RIA of federal regulators", has been going through the National Congress without clear expectations or clear evidence that justify its adoption.

At the subnational level (water and wastewater Brazilian regulators), there is no clear evidence of the RIA process. In the related literature, guidelines mention RIA in the state of São Paulo and some pilot courses and exercises of RIA in the states of Ceará and Alagoas. Such situation creates an opportunity to improve the discussion about policies and tools, which promotes enhanced sustainability through adaptive capacity modifications of the institutional regime (Smith et al., 2005).

Based on such a discussion, this Subchapter aims to evaluate the level of governance based on CRPs and the potential capacity to justify the adoption of RIA based on a link between them. In fact, the analysis of both governance and RIA has been widely accepted as the basis of innovative policy adoption (Weber & Rohracher, 2012). Moreover, evaluating the governance of regulators is important for understanding their conduct and how they carry out their responsibilities (Hill and Lynn, 2004). In fact, the proposed analysis helps to understand the strengths and limits of regulators in terms of governance capacity, which should be reflected in RIA adoptions and vice-versa.

One possible way to solve such a problem is to aggregate criteria by using a multicriteria decision analysis (MCDA) method, which also provides a suitable framework to structure several aspects of CRPs and the opinions of legitimate stakeholders (Munda, 2004; Wallenius et al., 2008). In addition, to the best of knowledge, there are few existing studies on this subject that adopt an MCDA approach, which reinforces the originality of this work.

The remainder of this Subchapter is organized as follows: as relationship between governance and RIA was discussed in the last Subchapter. Subsection 2 outlines the evaluation model. The empirical strategy is detailed in the Subsection 3. Subsection 4 discusses the results. Concluding remarks as well as policy implications are provided in Subsection 5.

5.2.2 Evaluation model

5.2.2.1 Context

In this Subsection, MCDA was presented as a suitable approach to structure a model capable of considering CRPs and the opinions of stakeholders and other legitimate policy makers. The model was designed in two main stages: (i) the construction of one or several outranking relations and (ii) the exploitation of these outranking relations (Roy, 1996).

In MCDA, it is difficult to define a method for decision making because it requires a clear understanding of the circumstances of the problem. According to (Greco et al., 2016), in (P. α) problems, the tool is oriented towards and relies on the selection of a small number (as small as possible) of "good" actions from which a single alternative may finally be chosen. In (P. β), the tool is oriented towards and depends on assigning each action to the category deemed the most appropriate. Finally, in (P. γ), the tool is oriented towards a partial or complete ordering (pre-order) that compares actions pairwise (for more details, see Greco et al., 2016). Note that such analysis proposition follows (P. β), since such a problem allows to evaluate regulators by comparing their actions to reference actions (without the influence of another regulator). The expected results should categorize regulators and infer some policy recommendations based on CRPs.

Thus, to solve the identified problematic (P. β), ELECTRE TRI-nC was used in this work rather than other outranking methods, e.g., preference ranking organization method for enrichment of evaluations PROMETHEE, the Gaia approach, and the qualitative flexible multiple criteria method QUALIFLEX method (see Greco et al., 2016) and was justified for the following reasons: (i) this innovative analysis demands an interactive co-constructed approach that relies on both the analyst and legitimate stakeholders, particularly regarding governance problems; (ii) the use of easy rules, i.e., ascending and descending rules that correspond to only one category for a possible assignment of a regulator, (iii) the consistency of the results is easily associated with the credibility level (see Almeida-Dias et al., 2010) and (iv) the model allows for the aggregation of multiple criteria, can be used for imperfect data, and uses heterogeneous scales.

5.2.2.2 Notation and basic data

Lets to consider the following four sets that contain the basic data: $A = \{a_1, \dots, a_i, \dots\}$ is a set of potential actions (23 Brazilian subnational regulators); $F = \{g_1, \dots, g_j, \dots, g_n\}$ is a coherent set of n criteria (10 criteria extracted from CRPs and external participation) (Roy 1996); $C = \{C_1, \dots, C_h, \dots, C_q\}$ is a set of completely ordered categories (6 categories that range from the absence of CRPs to the use of best practices); and $B = \{b_0, b_1, \dots, b_h, \dots, b_q, b_{q+1}\}$ is a set of characteristic reference actions that define the categories (b_0 and b_{q+1} are the two reference actions such that $g_j(b_0)$ is the worst possible performance and $g_j(b_{q+1})$ is the best possible performance on criterion g_j, for all $g_j \in$ F). It is worth mentioning that the assignment of the actions to categories depends solely on the comparison of those actions to the reference actions (i.e., the assignment of one action is not influenced by the assignment of another action).

5.2.2.3 Modeling with imperfect data

Note that in what follows, without a loss of generality, one can assume that all criteria are to be maximized, i.e., the preference increases when the performance for a given criterion also increases. Each criterion g_j is considered as a pseudo-criterion; two discriminating thresholds (preference and indifference) are associated with g_j. These thresholds are introduced to consider that the data are imperfect regarding the performances of the actions for a given criterion, and the arbitrariness of the data may affect the construction of such a criterion (Roy, 1996, Roy et al., 2014).

5.2.2.4 Building an outranking relation

As with other ELECTRE methods, the first phase of the ELECTRE TRI-nC method consists of building outranking relations (see, Figueira et al., 2013, 2016; Roy, 1991, 1996). To construct a fuzzy outranking relation, three main concepts are necessary: concordance, discordance and the degree of credibility. Here, criteria weights, denoted by w_j, are assigned to all criteria such that $w_j > 0$, for $j = 1, \dots, n$ (without a loss of generality, one can assume that $\sum_{j=1}^{n} w_j = 1$). The weight of a given criterion can be viewed as its voting power.

Concordance index. The overall concordance of the assertion of "a outranks a'" is modeled through a *comprehensive concordance index*, denoted as $c(a, a')$, which is defined as follows:

$$c(a, a') = \sum_{j \in C(aPa')} w_j + \sum_{j \in C(aQa')} w_j + \sum_{j \in C(aIa')} w_j + \sum_{j \in C(a'Qa)} w_j \varphi_j, \tag{5.2}$$

$$\varphi_j = \frac{p_j - (g_j(a') - g_j(a))}{p_j - q_j} \in [0,1[\quad (5.3)$$

where

The degree that a outranks a', $c(a, a')$, considers the criteria weight, w_j, which contributes to validating the assertion that "a is at least as good as a'" (denoted by aSa'). The variable $\varphi_j$represents the proportion of voters in favor of the assertion that aSa'. When the voters lean more towards indifference, the proportion is closer to 1, and in the presence of a strictly preferential situation that favors a', its value is zero.

It should be noted that in the case of a discrete scale, the following formula is used (cf. Roy et al., 2014):

$$\varphi_j = \frac{(p_j+1) - \left(g_j(a') - g_j(a)\right)}{(p_j+1) - q_j}, \quad (5.4)$$

where $q_j \leq g_j(a') - g_j(a) \leq p_j$ for $p_j \neq q_j$.

Veto power can be associated with certain criteria by using a veto threshold, denoted by v_j, such that $v_j \geq p_j$.

Discordance index. The *discordance index* is used to consider the veto power of the criteria. The veto power for each criterion is modeled through a *partial discordance index*, denoted by $d_j(a, a')$, where $j = 1, \ldots, n$, and is defined as follows:

$$d_j(a, a') = \begin{cases} 1 & if\, g_j(a) - g_j(a') < -v_j, \\ \frac{g_j(a) - g_j(a') + p_j}{p_j - v_j} & if - v_j \leq g_j(a) - g_j(a') < -p_j, \\ 0 & if\, g_j(a) - g_j(a') \geq -p_j. \end{cases} \quad (5.5)$$

Credibility index. The credibility index is obtained from an overall aggregating function. It is defined as follows:

$$\sigma(a, a') = c(a, a') \prod_{j=1}^{n} T_j(a, a'), \quad (5.6)$$

Where

$$T_j(a, a') = \begin{cases} \frac{1 - d_j(a, a')}{1 - c(a, a')} & if\, d_j(a, a') > c(a, a'), \\ 1 & otherwise. \end{cases} \quad (5.7)$$

The ELECTRE TRI-nC method makes use of the credibility index, $\sigma(a, a')$, which is based on the concordance/non-discordance principle. Thus, it represents the voting power of the criteria that is concordant with the assertion "a is at least as good as a'" and considers the deterioration effect of the criteria that are discordant with such an assertion.

5.2.2.5 The assignment procedure

The exploitation of the outranking relations is the second phase of the ELECTRE TRI-nC method. Let λ denote the credibility level, which represents the minimum credibility index, $\sigma(a, a')$, which the decision makers (in this case, policy makers) judge necessary to validate the assertion "a outranks a'" when all criteria are considered ($\lambda \in [0.5, 1]$).

The ELECTRE TRI-nC assignment procedure is composed of two joint rules, the descending rule and the ascending rule, which are conjointly used. Let's to consider a selecting function, $\rho(a, B_h)$, which preserves the role of the reference actions and allows voters to choose between the two consecutive categories (for more details, see Almeida-Dias et al., 2010). The following function was adopted:

$$\rho(a, b_h) = \min\{\sigma(a, b_h), \sigma(b_h, a)\}. \tag{5.8}$$

When using this function, the joint rules can be defined as follows.

Definition 1 (*Descending rule)*: choose a credibility level, λ $(0.5 \leq \lambda \leq 1)$ and decrease h from $(q + 1)$ until it reaches the first value, t, such that $\sigma(a, b_t) \geq \lambda$:

- For $t = q$, select C_q as a possible category to assign action a.

a) For $0 < t < q$, if $\rho(a, b_t) > \rho(a, b_{t+1})$, then select C_t as a possible category to assign a; otherwise, select C_{t+1}.
b) For t = 0, select C_1 as a possible category to assign a.

Definition 2 (*Ascending rule): choose a credibility level,* $\lambda(0.5 \leq \lambda \leq 1)$ *and increase* h *from zero until it reaches the first value,* k*, such that* $\sigma(b_k, a) \geq \lambda$*:*

a) For $k = 1$, select C_1 as a possible category to assign action a.

b) For $1 < k < (q+1)$, if $\rho(a, b_k) > \rho(a, b_{k-1})$, then select C_k as a possible category to assign a; otherwise, select C_{k-1}.

c) For $k = (q+1)$, select C_q as a possible category to assign a.

Finally, the descending and the ascending rules provide the highest and the lowest possible categories for which action should be assigned. Therefore, an action/regulator is assigned to a single category (the highest and lowest categories are the same) or to a range of possible categories (there is ambiguity, and the assignment is ill-determined).

5.2.3 Empirical strategy

Based on the reviewed literature on governance and RIA (Subchapter 5.1), the proposed empirical analysis follows an assessment framework (3 stages) as shown in Figure 5.5.

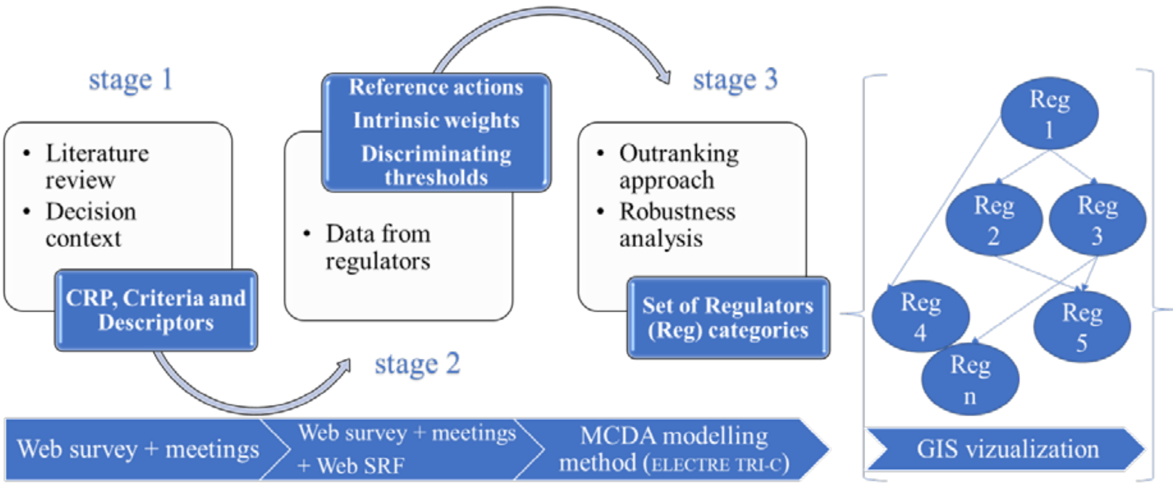

Figure 5.5 – Methodology approach.

First, a literature review on governance and RIA was performed in order to build a bridge between the two concepts and to identify core regulatory principles (CRP) (see Subchapter 5.1) and divide these principles into criteria, descriptors, and performances (stage 1). Here, the gap between data and knowledge led to interact with a focus group to address the subjectivity needed to determine the different stakeholders' points of view.

The strategy adopted in this Subchapter used a focus group that included five individuals who in some way represented stakeholders involved in the regulatory agenda, the governance and

RIA. The first member is a senior consultant in the water and wastewater sector with vast experience in working with the providers, municipalities, states and regulators. The second member is an expert academic and senior consultant in water resources and management in Brazil. The third individual is an international academic that has considerable knowledge in governance and RIA worldwide. The fourth member is a young academic that has been developing research on governance and other social aspects of the water and wastewater sector. The fifth member is another young academic with expertise in operational research on the utility sector. The focus group assisted with stages (1) and (2) and provided the following important contributions: (i) insights to define criteria that led to a “hierarchical structure of the criteria” (Braunschweig et al., 2001), (ii) preference information, and (iii) requirements that the model had to meet.

Second, the regulators were evaluated according to the set of specific criteria previously defined in stage 1 and collected in stage 2. The performance of Brazilian subnational regulators’ sample was measured and then connected to a geographical information system (GIS) for easier visualization/interpretation (Feo & Di Gisi, 2014). The sensitivity analysis was conducted, and isolated stress was added to each criterion to check the overall performance and detect any shifts between categories (stage 3).

To align the criteria and descriptors to the five CRPs, the focus group completed a survey[21] to allow to evaluate to what extent each pre-selected criteria and descriptor is important for describing and evaluating each CRP. Six levels were defined: (i) very strong; (ii) strong; (iii) moderate; (iv) weak, (v) very weak, and (vi) “no” presence.

The absence of data on this issue leds to contact the Brazilian Association of Regulatory Agencies (ABAR) to obtain their support for the proposed analysis. A total of 45 regulators were invited to participate through the ABAR. The information on one regulator that did not provide all required data removed from the assessment.

The revised Simos’ procedure (SRF) was used to determine the relative importance of intrinsic weights through a very simple procedure (the pack of cards technique) (Figueira et al., 2009; Figueira et al., 2013; Greco et al., 2016). Such a technique has many advantages,

[21] The survey (all criteria) is available at: https://goo.gl/XYwi2a.

namely, preventing criteria from being eliminated by a zero-weight assignment and allowing the incorporation of various weightings ascribed by stakeholders based on their expectations and preferences (Merad et al., 2004). To operationalize the SRF, the DecSpace[22] Internet software was used during the focus group meeting (for more details, see Figueira & Roy, 2002; Greco et al., 2016).

The discriminating thresholds were defined by using the focus group's knowledge of the regulators' data sources used to evaluate performance as well as the operational instructions used to define criteria when the values to be allocated to the preference, indifference and veto were determined (F.S. Pinto et al., 2017).

The results were obtained using MCDA-ULaval® (software version 0.6.1)[23]. The chosen credibility level (λ) was 0.65. As mentioned earlier, ELECTRE TRI-C provides the minimum and maximum categories that a regulator should be assigned to. If the minimum and maximum are the same, then the regulator is, without ambiguity, stable. If the minimum and maximum are different, then the regulator's category is ill-determined. In the latter case, an incremental change for each CRP (criteria) was made when it is possible to identify which category the regulator should be assigned to.

5.2.4 Results

5.2.4.1 Selecting criteria

Table 5.4 describes the criteria selected in this work to evaluate the regulators as well as the scales for those criteria. Based on the proposed level (moderate to very important), 10 criteria were selected from a total of 19. See Appendix XXX for details on all criteria.

As a result, the measure of consensus was satisfactory and reliable, which allowed to continue to the next step: selecting the most relevant criteria. Moreover, the outcomes regarding experts' perceptions confirm that the presence of all CRP tends to improve overall regulatory governance. In addition, the score for each criterion of each CRP was checked and validated in a second meeting with the focus group. Although regulatory quality has only one criterion

[22]Available at: http://decspace.sysresearch.org/index.html.
[23] Available at: http://cersvr1.fsa.ulaval.ca/mcda/?q=en/node/4

selected, “coherence” is also a determinant of regulatory quality because of its capacity to connect consistency, predictability and proportionality to the policy goals. The mathematical calculations were performed to allow for swifter programming.

Table 5.4 – CRPs and criteria.

CRPs	**Code**	**Description**	**Direction**	**Range**
Accountability	g_1	Evaluation of the regulators	Maximize	[1,4]
Administrative capacity	g_2	Human resource (rate between public servant and non-public servant)	Maximize	[1,5]
	g_3	Expenditure restraint	Minimize	[1,5]
Open government	g_4	Local availability information	Maximize	[1,5]
	g_5	Frequency of information	Maximize	[1,5]
	g_6	Public participation	Maximize	[1,5]
Regulatory quality	g_7	Policy Coherence	Maximize	[1,5]
Rule of law	g_8	Legal coordination	Maximize	[1,3]
	g_9	Data power access	Maximize	[1,3]
	g_{10}	Power of assurance’s decision	Maximize	[1,3]

As a result, the measure of consensus was satisfactory and reliable, which allowed to continue to the next step: selecting the most relevant criteria. Moreover, the outcomes regarding experts’ perceptions confirm that the presence of all CRP tends to improve overall regulatory governance. In addition, the score for each criterion of each CRP was checked and validated in a second meeting with the focus group. Although regulatory quality has only one criterion selected, “coherence” is also a determinant of regulatory quality because of its capacity to connect consistency, predictability and proportionality to the policy goals. The mathematical calculations were performed to allow for swifter programming.

5.2.4.2 Obtaining data

A total of 45 regulators were invited to participate in the analysis. However, only 53% (23) answered the request. According to the last report of the ABAR (2015), this sample represents approximately 75% of the localities covered by regulation. Study participants include the following: (i) the entities responsible for several localities, such as regulators from São Paulo (a multisector), Minas Gerais and Rio de Janeiro (water and wastewater); (ii) the main regulators from northeast Brazil (Rio Grande do Norte, Maranhão and Ceará); (iii) a regulator from northern Brazil (Acre); (iv) regulators from the center of Brazil, e.g., ADASA (a hybrid agency that regulates natural resources, water and wastewater services); and (v) a consortia of regulators (ARIS, ARES-PCJ and AGIR) from the south and southeast regions of Brazil.

5.2.4.3 Defining reference actions and parameters

The reference regulators were defined through interactions between the analysts and the focus group, while considering their experience. Here, the objective was to define each category by a single ("central") reference action. The performance of the "reference Brazilian subnational regulators" is presented in Table 5.5.

Table 5.5 – Categories of Brazilian subnational regulators.

Category	Reference Action	Description	g_1	g_2	g_3	g_4	g_5	g_6	g_7	g_8	g_9	g_{10}
C_1	b_1	Absence of CRPs	1	0,00	5	1	1	1	1	1	1	1
C_2	b_2	Incipient CRPs level	2	0,30	4	2	2	2	2	2	1	1
C_3	b_3	Minimum CRPs level	2	1,00	3	3	3	3	2	2	2	2
C_4	b_4	Moderate CRPs level	3	1,70	3	4	4	4	3	2	2	2
C_5	b_5	Good CRPs level	4	2,40	2	4	4	4	4	3	3	3
C_6	b_6	Best practice level	5	3,00	1	5	5	5	5	3	3	3

The analysts and focus group interacted to assign weights to the ten criteria through the SRF procedure (*cf*. Subsection 4). Initially, the focus group had difficulty defining the Z value (i.e., understanding the ratio). Here, the question was "to bear in mind that if the least important criterion is assigned with one vote, then how many votes should be assigned to the most important one? (Z=3)." After this discussion, the steps for the subsequent SRFs were presented to the focus group. The proposed method was well accepted, and the outcomes (k) of the procedure are presented in Table 5.6. The results for (*k)* show an interesting aspect regarding CRP (see Table 5.6). R*egulatory quality* was the main aspect highlighted by the focus group, followed by *Rule of law,* which reinforces their opinion regarding the proposed criteria in the Subchapter 5.1. *Open government* is in the middle of the weight scale, which reflects the generally accepted notion that in the regulatory process, regulators must consider stakeholders' input during decision making. However, the perception that *administrative capacity* was less important can be explained by the fact that the present situation of Brazilian subnational regulators is such that they need only minimum resources to ensure that the regulatory function properly implemented.

Table 5.6 – On providing the weights of the criteria.

Criteria	**Rank**	**White cards**	**Normalized Weights (k)**
g_1	4		10.7
g_2	5		9.7
g_3	9		4.6
g_4	10		9.7
g_5	6		5.6
g_6	2		8.7
g_7	7		13.7
g_8	3	2	13.8
g_9	1		9.7
g_{10}	8	2	13.8

Regarding the discriminating thresholds, Table 5.7 indicates that both preference and indifference were chosen for the criteria. However, the focus group considered the discriminating (preference and indifference) thresholds as preference parameters and similarly assumed that these thresholds are part of the scale definition that, as a consequence, are intrinsically linked. Moreover, veto thresholds were associated with some of the criteria, reinforcing their role (*cf*. Table 5.7).

Table 5.7 – Thresholds.

Parameters	g_1	g_2	g_3	g_4	g_5	g_6	g_7	g_8	g_9	g_{10}
q^β	-	0.25	1.0	1.0	1.0	1.0	1.0	-	-	-
p^β	-	0.5	2.0	2.0	2.0	2.0	2.0	-	-	-
v^β	4.0	2.0	3.0	3.0	3.0	3.0	3.0	-	-	-

5.2.4.4 Stage (iii): additional analysis

As mentioned earlier, ELECTRE TRI-nC offers the lowest and highest possible categories a regulator should be assigned to. Distinct credibility levels were combined in several ways (see Appendix XXXI). In this Subchapter, $\lambda = 0.65$ was adopted. Considering such scenarios, the method provides a unique category (which is always the same) for 43.6% of the regulators. For the 0.65 and 0.7 scenarios, the method provides between <2,3 and 3,3> categories for 34% of the regulators. Therefore, the results show that this method leads to robust conclusions that are suitable for developing implications regarding the assessment and arrangement of Brazilian subnational regulators considering the link between RIA and CRP.

With $\lambda = 0.65$, the results obtained from the ELECTRE TRI-C showed that approximately 35% of the regulators represent the minimum presence of governance (CRPs) <1-3>; 30% between weak and moderate <3-4>; and 26% represent the moderate presence of governance. This situation reflects the importance of investing in such an agenda in Brazil, particularly at the subnational level. Figure 5.6 highlights the results achieved. All regulators that could be assigned to two different categories (minimum and maximum) were also depicted in this way. The presence of △ means that the regulator could be moved to another category if CRP improved.

Figure 5.6 shows that the state of São Paulo (maximum) has the most CRPs, and the states of Rio Grande do Sul (stable) and Minas Gerais have a good level of CRPs. Moderate conditions are present in the states of Minas Gerais (minimum) and Alagoas and the municipality of Teresina (stable). The remainder of the categories (minimum and incipient) are presented in the north, northeast, southeast littoral and mid-west parts of Brazil. This picture confirms how governance is heterogeneous and that it is linked to the providers' capacity and importance. In addition, governance can be highly demanding for regulators, although it does not directly reflect on the performance of services that are provided.

Table 5.8 indicates that 9 of the 23 regulators have the capacity to shift among categories. Considering that RIA should improve CRP and vice-versa and that there is no mandatory RIA in such an environment, regulators may improve their performance by adopting or encouraging its use. The limitations of RIA should be respected, and an important aspect of such an analysis is regarding the possibility that it can, depending on the gap of each CRP, be used as a policy tool for the regulatory environment. Improving "accountability" by using good practices (processes and functions (RIA), reporting, oversight reviews and ethical procedures) may change the practices regulators, e.g., ARSEC, ARSI, ARSAE-MG, AGIR, AGR, ARSEMA and ADASA. In terms of "administrative capacity" regulators, ARSEC, ARSI and AGEAC may move among categories; in this case, the control over general expenses and human resources should be reduced by reviewing their financial autonomy.

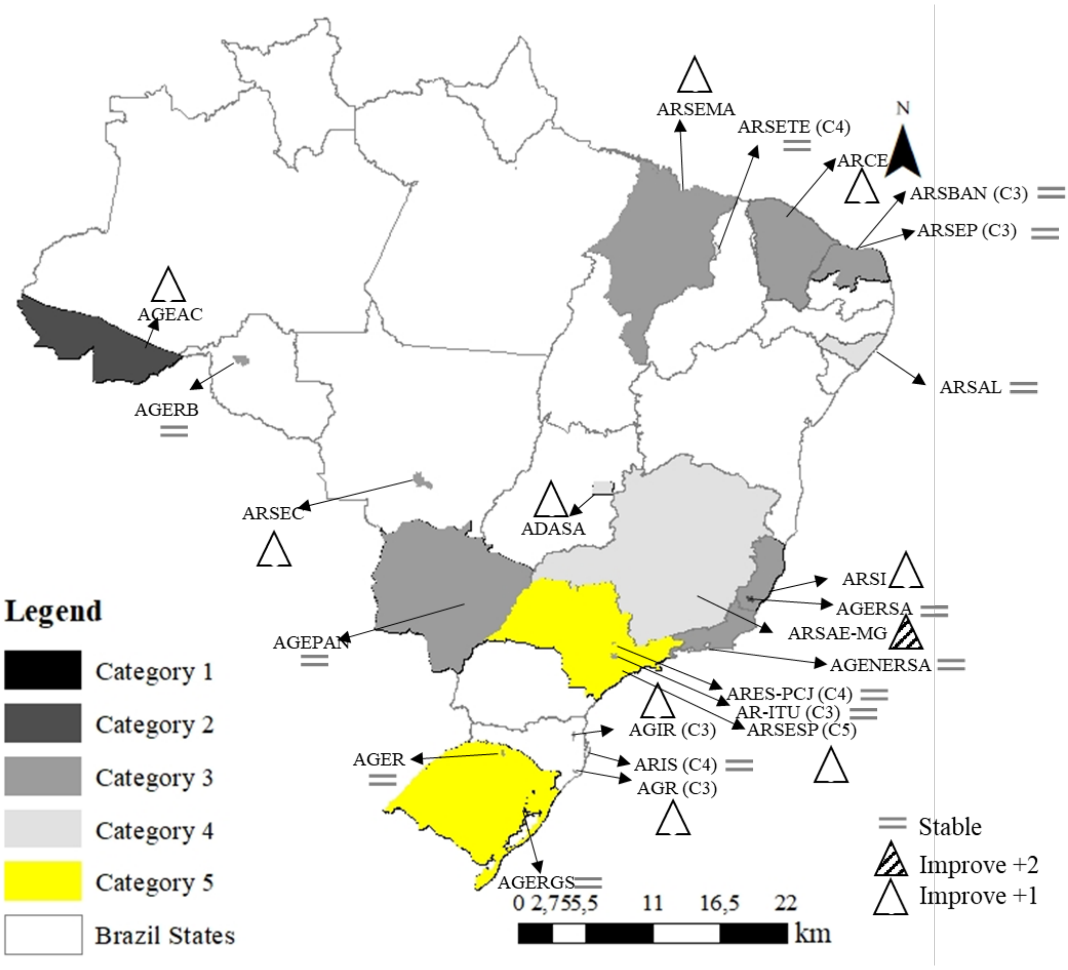

Figure 5.6 – Spatial picturing of Brazilian subnational regulators.

Here, RIA should include investing in human resource capacity and new employees. "Open government" may shift regulators, such as ARSEC, ARSAE-MG, AGIR, AGR, ARSEMA, AGEAC and ADASA to the next category, and RIA should improve public participation and transparency in the decision-making process. When "Regulatory quality" is improved through clear and politically coherent decision making, regulators may shift among categories, such as ARSI, ARSAE-MG, AGIR, AGR and AGEAC. Finally, considering the "rule of law", it is true that establishing coordination and monitoring by laws, enforcing regulators' decisions, and aligning responsibilities may shift regulators, such as ARSEC, ARSI, ARSAE-MG (+2), AGIR, AGR, ARCE, ARSEMA and AGEAC. In the case of ARSESP, improving each CRP is not sufficient to shift towards the next category. However, some of the most straightforward results include a gap in governance and RIA's capacity to improve the environment of the evaluated regulators.

Table 5.8 – Sensitivity analysis.

Regulator	Accountability (+)	Administrative capacity (+, -)	Open Government (+, +, +)	Regulatory Quality (+)	Rule of Law (+, +, +)	Min (a)	Min (b)
ARSEC	+	+ -	+ **0** +	+	**0** + +	**C_3**	△△△=△
ARSI	+	+ -	+ **0** +	+	**0** + +	**C_3**	△=△△△
ARES						C_4	Stable
ARSBAN						C_3	Stable
ARSAE-MG	+	+ -	+ + +	+	**0** + +	**C_3**	△=△△▲
AGERB	+		+ + +	0	0 0 0	C_3	Stable
ARSAL						C_4	Stable
AGEPAN						C_3	Stable
AGIR	+	+ -	+ **0** +	+	**0** + **0**	**C_3**	△=△△△
ARIS						C_4	Stable
AGR	+	+ -	+ + +	+	**0** + +	**C_3**	△=△△△
AR-ITU						C_3	Stable
ARCE	+	+ -	**0 0** +	+	++ +	**C_3**	= = = =△
ARSETE						C_4	Stable
AGER				0		C_3	Stable
ARSEP				+		C_3	Stable
ARSEMA	+	+ -	+ + +	+	**0** + **0**	**C_2**	△=△=△
AGENERSA						C_4	Stable
AGERGS						C_5	Stable
AGEAC	+	+ -	+ + +	+	+ + +	**C_2**	==△△△
AGERSA						C_4	Stable
ADASA	**0**	+ -	+ **0** +	+	+ + **0**	**C_3**	△=△= =
ARSESP	+	+-	**0 0** +	+	**0** + **0**	**C_5**	= = = = =
Legend	△ (+1)	▲ (+2)	0 (no change)				

5.2.5 Concluding remarks

First, to the best of the knowledge, none of the existing assessment frameworks have been used a previous Subchapter, particularly on this topic. Indeed, a variety of motivations for using MCDA in public sector decision making exists because it can provide a structured and formal platform for stakeholder engagement. In this Subchapter, the attempted to evaluate Brazilian subnational regulators according to the CRP of governance related to the regulators' independence and accountability; the relationship between the regulators, policy makers and other entities with similar responsibilities; operators and customers; the process by which decisions are made; the transparency and predictability of decision making; and the regulators' organizational structure and resources provided a qualitative link between such issues of the thesis, i.e., RIA and governance.

Second, any governance exercise should be evidence-based and should include the involvement of all stakeholders because of its broader goals. Thus, to define criteria (connected to the CRPs), descriptors, impact levels, weight coefficients, thresholds, and categories, an online survey was distributed. In addition, the key stakeholders' judgments were collected in a focus group, where the author acted as facilitators. In this scope, it is of great relevance to review studies on public participation in case studies to find successful social innovative experiences and determine their main limitations and difficulties in implementation.

Finally, the assumption that RIA improves governance and vice-versa is essential for enhancing the regulatory function. Here, the use of RIA (legal and practice requirements) as a way to improve governance. This assumption provides information for a discussion regarding the shift among categories based on the lack of identified CRPs. Establishing RIA through legal acts, such as laws, decrees and resolutions, may improve the aggregate performance of the surveyed regulators as discussed in Subsection 4.

Without any doubt, the results from the ELECTRE TRI-nC may provide access to better information and indicate the most appropriate stimulus to improve or recommend policies, e.g., RIA could impact the governance structure. In addition, it is insufficient to judge the actions of an independent regulating agency solely based on the efficiency and effectiveness of the regulatory process; the agency should also be evaluated by its conduct and how it carries out its responsibilities.

Investigating the link between CRPs, RIA and sector performance is imperative for operationalizing and quantifying governance. In addition to empirical work on the effects of good (or bad) governance levels, it would be useful to investigate the influence of certain constraints or externalities on governance indicators.

Established approaches to policy analysis for governance tend to focus on only a notion of regulatory function. Indeed, the proposed approach can lead to relevant discussions on policy by combining CRP features into a global performance score.

Moreover, the ability to interpret the outcomes of such an analysis is a remarkable starting point for policy discussion because of the added value rationale that will surely generate public interest and encourage regulators to more readily address governance limitations (Nardo et al., 2005; Pinto, 2016).

Finally, it would be useful to explore the relationship between mandatory RIA, the level of governance and regulators' overall performance to provide evidence for the proposition that such a policy tool may be a driver for public competitive strategies.

5.3 BETTER UTILITIES REGULATION? MERITS AND IMPLICATIONS OF A "MANDATORY" REGULATORY IMPACT ASSESSMENT IN BRAZIL

Paper submitted to an ISI journal, B.E. de Carvalho, Rondon, R., R.C. Marques and O.C. Netto

Abstract: In the Brazilian post regulatory state context, RIA may be a vehicle to overcome certain institutional deficiencies of agency rulemaking. Despite some certain criticism, one of the merits of RIA is that it may work as a regulatory driver to maximize the effects of good governance principles. Institutional setting in which the discussion of RIA is taking place in Brazil and argues that a "mandatory" RIA could be an appropriate policy, even in the Brazilian weak governance environment is proposed. Accordingly, the merits of adopting a "mandatory" RIA in Brazil can only be fully understood in view of the "agencification" phenomenon that helped shape the Brazilian regulatory State. Due to the lack of uniform procedural rules for agency rulemaking, the proposed RIA rules may serve the basis for judicial review, social control and administrative oversight of federal agencies providing additional legal grounds to challenge irrational, illegitimate, arbitrary and disproportionate agency rules.

Keyword: Agencification; Brazil; Regulatory Governance; Regulatory Impact Assessment.

5.3.1 Introduction

In the last decade, widespread dissatisfaction was noticeable over Brazilian government performance in Brazil, particularly regarding the delivery of public services (utilities). The Brazilian government inability to respond to such “lack of trust” in the regulatory system led to a national debate about the political interference over regulatory agencies, and the lack of transparency, regulatory quality, coordination and accountability of regulators, not to mention a series of corruption scandals involving politicians and major construction groups.

Such perception of government failure to deliver public services posited a scenario in which the only alternative for expanding infrastructure investment is building an adequate institutional environment to attract private, not public, investment. In this context, a new policy agenda has been pushed by initiative of the federal government, largely focused on improving the governance of the regulatory system, including: (i) a legislative proposal amending the law of Brazilian regulatory agencies, which aims to improve coherence, capacity, autonomy, independence, accountability and effectiveness of them (Bill no.52/2013, or PL, Projeto de Lei in Portuguese); and a legislative proposal to establish a “mandatory” regulatory impact assessment (MRIA, hereafter) to be carried out by federal regulatory agencies (PL no.1539/2015).

Institutional transplant is a problematic solution due to institutional, political and legal reasons (see, for instance, Dubash & Morgan, 2012). In fact, diffusion of RIA has been inspired by normative claims of better regulation and governance both in academia and in the international policy realms; for some, RIA is about embedding good governance into the rule-producing machinery of government to improve its decision-making quality (Adelle et al., 2015) as discussed in Subchapter 5.1. Theoretically, RIA’s broader dimension would not just foster regulatory quality but also promote compliance with requirements of good governance. In this sense, the adoption of RIA has been perceived as move forward towards "better regulation", particularly in precarious regulatory settings.

The Subchapter reviews certain legislative and executive initiatives to adopt RIA in Brazil as part of agency rulemaking. It assumes that the poor delivery of utilities in Brazil has a crucial institutional dimension related to the process of agencification, which may explain the circumstances driving the adoption of a MRIA Bill in Brazil. The work attempts to explain the causes of the Brazilian weak regulatory environment and poor delivery of public services to clarify the arguments leading to the adoption of a MRIA. Furthermore, it reviews the proposed Brazilian RIA model to bring to light its rationale and particularities.

After this brief introduction, the Subchapter is organized as follows. Subsection 2 explains the methodology and frame the policy/research enquiry. Subsection 3 provides the notion of MRIA in addition to Subchapter 5.1. Subsection 4 analyses the adoption of RIA in Brazil considering the contours of the Brazilian administrative legal tradition and the current stage of institutional development of the Brazilian "regulatory state" to discuss how the phenomenon of the agencification took place in Brazil. Based on the particularity of the Brazilian agencification and its legal tradition, Subsection 5 draws up considerations and policy implications about the adoption of a MRIA in Brazil based on the rules and procedures set forth under a recent Bill in discussion in the Brazilian Congress and the federal government proposed RIA's guidelines (under consultation).

5.3.2 Adoption of RIA: framing the institutional analysis

Accordingly, the Latin American RIA agenda was meant to overcome difficulties of sector-based regulatory changes by means of a technical oversight body. It is also the case of Brazil. The Brazilian federal government have open for consultation a RIA guideline and a legislative proposal has included RIA as a mandatory part of agency rulemaking. Despite the influence of international organizations like the OECD or the World Bank and backed by specialized literature, RIA as a policy tool – and a legal mechanism - is subjected to exogenous variables and an institutional setting, which makes the case of adoption of RIA in Brazil. The Subchapter addressed the proposed Brazilian RIA model based on the following qualitative framework (Table 5.9).

Table 5.9 – Research Analytical Framework.

Categories	Objectives	Research Questions
Contextual	Identify the problem/situation of utilities regulation in Brazil	What are the circumstances driving the adoption of MRIA Bill in Brazil?
Diagnostic	Verify the causes of Brazilian weak regulatory environment and poor delivery of public services	What are the perceived causes related to the “weak” regulatory environment leading to poor service delivery in Brazil?
Evaluation	Clarify values and arguments about the adoption of MRIA Review the proposed Brazilian RIA model to systematize its rules	Is there support about RIA´s ability to improve regulatory governance? What are the contours of Brazilian MRIA model?
Categories (cont.)	**Objectives**	**Research Questions**
Strategic	Assess to what extent the adoption the proposed Brazilian MRIA can improve regulatory governance and improve the delivery of public services	Should the Government adopt RIA Rules as proposed? and why? Should the Brazilian RIA Model be improved? and how?

5.3.3 RIA and governance

5.3.3.1 RIA and collaborative governance: RIA’s procedural nature

The debate about limits of the command-and-control model is not new. Classic economic works on regulatory inefficiencies (Coase, 1959; Posner, 1969; Peltzman, 1976) had already shown “when” and “why” an industry is able to use the State for its purposes, and how consumers groups influence the regulatory processes. However, following the regulatory reforms of the 1990´s, discussion about the utilities regulation has moved to higher level of analysis as the focus shifted to the governance of regulation in the so-called post regulatory state era (Levi-Faur, 2011; Scott, 2004).

In the context of post regulatory state, regulation started to be regarded not just as inefficient and ineffective, but also undemocratic. By the same token, the literature review started to focus on the institutional design (and culture) for effective and legitimate regulation (Lobel, 2012). The diagnostic tends to be associated with the perception that compliance levels are disappointingly low; regulatory bodies are unable to persuade stakeholders of the way forward and to find a collective solution for complex situations; and agencies lack resources to support the private sector, and to monitor, enforce and revise regulations based on evidence (Solomon, 2008; Dorf & Sabel, 1998; Freeman, 1997). Judicial checks on administrative agencies imposed by conventional administrative law is often seen as disruptive, which would justify a shift in agency´s approach to assist actors even when monitoring their performance (Dorf & Sabel, 1998). Such pragmatic approach relies on successful cases of new modes of governance incorporating public participation, benchmarking, and information sharing to address regulatory issues with industry active participation (Freeman, 1997). In fact, the debate on how to move beyond the hierarchical approach of command-control based regulation (Scott, 2004) has renewed the emphasis on issues of accountability, legitimacy and transparency (Black, 2010; Lodge, 2004) by approaching decision-making in a "non-hierarchical" and "mutually interdependent" manner based on efficiency, transparency, and consensus-building (Bartolini, 2011).

5.3.3.2 RIA as a mandatory policy tool

Diffusion of RIA in EU and by OECD have followed the agenda of ‘Better Regulation’. In the U.S. its diffusion was partly due to its nature as a controlling mechanism in the rule making process of regulatory agency. In fact, institutionalization of RIA may take various forms. Whether it should be required by law (by a legal mandate), it is not without controversy, though (Rose-Ackerman, 2011). According to Rose-Ackerman (2011), adoption of RIA has followed different standpoints: the first line of arguments about the adoption of RIA are dealt with under the agenda of Better Regulation and tend to refer to the value of public consultation, democratic values, greater openness and participation. Second, there are some that see RIA as a technique to import values from the private sector into the bureaucracy (new public management). The third set of arguments arises from legal scholars who see the implementation of RIA as an opportunity to foster legal principles.

The critique of RIA is sound in the U.S. where CBA methodology prevails. To its critics, CBA technique has very challenging bottlenecks, including (i) excessive emphasis in quantification and monetization of risks, (ii) complexity in determining discount rates, (ii) failure to fully assess the value of avoiding non-marginal consequences, and (iv) disregard to distributional concerns (Harrington et al., 2009). Others see failures of CBA-centered RIA as a result of the operation of politics in regulatory review (“politization”), lack of accuracy in the methodology (“accuracy”), and manipulation of the subject according to an analyst’s policy preferences (“bias”) (Shapiro & Schroeder, 2008). In fact, difficulties in applying CBA in “hard cases” is still a hot topic in American administrative law (Rose-Ackerman, 2011; Sunstein, 2012), and questions still remain whether CBA is an appropriate method to deal with social choices and qualifies them as a normative principle (Rose-Ackerman, 2011)

In defense of a MRIA, there are claims that RIA not just disseminates technical information but also contributes to improve the regulatory governance. Utility regulation generally suffers from poor quality data and information asymmetry commonly found in regulated markets. In certain contexts, by defining mandatory rules for RIA implementation, government intend to pressure the regulator to improve the overall quality of the regulatory function through a better-informed rule making process reinforced by; (i) data collection and dissemination; (ii) stakeholder participation and information sharing; (iii) motivated and open decision-making process; and (iv) risk and scenario assessment.

A MRIA may force the government to re-allocate resources to the core government activity (finance, human resources, and infrastructure), which may contribute to the regulator's organization culture. In this context, there is a cultural process associated with RIA, which requires that its implementation becomes part of the organizations' routine. Obviously, such organizational effect is only possible when there are minimum resources. Under this perspective, the rationale shifts, and the resource limitations cease to be associated with a subjective perception whether RIA's potential gains are perceived or not; conversely, RIA's costs in the formation of human resources, acquisition of additional infrastructure and services for its adoption shall not be discretionary and will be allocated in the agency's budget as a legal requirement. In fact, it may foster reallocation and\or rationalization of resources when they are not apparently available.

After all, for those who support adoption of MRIA, the costs for adoption of RIA would be justifiable as a matter of public interest since citizens have a vested right to participate in the regulatory processes and will be better equipped to challenge arbitrary, discriminatory, unreasonable and disproportionate regulatory decisions "ex-ante". From both collaborative and adversarial perspective, depending on the context and the institutional setting, there are arguments that support the adoption of a MRIA as an important step towards a culture of good regulatory practices.

5.3.4 Adoption of RIA in Brazil

5.3.4.1 Institutional setting: utilities regulation in Brazil

The Brazilian legal framework for utility regulation is quite complex and rigid. Utilities regulation in Brazil is based on a “hybrid” regulatory system that combines American style utilities regulation and “French based” administrative contracts to delegate the provision of utilities (contract de concession administrative) and public services regime (service publique) to operate infrastructure and deliver the services. Under these two influences, emerged the Brazilian administrative law tradition. The public services regime is largely founded on the framework set forth by the 1988 Brazilian Federal Republic Constitution (CRFB/1988) which defines constitutional rules for delivery (provision) and concession (delegation) of public services (Article 175).

Based on the constitutional framework, federal legislation provides general rules for concession of public services (Law no.8987/95), public private partnerships (Law no.11079/2004), administrative contracts and public procurement (Law no.8666/93). The Brazilian Constitution systematically allocates administrative and legislative authority over the provision of public services among federal (articles 21, 22, 23 and 24), state (articles 23, 24, 25) and municipal levels (articles 23, 24 and 30). Therefore, due to the federal system, regulation of public utilities is divided between the three level of government, a complex decentralized system to operate infrastructure with several competences assigned to local and state level, which can be problematic given the great administrative capacity disparity at the sub-national level.

In Brazil, regulation and the creation of the regulatory agencies was not an exclusive product of the rationale of the 1990’s. Some regulators were created under the interventionist model of the 1960’s and remain important, such as the securities commission (Comissão de Valores Mobiliários - CVM), the Brazilian Central Bank (Banco Central do Brasil - BCB), the insurance regulator (Superintendência de Seguros Privados – SUSEP), the environmental agency (Instituto Brasileiro do Meio Ambiente – IBAMA) to name a few. However, regulation of public services has been largely influenced by the rationale of the 1990’s in combination with the legal administrative tradition of delegation by contract and the notion of public service, which still remain core at the Brazilian regulatory regime.

The development of a wider regulatory framework for public utilities regulations was largely a result of the need to control private sector involvement in natural monopolies previously operated directly by the public sector or through state owned companies. In 1995, Brazilian State began to change its role, from operator to regulator (the so-called "Regulatory State"), which is clearly reflected in the content of the amendments of the 1988 Constitution number 5, 6, 7, 8 and 9. The five amendments broke the monopoly of the state in important utilities and made possible private operators, domestic and foreigners, to invest and operate certain infrastructure sectors (piped gas, oil, coastal shipping, telecommunications) and redefined the concept of Brazilian companies irrespective of the origin of the capital.

Following constitutional amendments, Brazil has produced a large amount of specific legislation directed to infrastructure sectors. Such legislative packages also created regulatory agencies with authority to regulate utilities ("agencification"). Under the regulatory state rationale, from 1995-98 a first generation of regulatory agencies were created to oversee private sector operation of former legal monopolies in the energy, telecommunication and oil and gas sectors, including national energy agency (Agência Nacional de Energia Elétrica - ANEEL), the national telecommunications agency (Agência Nacional de Telecomunicações - ANATEL), and the national oil agency (Agência Nacional de Petróleo - ANP). From 1999 until 2000, the congress approved the creation of the national sanitary surveillance agency (Agência Nacional de Vigilância Sanitária - ANVISA), the national health insurance agency (Agência Nacional de Saúde Suplementar - ANS) and the national water agency (Agência Nacional de Águas - ANA) to monitor and control on externalities and the use of natural resources. In 2001 and 2002, two other agencies were created to oversee the operation of logistic and transportation infrastructure: the national ground transportation agency (Agência Nacional de Transportes Terrestres - ANTT) and the national water transportation agency (Agência Nacional de Transportes Aquaviários - ANTAQ). Finally, in 2005 the national agency of civil aviation (Agência Nacional de Aviação Civil – ANAC) was created.

Agencification in Brazil is a process not without legal controversy and the very nature of the vested powers of agency and their role in utilities regulation is still troublesome among legal scholars. In fact, agency rule-making in Brazil has become a controversial matter, an unsettled legal scholarly debate with consequential and practical impacts as a matter of judicial review. The very nature of rule-making authority (and its limits) is at the centre of the legal debate. The root of debate is largely based on the classical doctrine of separation of powers and a strict interpretation of the Brazilian Constitution under which the delegation of legislative power would be plainly prohibited (Article 2 of the CRFB/1988). Actually, under the Brazilian constitutional framework, the President has the authority to pass (a) provisional measures with immediate law effects (to be validated by Congress) (article 62, CRFB/1988 and (b) executive orders for the strict execution of the Law (article 84, VI, CRFB/1988). To control the executive branch discretion, the Congress has the power to suspend the so-called "normative acts" enacted by the executive branch that exceed their regulatory authority or limits of the legislative authority (Article 49, CRFB/1988) (the Brazilian administrative law ultra vires doctrine). Under the traditional administrative law, the "narrow" or "strict" interpretation of the doctrine of separation of powers is also founded on certain transitory rules that revoked all early provisions that had delegated authority to the Executive Branch to exercise normative functions based on the "previous" legal or constitutional authority (article 25, II, of Ato das Disposições Constitucionais Transitórias). In this context, four legal doctrines address the issue of agencification in Brazil, particularly the legal nature - and limits - of the rulemaking authority of regulatory agencies.

- *autonomous rulemaking authority*: agency rule-making would be based not on the delegation of legislative authority, but on the administrative authority of agency to issue "autonomous" administrative rules in accordance with the statutory provisions that created the agency;
- *Delegalization:* agency rule-making is a product of the phenomenon of delegalization which consists in the adoption of a legislative policy determining that a certain subject-matter will be decentralized to a specialized regulatory authority, not as a matter of delegation of powers, but as "legal technique" that authorizes the creation of sector-specific regulation;
- *Delegation of Powers:* agency rule making would derive from the delegation of legislative authority, which, for those who support it, is not prohibited under the CRFB/1998; in this case, the prohibition would be applied to administrative acts without a proper delegated authority from the legislative branch, and to administrative acts contrary to, or exceeding the limits of, the statutory provision that transferred normative powers to the agency; and
- *Moderate Separation of Powers Doctrine:* agency rulemaking would be based on general administrative regulatory authority, which is limited to issue administrative rules for the strict execution of the Law. In practice, *the doctrine of Separation of*

Powers has been moderated by the understanding that agency rulemaking authority is also found in agency administrative discretion, which arguably allowed the possibility of deliberations on “technical issues”.

In the Brazilian post regulatory state context, agencification has brought to the legal realm a set of theoretical challenges that made scholars and policy makers not just to address the issues of accountability and legitimacy in the agency rulemaking, but also the application of the principle of rule of law in the regulatory arena, which challenged the legal administrative tradition and posed uncertainty concerning the grounds - and the extension of - judiciary review of agency rulemaking.

5.3.4.2 Recent Post-regulatory state initiatives in Brazil

In the post regulatory context, the prevailing rationale of the 1990 did not replace the traditional interventionist state culture and agencies remain longa manus of the government. In 2007, the Brazilian federal government launched a partnership with the Inter-American Development Bank (IDB) to implement a “better regulation” program for the Brazilian regulatory agencies. The Program for Strengthening Institutional Capacity for Management in Regulation (PRO-REG) was partially financed through funds from the 1811 OC/BR Loan Agreement and adopted by Decree no.6062/2007 as amended by Decree no.8760/2016. In May 2013, the program started to run only with resources from the Federal Budget.

Under one of the most serious economic crisis and following an abrupt change in government, a new programme – the Programme for Investment Partnerships (PPI) was launched by the Brazilian government signaling a market-friendly infrastructure policy. The Brazilian Presidency issued the provisional measure no.727/2016 to establish a regime to increase private investment in infrastructure projects, especially via public-private partnerships and re-organize decision-making arrangements. The provisional measure no.727/2016 was approved by Congress passed into Law no.13334/2016 (as amended by Provisional Measure no.768/2017). The PPI sought to address a number of critical regulatory governance aspects and attract new higher level private investment in infrastructure sectors by opening the infrastructure concession market for new bidders (Lodge et al., 2017). At the institutional front, PPI intended to guarantee stability of PPI projects (Articles 2, IV and 3, I of Law no.13334/2016), strengthen the regulatory role of the State and the autonomy of regulatory agencies (Article 2, V of Law n. 13334/2016) and secure higher level of certainty (Article 2, V and 3, III, of Law no.13334/2016).

Two other initiatives were launched to improve regulatory governance. First, the Senate Bill Proposal on the Governance and Accountability of Federal Regulatory Agencies, (PLno.6621/2016, largely based on PL no.52/2013 - Federal Agencies Bill) which is still under discussion in the Chamber of Deputies. In fact, Article 6 of the Federal Agencies Bill (PL no.6621/2016) determines “the adoption and proposals to amend normative acts of general interest of the economic agents, consumers or customers of services provided shall, according to the regulation, be preceded by a RIA, which shall contain information and data about the possible effects of the normative act.” Secondly, the Congress Bill Proposal on MRIA prior to the enactment of regulatory acts (PL no.1539/2015 - RIA Rules”) containing 36 articles that provides the legal framework for implementation of a MRIA in Brazil. Formal justification of a MRIA is found in legislative material that supports PL no.1539/2015 reasons include (a) low uniformity and high asymmetry in rulemaking of regulatory agencies in Brazil whilst it is not uncommon situations when agency adopts innocuous support material to justify their rules; (b) adoption of MRIAs in Brazil would enhance the transparency of regulation; and (c) alleged “consensus” about the benefits of RIA to improve regulation supported in expert opinions, comparative law, as well as in the diffusion of RIA globally, as recommended by OECD.

In 2017, under the PRO-REG, the Brazilian Presidential Office launched for comments public notice no.01/2017 on the Guidelines and Roadmap for Implementation of RIA. Such public notice is based on the draft proposal resulting from technical discussions between Federal Regulatory Agencies, Ministry of Finance, Ministry of Planning, Development and Management, and National Institute of Metrology, Quality and Technology – INMETRO, and follow the rationale of the Technical Note no.4/2017/AESP/SAG/CC-PR issued by the Office of the Chief of Staff of the Presidency and aims to consolidate and systematize RIA, as a fundamental tool for “high level regulation”, which integrates public participation in the regulatory process. Thus, irrespective of the outcome of PL no.1539/2015, the Brazilian government has, voluntarily, started to institutionalize the adoption of RIA.

5.3.4.3 RIA rules

Under the PL no.1539/2015 (RIA rules), the proposed Brazilian RIA model has structural similarities with the American model. Although the institutionalization of RIA in Brazil followed a quite different context, to a certain extent, the proposed Brazilian RIA models resembles the American style regulation where RIA is also a mechanism to control agency behavior and is exclusively applicable to secondary legislation (i.e. regulatory acts of the administrative agencies) (Table 5.10).

In Brazil, RIA Rules also refer to the application of CBA methodology, which should be complemented with the assessment of potential effects of the regulatory proposal, a “risk analysis”. According to RIA Rules, its objective is to support agency’s decision making (ex-ante) and monitor the regulatory decision (ex-post) (Article 1). In that scope, RIA would also serve the purpose to control agency rulemaking by the executive branch. RIA serves both a managerial and an institutional purpose. Under the managerial dimension, RIA Rules state that RIA purpose is to guide and support decision-making process of regulatory agencies, and improve overall regulatory quality by promoting efficiency and effectiveness of regulatory decisions, and coherence of regulatory policies (Article 4). Under its institutional dimension it allows public participation and improves administrative control of the regulatory decision-making processes (Article 4).

Table 5.10 – Proposed RIA framework.

Level of authority	**Scope**	**Oversight**	**Process**	**Objective**	**Background**

Federal Regulatory Agencies	Secondary legislation	Agency's Board Review. Technical opinion by external administrative body (SEAE) of Antitrust System	Full RIA Process: Problem definition, Alternative selection, Public consultation, Assessment Report, Independent Validation (SEAE) and Monitoring	Strengthen regulatory governance	PLS 1539/2015 (RIA Rules Under discussion), RIA Guidelines (Public notice no.01/2017, under discussion); PLS Bill no.6621/2016 (Agency Law under discussion)

Level of authority: RIA rules determine that the federal regulatory agencies must conduct "ex-ante" RIA as part of their rule making procedure (Article 3). As noted before, in Brazil, regulatory agencies are administrative bodies subject to special legal regime established by a specific law, created exclusively for the exercise of a regulatory function and endowed with administrative autonomy (article 2, III). The Bill lists the federal regulatory agencies to which RIA rules should be applied, but other entities may only fall into the category of regulatory agency if determined by a specific law or executive order; that is, the list is indicative and may be expanded. State and Municipal agencies are not obliged to adopt RIA since RIA rules do not apply to them.

RIA mandatory character: a key feature under the proposed legislation is its mandatory character. RIA rules determine that federal regulatory agencies must perform a "full RIA" prior to enactment of new administrative rule or changing an existing one (article 3). If the agency fails to perform "ex-ante" RIA, the rule shall be deemed null and void (Article 37). Such rules (or, normative acts) are administrative acts of general applicability adopted, as authorized by law, by a regulatory agency (or, the governing body of regulatory agencies generally a collegiate), which has a potential impact on rights and obligations of economic agents, consumers or customers of public services, or the regulated activity itself (Article 2, III). Article 3 also requires the performance of a RIA prior to the enactment of (i) sectorial plans or (ii) administrative acts that convey, alter or extend public grants, under the authority of the agency (direito de outorga, in Portuguese) (article 3, II; and III, RIA Rules). Public grants are rights granted by the government allowing any private person to explore a legally defined "public good" or perform a "public service", as authorized by law. Agency's board may only dismiss the performance of RIA, in the following situations in case of "limited scope" administrative acts applied to individual situations (i.e. orders), licenses (except, "public grants"), and acts of internal organization of the agency with no impact on (a) the rights and obligations of economic agents, consumers or customers, or (b) agency's budget. RIA guidelines offer additional clarification as per the extension of Article 3 of RIA and details the administrative acts (or, rules) that are excluded from RIA application:

- rules applied to agency internal organization whereas its legal effects are restricted to the agency;
- administrative orders that decide specific situations or are applied to determined person;
- administrative acts in strict compliance of the Law whereas agency is not allowed to decide in any different way (no administrative discretion); and
- rules of notorious low impact.

Agency rulemaking oversight: RIA is subject to a technical review by the Secretariat for Economic Monitoring of the Ministry of Finance (SEAE) as part of RIA procedure (RIA Rules, article 6, VII). According to articles 22-24 of the RIA Rules, SEAE shall perform the scrutiny and validation of RIA's data, analysis and alternatives and shall ratify the proposal, with or without caveats and suggestions. SEAE technical opinion about the proposed rule will be submitted to the agency board for final decision. If the board decision is contrary to the SEAE recommendations, the agency shall provide a reasoned decision, which clearly explains the reasons that support the decision (Article 24 of RIA rules). The SEAE is an established technical body that integrates the Brazilian Antitrust System (Law no.8884/94 as amended by Law no.9021/95 and Law no.10149/2000, as revoked by Law no.12529/2011 – Antitrust Law). According to article 19 of the Antitrust Law, SEAE already has a statutory mandate to (i) issue technical opinion on the aspects related to the promotion of competition, on proposals for changes in normative acts of general interest of economic agents, consumers or customers of services rendered subject to public consultation by the regulatory agencies and, when it deems pertinent, requests for revision of tariffs and proposals (item I, Article 19); (ii) issue technical opinion, when it deems it appropriate, on drafts of normative acts elaborated by any public or private entity submitted to the public consultation, in the aspects related to the promotion of competition; (iii) elaborate sector-specific studies in the interest of the Ministry of Finance in the formulation of sector public policies; and (iv) review laws, regulations and other normative acts of the federal, state, municipal and Federal District public administration that affect or may affect competition. In fact, the well-established technical role of SEAE, as part of the antitrust proceedings, already include matters that arise from the interface between the enforcement of the Brazilian competition law and the application of rules issued by regulatory agencies in Brazil. In 2016, SEAE had issued over 400 opinions on public hearings about regulatory rules with intensive participation in key infrastructure sectors, focused on efficiency and rationalization, through competition incentives and proposal for withdrawals of regulatory barriers (OECD 2017).

Judicial review: The Brazilian Constitution provide ample room for judicial review of administrative act as no injury or threat to a right that may be excluded from judicial review (CRFB, article 5, XXXV). Thus, any party in an administrative proceeding enjoys the protection of due process of law. However, in the Brazilian legal system there is no administrative court, and administrative claims have to be brought to general courts of law. In addition, there is no legal rule defining the precise scope of judicial review and deference to the technical discretion of the agency has become a common practice. It is true that regulatory decisions may be subject to judicial review in accordance with general administrative law (Administrative Procedure Act, Law no.9784/1999 – the “Brazilian APA”), but the framework of Brazilian APA provides no specific standard for the review for agency rulemaking. As noted before, all legal doctrines that dispute the nature of agency rulemaking authority agree on the deference to the rule of law and its procedural requirements (legality control). In recent cases, courts have also applied test of reasonableness and proportionality to sustain that rules are applied adequately, and that administrative intervention is necessary and proportional. However, it is unclear whether a more intense judicial review would apply to rulemaking. Since RIA rules also define procedural and substantive requirements, it will provide clearer legal grounds for judicial review of agency rulemaking. Therefore, once RIA rules are in force, regulators will have to comply with: (i) rulemaking procedures (i.e. public notice and consultation requirements as per articles 6, 29-33 of RIA rules); (ii) Data-collection and dissemination of information (article 8 of RIA rules) (iii) requirements of assessment and analysis of alternatives to the proposed rule (CBA and Impact Analysis) (articles 17-18 of RIA rules); (iv) minimum requirements of RIA report (articles 19-21 of RIA rules) and (v) external review by technical body (SEAE) (articles 22-25).

The importance of due regulatory process in the Brazilian agency rulemaking has found more and more support among legal scholars. The requirement of open government would be a way to tackle the apparent lack of legitimacy of agency rulemaking. Furthermore, the theoretical challenges posed by agencification, particularly the perception of impairment to the operation rule of law in the administrative apparatus, is mitigated by RIA statutory requirements of rationality in the agency rulemaking, which is in line with the existing legal doctrines under which regulation should be subsidiary, efficient, proportional, reasonable, adequate and necessary.

Process: RIA Rules prescribes a “full” RIA process, which can be further detailed by the agency. Article 6 of the RIA Rules, establishes that the RIA process comprises 8 stages: (i) determination of the problem and the objectives of the proposed rule; (ii) advance public notice of the proposed rulemaking; (iii) selection of alternatives and data collection; (iv) public comment of the proposed rule (public notice or consultation); (v) CBA and an IA, review of additional contributions, and validation of data; (vi) issuance of the RIA report; (vii) scrutiny and validation (technical opinion) by the SEAE; (viii) monitoring the implementation of the proposed rule. Generally, the proposed procedure contemplates the fundamental steps of a RIA model, as both a collaborative and rational tool. Given the lack of general framework in the agency rule-making the RIA fills an important gap to provide legal grounds for judicial review in case, regulators do not comply with procedural requirement. Indeed, it strengthens the due administrative process of regulatory agency in Brazil as the Brazilian APA does not provide a specific framework for agency rule making.

5.3.5 Discussion and policy implications

5.3.5.1 Context

In the context of post regulatory state, Brazilian government was confronted with serious regulatory governance problems that weaken state ability to secure the delivery of public services and expand the infrastructure network through private sector involvement. Under a serious fiscal crisis, the Brazilian government has launched a set of institutional initiatives to strengthen regulatory governance, including the adoption of a MRIA as integral part of rulemaking process of federal regulatory agencies. Further, discussion about the adoption of RIA in Brazil has been influenced by the promotion of RIA by international organizations, particularly the OECD and the World Bank, which encourage the adoption of RIA as a tool for good governance.

5.3.5.2 Diagnostic

Conflicting rationale leading to an incomplete transition of the Brazilian Regulatory State: the Brazilian legal framework is a by-product of the combination of the administrative legal tradition and the rationale driving the waves of regulatory reforms of the 1990's. In 1990's, privatization and liberalization of public sector markets were implemented in Brazil as part of a broader macroeconomic policy that aimed at economic stabilization and a set of structural reforms that changed – at least partially - the role of the State in the economy. The 1995 strategic plan to reform the Brazilian administrative apparatus (Plano Diretor da Reforma do Aparelho do Estado, in Portuguese) relied on the creation of dedicated and single-purpose independent regulatory agencies to (a) insulate political interference from technical decision-making process and (b) better the institutional environment by promoting private investment in the utilities sector via credible government commitments (Cunha et al., 2017). In fact, regulatory agencies in Brazil were largely a result of such programmatic view (Bresser-Pereira, 2004). However, these regulatory agencies did not become the desired independent administrative bodies nor were properly constrained (Cunha et al., 2017), and the result was the creation of a new platform for a "regulocracy" (Levi-Faur, 2011). Actually, despite of the regulatory state prototype and the idea of administrative independence, the interventionist kinds of governments, which by and large characterized Brazil until mid-2016, maintained political interference in the regulatory agencies and the Brazilian regulocracy followed the traditional state bureaucratic regime. Such institutional setting has been marked by "interaction deficits", slow regulatory innovation and left key institutional gaps in the governance of regulatory regimes (Cunha & Delia, 2012). Such incomplete transition of the Brazilian regulatory state was challenged by an opposed administrative culture based on interventionist bureaucratic tradition, which has limited the ability of the regulatory agency to perform its function with autonomy, increased the perception of risk by private investors, and raised the chance of opportunistic behavior by public and private actors (Melo & Pereira, 2017). As noted by (Lodge et al., 2017), regulatory governance is key to attract investment in infrastructure sectors, and whatever the preferences are, in order to facilitate desired investment, it is necessary a stable policy framework to allow long term planning and consistent decision making (Lodge et al., 2017). Indeed, there is a general perception that the

Brazilian government needs to commit itself not to interfere in the functioning of the regulatory agencies, both politically and financially, because it undermines the credibility of the regulatory agencies raising the cost and changing the profile of new infrastructure investments (Cunha & Delia, 2012; Melo & Pereira, 2017).

Low regulatory capacity and limited use of regulatory tools: in the Brazilian regulatory system, formal independence of regulatory agencies is not legally accepted, and agencies are subordinated administrative bodies. Since the 1990s, there are concerns among scholars and policy makers on how - and to what extent - the politization of agencies and closeness to the regulated industry would jeopardize agency regulatory capacity and undermine the "public interest" in their decision-making. In fact, based on the assessment of the development of the Brazilian institutional framework and on the review of their legislative material, the post regulatory initiatives in question, largely founded on the adoption of RIA, are an attempt to enhance analytical, oversight and delivery capacities in the agency rulemaking (Lodge et al., 2017). The use of regulatory and policy tools (such as RIA) to improve regulatory capacity are relatively recent in Brazil; societal participation remains generally weak; and government seems to lack a comprehensive approach to regulatory management leading agencies to implement regulation without a clear framework or orientation (Cunha & Delia, 2012). Furthermore, the problem is aggravated at the subnational level due to the assignment of regulatory competences to agencies with very different incentives and capabilities, and without coordination with the federal level (Cunha & Delia, 2012).

Unclear rules for agency rulemaking, blurred competences of support institutions, and improper oversight and social control: agencification took place in Brazil without clear rules for agency rulemaking. In fact, the very nature of the vested powers of agency - and their role in utilities regulation - remains surrounded by uncertainty among legal scholars. Not just the unclear set of rules is a cause of theoretical challenges to scholars, but it also creates an unstable institutional environment for service providers and regulators, increasing the chance of opportunistic behaviors, and creating a perception that regulators are not accountable and lack legitimacy. Furthermore, the rule of law in the regulatory arena is discredited by the uncertainty concerning the legal grounds and the extension of judiciary review of agency rulemaking. Indeed, the lack of specific rules on agency rule making diminish the ability of public participation reducing even more the already weak social control of the regulatory agency and the ability of the government to oversee agency rulemaking.

5.3.5.3 Evaluation

There is support in policy and academic materials about the merits of RIA to improve regulatory governance (as discussed in Subchapter 5.1). However, generally, institutional transplants face the problems of adaptation and adherence to the domestic legal and administrative systems. The adoption of RIA in Brazil is more than a transplant of a “best regulatory practice” and is largely founded on and/or justified by the existence of an institutional gap due to the incomplete transition of the Brazilian regulatory state. Actually, the merits of adopting a MRIA in Brazil can only be fully understood taking into account the context in which the phenomenon of agencification took place, as well as the influence of the administrative legal tradition in the formation and functioning of the Brazilian legal system. Under the current stage of development of the Brazilian institutional framework, the adoption of RIA provides an opportunity to supplement the current framework with specific substantive and procedural rules about agency rule making. It signals the government intent not just to foster a better regulation agenda but a renewed commitment with agency independence, a key factor to attract private investment. Such line of reasoning is also largely founded on normative arguments associated with the requirements of collaborative governance and the need to strengthen the rule of law in the Brazilian agency rulemaking. Procedimentalization provides legal grounds for judicial review, and also allows stakeholders to participate and protect their individual rights “ex ante”; it tackles the alleged lack of accountability and legitimacy through administrative due process. The lack of clear statutory law about agency rulemaking and the controversy on the nature of rulemaking power of the agency makes the RIA Rules an important mechanism to secure regulatory quality and open government in the Brazilian regulatory governance system. Brazilian MRIA Model resembles the United States Model, without such emphasis in the CBA analysis, quantification and monetization. In that sense, Brazilian RIA Rules fills an additional institutional gap as controlling mechanism in agency rulemaking.

5.3.5.4 Regulatory strategy

In the context of the Brazilian post regulatory state, the proposed MRIA rules has merits. RIA rules form a body of collective choice rules that create a framework for institutional change in the production of operational rules that will shape the regulatory arena. In that sense, RIA serves a higher purpose. It is not a mere managerial technique; it is both framework and a tool to improve regulatory capacity. Until now, there is no adequate statutory law that defines the nature, limits and procedures for agency rulemaking. Such weak legal framework is partly due to agencification, without both a legal tradition and a statutory law that support the institutionalization of agency decision-making, which, to a certain extent, discredit the rule of law and creates incentives for institutional failures and/or the capture of agency by private interests. Limited to federal level, the adoption of RIA rules in Brazil has the potential to produce reallocation of resources to one of the core outputs of the regulatory function, i.e, rulemaking.

CHAPTER 6. CONCLUDING REMARKS

6.1 MAIN FINDINGS

The four concerns of this thesis made different contributions to the literature. In short, Chapter 2 introduced the RIA theory that is relevant to support its conceptual and framework model. Based on a detailed dataset and consultation process regarding the PWS, Chapter 3 presented the application of RIA in point to evaluate the impact of Law no.194/2009 using modelling methods to cover all stages defined in the previous chapter. Chapter 4 follows the same idea in Chapter 3. RIA is applied in the Brazilian WSS exploring each study case and providing a working model to measure the current impact of regulators' intervention as the case of ADASA, and ex-ante impact analysis as the case of ARSAE-MG and ARSESP. Finally, Chapter 5 provides the link between RIA and governance and uses the outcomes of such review to evaluate the presence of governance among Brazilian subnational regulators. Indeed, the discussion around MRIA is provided in the last Subchapter.

The paper of Chapter 2 presents a state of art review combined with the proposed model of RIA worldwide. As it is argued in that chapter, the implementation of RIA remains a challenge and the academic production on this matter is still concentrated – public administration, political science, law, and economics correspond to approximately 76% of the total of documents surveyed. The conceptual and framework model proposed demonstrates how the RIA process is related to some principles of governance, i.e., *open government*. Nowadays, the profile of RIA can only increase as a concern when communities and government recognize the importance of a true anticipatory and prescriptive mechanism based on evidence in their decision-making process. In short, RIA arrives as a policy tool that can improve governance (as suggested in the title of the thesis), even though it has limits in terms of practical implementation and adoption in recession crises. In this respect, RIA should serve as a barrier, especially in the corrupted environment, as a hypothesis to explain the gap between RIA's legal requirements and its practice.

Two papers address the RIA's model in PWS. RIA's comprehensive application (first part) presented in Subchapter 3.1 suggests that in PPP arrangements, which have been noteworthy worldwide, the proposed approach enables the capture of stakeholders' real perception in order to design or review laws or regulation in a more effective way. Therefore, despite not being perfect for benchmarking units nor as complex as local governments, the analyses carried out in Subchapter 3.1 led to a type of qualitative technique that, if properly applied, may contribute to improving the efficiency of the quantitative techniques, e.g., MCDA modeling methods in RIA, by allowing them access to a new type of information, which is relevant for understanding and modeling the problem studied. This type of approach could be used to develop the discussions around the first stage of RIA in support to the ERSAR.

TOPSIS technique used to evaluate the impact of Law no. 194/2009 (Subchapter 3.2) provides a suitable way to understand the global evolution of concessionaires surveyed and also the performance of them in each proposed objective. Although this exercise of RIA was done by consultation with some devising technique, the outcomes expected may not reflect the accurate impact of the mentioned law, as discussed before. Finally, at the end of RIA's application, the related outcomes of a such analysis were discussed with ERSAR in the ongoing review the referred law.

Chapter 4 is composed of three papers that address RIA's implementation in different cases in Brazil regarding the WSS.

Subchapter 4.1 addresses the RIA model as a noticeable policy tool whose multi-methodological approach contributed to an inclusive learning process that promoted the legitimacy of the output of Resolution no.08/2016. Therefore, this ex-tempore analysis allowed to critically assess the new targets proposed by mentioned resolution. Researchers are aware that this academic exercise greatly depends on assumptions, and when ranking policy options, projections must be carefully used and treated accordingly. It enables decisions that are more reliable when the decision makers face a complex problem and when society and in a such case, CAESB requires more accountability and effectiveness. Finally, the RIA approach included in the environmental regulatory system should serve as a start point to promote discussion and attract public interest for policymakers.

Subchapter 4.2 recognized a practical application of the RIA method in an authentic background. Findings empower ARSAE-MG with a better understanding - based on data evidence - to go beyond current policy decision practices. This RIA exercise creates positive conditions and arguments to improve the discussion about ARSAE-MG regulatory function in terms of wastewater service diffusion. Moreover, it was possible to stimulate ARSAE-MG to invest in building a reliable database to reduce information asymmetry in comparison to other regulated companies.

In fact, both application of RIA are considered as a start point to promote discussion and attract public interest to the RIA framework applied to the WSS.

The importance to commit resources to preparedness efforts seems relevant. One case is the integration of monitoring and forecasting data in vulnerability/resilience and impact assessments (Subchapter 4.3). Those efforts should always be fostered, even if they require an extensive data collection, not necessarily either straightforward or easy, mainly for lower developed regions, as they will pay clear dividends. Naturally, with increasing data, as environmental and cost details, along with accurate consumption patterns, better solutions/plans can be developed. Here, a proposed impact assessment rationale to scarcity related prices change should avoiding random and arbitrary reasoning.

Finally, Chapter 5 makes a contribution to the literature on RIA and governance by advocating the clear link between them.

Subchapter 5.1 combines literature review with experts' consultation and provides a suitable approach, whose main findings were the result of the intersection between the literature review and expert consultation. RIA has a higher probability to become a regulatory driver to *accountability*, *open government*, *regulatory quality* – more – *administrative capacity* and *rule of law* – less – but it is dependent on the administrative culture and the current institutional environment. In fact, the consolidation of RIA related to strengthening of the SD agenda should guarantee social, environmental and economic sustainability in infrastructure, and governments should be responsible to assess impact before implementing regulatory options.

In Subchapter 5.2 CRPs have been carefully described as well as the criteria, before setting a governance assessment and demonstrating how the appropriate stimulus to improve or recommend policies, e.g., if RIA improve CRP, "how does it impact (improve or not) the governance level?". In fact, the main findings here is that how governance is heterogeneous and that it is linked to the providers' capacity and importance. In addition, governance can be highly demanding for regulators, although it does not directly reflect on provided service performance.

Finally, in the context of the Brazilian post regulatory State (Subchapter 5.3), the proposed MRIA rules have merits. They form a body of collective choice rules that create a framework for institutional change in the production of operational rules that will shape the regulatory arena. In that sense, RIA serves a higher purpose. It is not a mere managerial technique, it is both framework and a tool to improve regulatory function.

6.2 POLICY IMPLICATIONS

Whenever a proposal is developed and tested, mistakes, misjudgments and malpractices are also likely to occur. It happened in the PWS case, for instance, when trying to implement RIA considering only the Law no.194/2009. Here, some worries along the process were found: (i) the comprehension of the RIA framework along all stages, (ii) available data, (iii) stakeholders' involvement and (iv) the gap of decision-making culture into regulator environment. Another sensitivity point in the PWS is about 'risk sharing'. Such involvement into the RIA process highlights the needs to internalized or create measures regarding this aspect to improve the ongoing contracts and the new possibilities. In fact, failures in any of these areas can result in an ongoing PPP not meeting customer, municipality and concessionaire expectations. Finnaly, although this process should contributed to improvements of the PWS based on the evidence presented, its future review or new proposal needs to be deeper and more structured, if possible, by the RIA ex-ante approach.

In the first case of testing RIA in Brazil, Subchapter 4.1, the need to take into account more policy options and also different preferences in order to provide more efficient governmental action was clear. Here, RIA represents a clear frame to support legitimate the proposed targets in a long-term perspective.

Regarding the test of the proposed RIA framework in WWS (Subchapter 4.2), it creates positive conditions and arguments to improve the discussion about ARSAE-MG regulatory function in terms of wastewater services diffusion. Also, the institution should support local governments to enforce connection laws in regions where infrastructure is available. Although the limited power of such regulator, this exercise serves as a start point not only to improve the quality of local government, but also to guarantee the fundamental position of the regulator, since the RIA approach intermediates interests of the provider, the customers and the local government, without interference of other independent government powers, for example, the Public Ministry.

In terms of policy implications in a wider perspective, the case of SPMA (Subchapter 4.3) shows that including the utility and sector regulators, resource management (or environment), and customer related institutions is critical for a more participatory process. Here, the use of RIA shows that the proposed frame for suitable prices open the discussion regarding media relations, increase customer acceptance – possibly reducing complaints, and control private water tank prices as well as non-utility water intakes (usually in industry and irrigation sectors) based on evidence establishing effective and rational enforcement mechanisms and compliance along the process in which the ARSESP's intervention was not properly applied.

Although Chapter 5 corresponds to a literature review combined with modeling method and institutional setting, its main implication was that RIA serves as a vehicle to overcome certain institutional agency rulemaking deficiencies.

In a wider view, Subchapter 5.1 implied that the consolidation of RIA relates to the strengthening of the sustainable development agenda, and it should guarantee social, environmental and economic sustainability in infrastructure. Public officials should be responsible to assess related impact before implementing regulatory actions.

Concerning governance presence, the assumption that RIA improves governance and vice-versa is essential for enhancing the regulatory function. This assumption provides information for a discussion regarding the shift among categories based on the lack of identified CRPs as discussed in Subchapter 5.2.

Establishing RIA through legal acts (Subchapter 5.3), such as laws, decrees, and resolutions may improve the aggregate performance of the surveyed regulators. In respect of it, the use of regulatory and policy tools (such as RIA) to improve regulatory function is relatively recent in Brazil; societal participation remains generally weak; and government seems to lack a comprehensive approach to regulatory management leading agencies to implement regulation without a clear framework or orientation. Moreover, the lack of clear statutory law about agency rulemaking and the controversy on the nature of agency rulemaking power makes RIA rules an important mechanism to secure regulatory quality and open government in the Brazilian regulatory governance system. Finally, given the scope of RIA rules to high-level regulation, the adoption of mandatory RIA rules in Brazil may impact positively the administrative capacity of federal agencies, and influence subnational regulatory agencies to follow the model, which may allow better administrative oversight and social control, mitigating the perception of illegitimacy in agency rulemaking.

Along with the theoretical, technical and viability studies including RIA's applicability, regulators or governments ought to:

- create a legal precedent to estimulate the adoptions of RIA's fully or step by step;
- develop a culture of RIA;
- create conditions to implement RIA, investing in capacity, infrastructure and human resource.

After these basical requirements, regulators and governments ought to:

- design a logical and transparent database of stakeholders according to the particularity of the intervention;
- develop new support data that could represent the perspective of all stakeholders involved in a specific intervention in a balanced way;
- describe, design and implement clear rules adapted to the reality of each regulator in order to implement RIA, either in full or partially until it matures enough to be dealt with;
- develop a robust set of evaluation criteria to select regulations that should be submitted in the RIA process (ex-ante, extempore or ex-post);
- organize a compendium of all relevant laws, regulations, and standards that could be checked using an evidence-based policy tool; and
- organize and develop a database to support all relevant intervention (ex-ante, ex-tempore or ex-post).

It is expected that the application of RIA model – which operationalizes and measures the quality of new, ongoing or past interventions – to all regulators may have major theoretical and policy implications. Nevertheless, the results obtained for Portugal and Brazil already suggest that there should be plenty of room for improvement in both countries concerning decision-making quality and also related to the governance.

6.3 FUTURE RESEARCH

The four core concerns of the thesis left unanswered questions that still deserve careful consideration. With regard to the first aspect, more research on RIA implementation used methods – consultation, monocriterial and multicriteria – would be welcomed (e.g. indicators and thresholds). Evidently, this would require that the author(s) investigate theory on operational research and identify complementary methods, which may support the whole RIA process, taking into account positive and negative aspects. Moreover, the following topics would also be interesting for research: (i) studies focused on the quali-quantitative applicability of the RIA in utilities worldwide, (ii) studies focused on the RIA with interface between regulation of natural resources and services management as discussed in Subchapter 4.3, (iii) studies focused on the excessive regulation "red tape" (iv) empirical studies regarding RIA and governance (quantitative) as discussed in Subchapter 5.1.

There is a knowledge gap in terms of underlying bias into the RIA process that requires studies focused on investigating potential and complementary bias, and also (de)biasing techniques that influence the decision process. Moreover, to deal with prospective information and uncertainties into the RIA analysis, it should be interesting to investigate how it can support RIA in additional analysis, dealing with uncertainties.

The dataset used to assess any intervention (ex-ante, ex-tempore or ex-post) by governments/regulators should continue to be enriched and updated (as recommended before). The effects of other variables in a context analysis should also be tested in future studies. In addition, the framework suggested and used in Chapters 3 and 4 for interventions could be further developed (e.g. by collecting input from audit institutions, civil society organizations and the local governments themselves) and applied to a set of regulations.

Evidently, a major follow-up of this thesis is the application of the RIA model to the PWS and Brazilian WSS and its relationship with governance. The usefulness of this research would be twofold. On the one hand, it would enable investigators and policy-makers to address several research questions with obvious academic interest, for example: "Are regulators or other government institutions prepared to implement RIA?", "Are governance practices consistently associated with the RIA process?".

On the other hand, the application of this model to a set of regulators would enable researchers and key stakeholders to address some questions with practical relevance, namely: "Does the implementation of RIA justify its transaction costs?"; "Should the results attained be in any way linked to policy instruments?"; "How can the RIA establish itself as a powerful tool for citizens?". Finally, after the RIA is applied, the regulator could be asked to consider the necessity of slightly adjusting the current MCDA model to better fit the users' needs (e.g. regarding the descriptors, scoring functions, reference levels of the criteria, and/or weighting coefficients). At the end, investigating potential motivations that can stimulate the adoption of RIA into institutions' culture complements all those future researchers on such matter.

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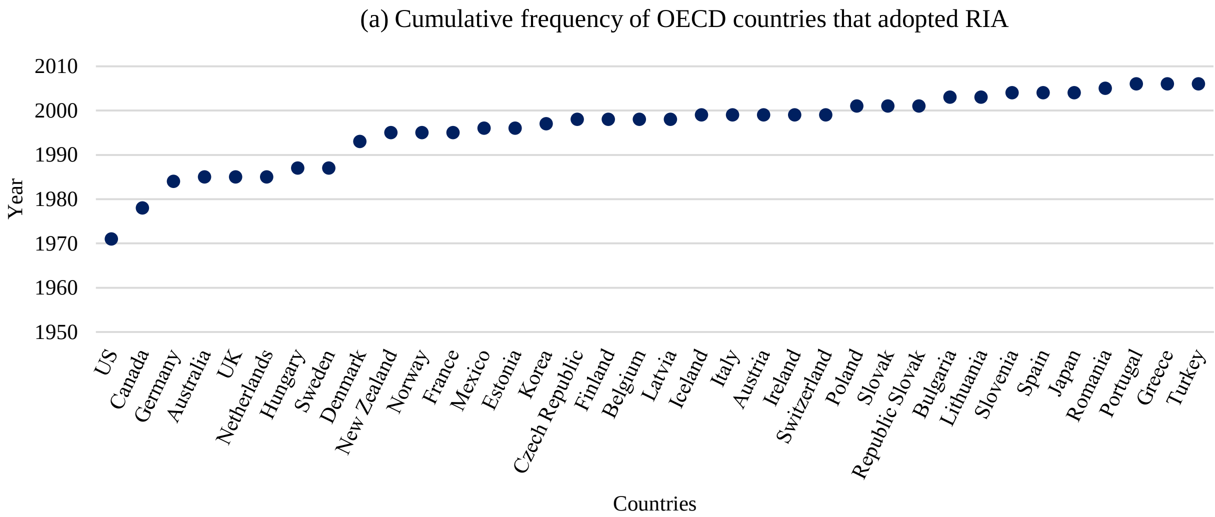
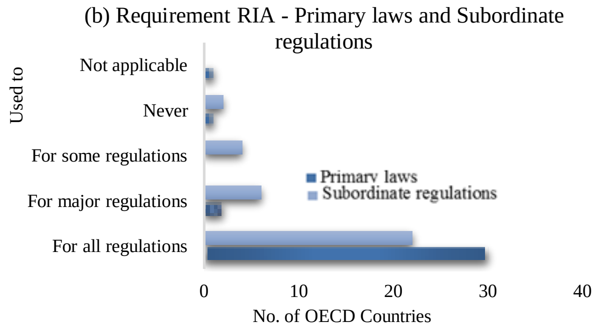
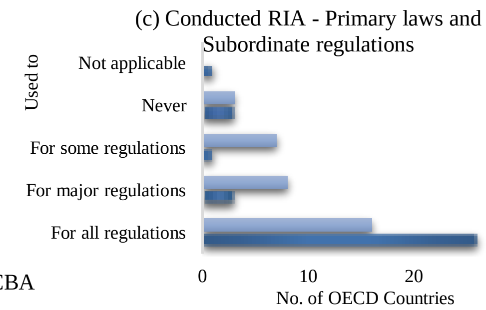
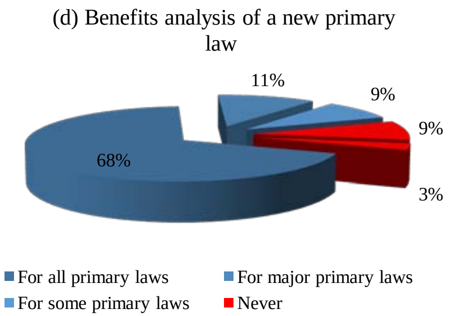
APPENDICES

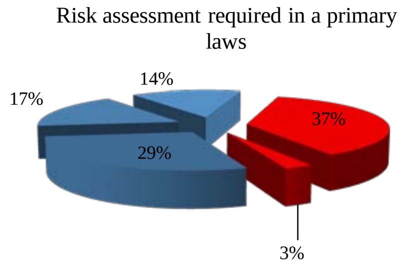
APPENDIX I – RIA: THE STATE OF THE ART[24]

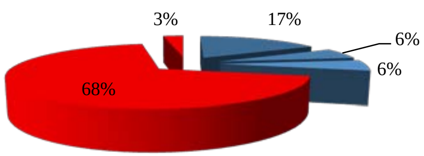












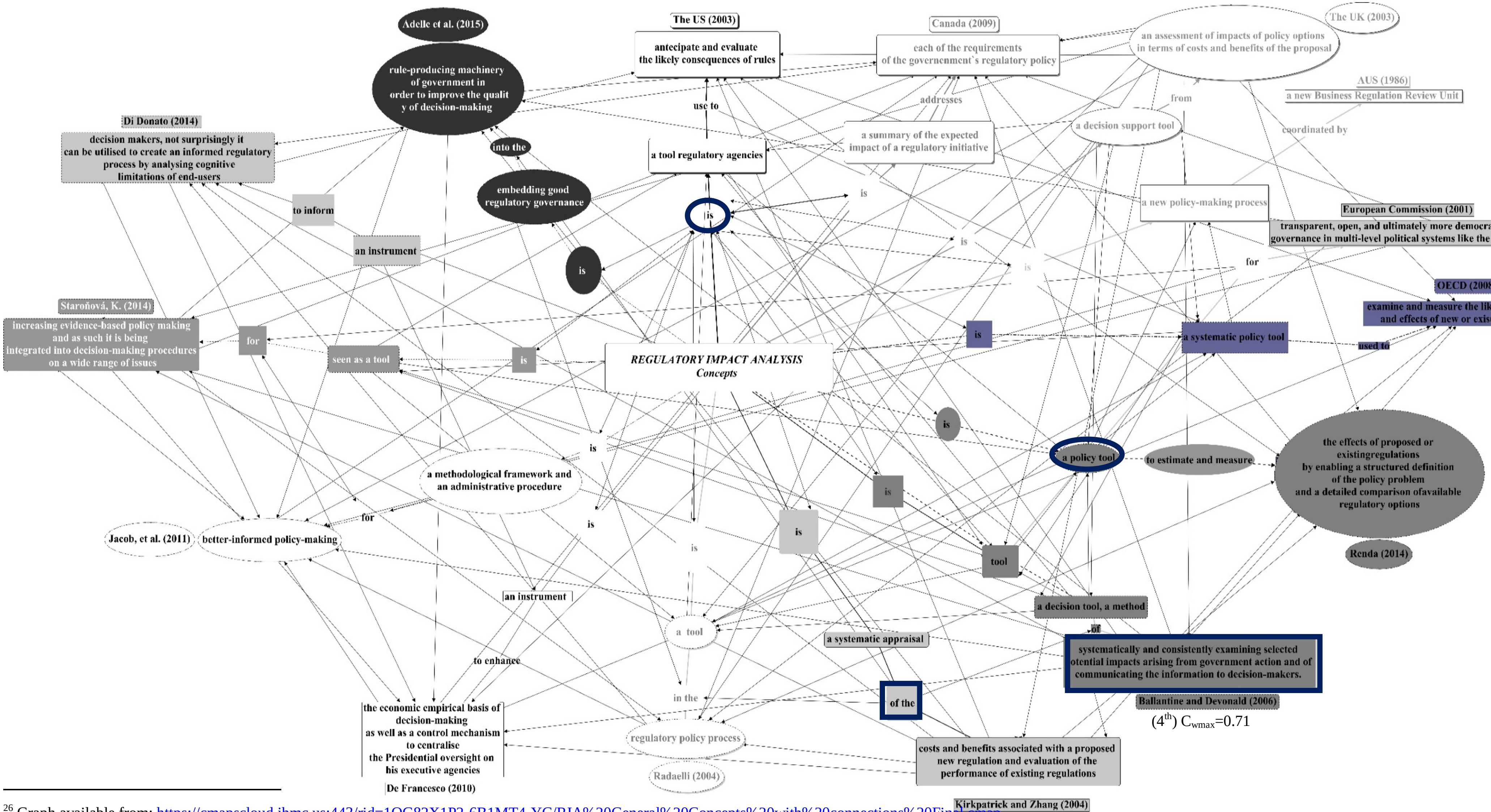
[24] Source:(OECD 2012; OECD 2015)

APPENDIX II – IA CONNECTIONS

IA connections[25]	Time perspective	Sponsor institution	Predominant area of applicability	Voluntary (V) or Compulsory (C) adoption
EIA	ex-ante	Private/Public	Environmental	The most case (C)
SIA	ex-ante	Private/Public	Social	C/V
HIA	ex-ante	Private/Public	Social and Economics	C/V V
SEA	ex-ante or ex-post	Public	Environmental	V C/V
LE	ex-ante	Public	Multidisciplinary	
OA	ex-ante or ex-post	Public		C
HRIA	ex-ante	Private/Public		V
CIA	ex-ante	Private/Public		V
PDIA	ex-post	Public		V
CCIA	ex-ante or ex-post	Private/Public		V V
RIA	ex-ante or ex-post	Public		

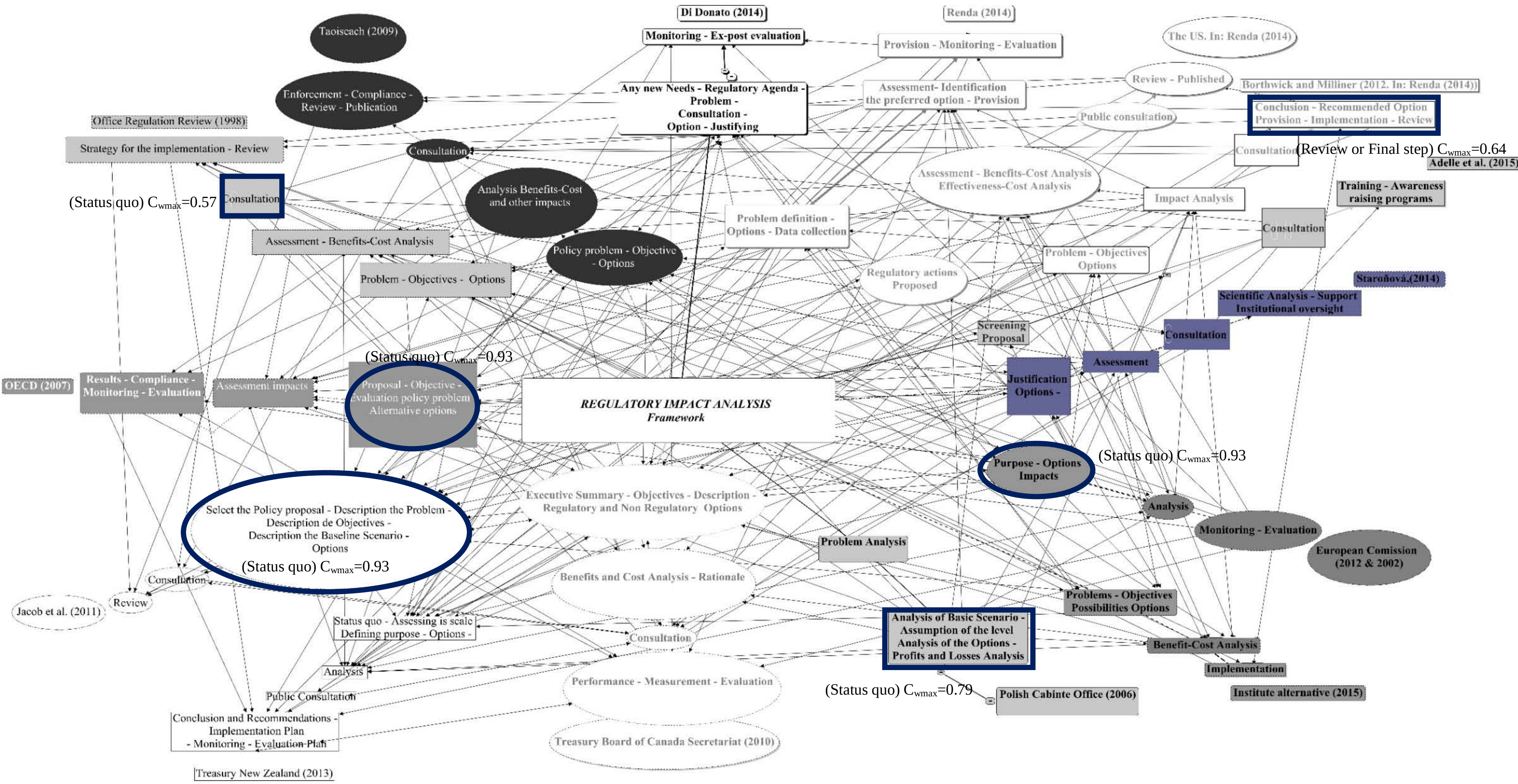
[25] Source: (Taylor et al. 1990; Partidário 2005, Radaelli 2007; OECD 2008; Valente 2010; National Academic of Science 2011; Morgan 2012; Tetlow & Hanusch 2012; Li et al., 2014)

APPENDIX III – CONNECTIONS BETWEEN CM-RIA BASED ON CONCEPTS SELECTED[26]



[26] Graph available from: https://cmapscloud.ihmc.us:443/rid=1QG82X1P2-6B1MT4-YC/RIA%20General%20Concepts%20with%20connections%20Final.cmap

APPENDIX IV – CONNECTIONS BETWEEN FCM-RIA BASED ON CONCEPTS SELECTED[27]



[27] Graph available from: https://cmapscloud.ihmc.us:443/rid=1QG8RNS1F-18K2J80-68Q/RIA%20Framework%20with%20connections%20Final.cmap

APPENDIX V – OBJECTIVES, CRITERIA, DESCRIPTORS, INDICATORS AND SOURCE

Objectives	Ref	Impact in terms of	Criteria	Descriptors	Indicators	Source
Protect the customer interests	O1I1	Accessibility	(C_1) Physical accessibility	Allows you to evaluate the context of objective 1 as regards the possibility of connection to the physical provider's infrastructure.	Accommodation with effective service (no.)/Total no. of accommodation (no.)	(ERSAR, 2011)
	O1I2	Quality	(C_2) Safe water	Allows you to evaluate the context of objective 1 as regards the quality of the water supplied by providers.	Analysis on the quality of water intended for human consumption, among those required by legislation (%) Analysis on the water quality (%) Required water quality analysis (%) Water analysis compliance (%)	(ERSAR, 2011)
	O1I3	Economic	(C_3) Tariffs	Allows you to evaluate the context of objective 1 as regards the relation between the total revenues and the activity level.	Total revenues Activity level	ERSAR, Vol.3
	O1I4		(C_4) Affordability level	Allows you to evaluate the context of objective 1 by the weight of the average household expenditure on water and waste services within the household monthly average disposable income.	Average charge for the water supply service (€/year) Average yield available (€/year)	(ERSAR, 2011)
	O1I5	Feedback	(C_5) Feedback	Allows you to evaluate the context of objective 1 in terms of reply to written suggestions and complaints.	-	(ERSAR, 2011)
Ensure a level playing field and transparency in terms of reports and concession contracts	O2I1	Governance	(C_6) Transparency	Allows you to evaluate the context of objective 2 in respect of equality and transparency by the internet documents available.	Reports available "before and after year of adaptation" (financial and quality) Concession contracts available.	Concessionaires contracts and expert consult
Objectives (Cont.)	**Ref**	**Impact in terms of**	**Criteria**	**Descriptors**	**Indicators**	**Source**

Objectives (Cont.)	Ref	Impact in terms of	Criteria	Descriptors	Indicators	Source
Safeguard the economic-financial sustainability, operational and infrastructural	03I1	Economic	(C_7) Coverage of total costs	Allows you to evaluate the context of objective 3 regarding the company's ability to generate resources to cover the costs arising from the development of its activity.	Income and total earnings (€/year) Total expenses (€/year)	(ERSAR, 2011)
	O3I2	Economic	(C_8) Non-revenue water	Allows you to evaluate the context of objective 3 concerning water-related economic losses, despite being captured, treated, transported, stored, and distributed, not enough to be billed to users.	Water system (m^3/year) Unbilled water (m^3/year)	(ERSAR, 2011)
	O3I3	Economic	(C_9) Equity-to assets ratio	Allows you to assess the context of objective 3 as regards the proportion of total net assets covered by equity.	Equity (€/year) Assets (€/year)	(ERSAR, 2011)
	O3I4	Economic	(C_{10}) Investment per households	Allows you to assess the context of objective 3 as regards the allocation of accumulated investment in relation to accommodation.	Accumulated investment (€/year) lodging with services	Concessionaires contracts and expert consult
	O3I5	Operational and infrastructure	(C_{11}) Adequacy of treatment capacity	Allows you to assess the context of objective 3 regarding existence of adequate capacity of treatment plants.	Utilization of treatment plants (m^3) Underutilization of treatment plants (m^3) Total capacity of treatment plants (m^3)	(ERSAR, 2011)
	O3I6	Operational and infrastructure	(C12) Mains replacement	Allows you to assess the context of objective 3 regarding the existence of a continuing practice of rehabilitation of pipelines to ensure its gradual renovation and an acceptable average age of network.	Average length of pipelines (km) Mains rehabilitated over the last five years (km)	(ERSAR, 2011)
	O3I7	Operational and infrastructure	(C_{13}) Mains failures	Allows you to evaluate the context of Objective 3, as regards the existence of a reduced frequency of defects in pipes.	Malfunctions in conduits (no./year) Total length of pipelines (km)	(ERSAR, 2011)

Safeguard the economic-financial sustainability, operational and infrastructural	O3I8	Operational	(C_{14}) Adequacy of human resources	Allows you to assess the context of objective 3 as regards the existence of an adequate number of employees.	Turnouts (no.) Personal affection to water supply service (no.) Outsourcing personnel affection to water supply service (no.)	(ERSAR, 2011)
	O3I9	Economic	(C_{15}) (Earnings before interests, taxes, depreciation and amortization) *	Allows you to assess the context of objective 3 as regards operation of regulated activities of systems, in particular, influenced by investment financing.	Operating profit (€/year) Amortization of the period (€/year) Provisions for the year (€/year) Adjustments (€/year) Reversals of depreciation and provisions (€/year) Subsidies to investment (€/year)	ERSAR (economic report)
	O3I10	Economic	(C_{16}) Work safety system certification	Allows you to assess the context of objective 3 as regards the OHSAS 18001 Standard, along with certification or similar by Fund Manager.	Is there a certificate? (yes or no)	(ERSAR, 2011)
	O3I11	Economic	(C_{17}) Quality management system certification	Allows to evaluate the context of objective 3 with regard to certification with ISO 9001 or similar by the managing body.	Is there a certificate? (yes or no)	(ERSAR,2011)
	O3I12	Economic	(C_{18}) Risk share	Allows you to assess the context of objective 3 as regards contractual risk matrix between private and public.	Risk in terms of legal aspects and economic aspects "before and after the year of adaptation"	Concessionaires' contracts
Objectives (Cont.)	**Ref**	**Impact in terms of**	**Criteria**	**Descriptors**	**Indicators**	**Source**
Protect the environ ment in terms of conserv	O4I1	Environment and economics	(C_{19}) Real water losses	Allows you to evaluate the context of objective 4 as regards real losses (leakage), while scarce commodity that requires a rational management.	Losses (m^3/year) No. of water connection extensions (no.)	(ERSAR, 2011)

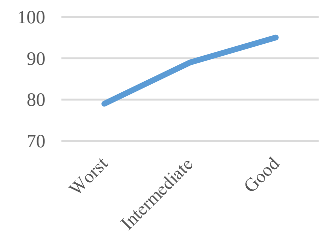
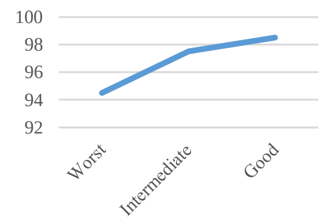
	O4I2	Legal accomplishment	(C_{20}) Fulfilment of the water intake licensing	Allows you to evaluate the context of objective 4 regarding the adequate protection of water catchment, while scarce commodity that requires a rational management.	Water collected in licensed borrowings (m^3/year) Water abstracted (m^3/year)	(ERSAR, 2011)
	O4I3	Energy	(C_{21}) Standardized energy consumption	Allows you to evaluate the context of objective 4 concerning the adequate use of energy resources, while scarce commodity that requires a rational management.	For pumping energy consumption (kWh/year) Uniformity factor (m^3/year x 100 m)	(ERSAR, 2011)
	O4I4	Conservation	(C_{22}) Sludge disposal	Allows you to evaluate the context of objective 4 concerning the final destination of the resulting water treatment sludge, while potential sources of contamination of natural resources.	Sludge with appropriate destination/Sludge stored initials (t/year) Sludge produced in the system (t/year) Sludge from other systems (t/year) Sludge stored (t/year)	(ERSAR, 2011)
	O4I5	Conservation	(C_{23}) Annual water consumption per capita or per accommodation	Allows you to evaluate the context of objective 4 concerning water consumption for accommodation, while scarce commodity that requires a rational use.	Consumption (m^3/year) Resident population (answered) (inhabitants)	(ERSAR, 2011)
	O4I6	Environmental	(C_{24}) Environmental management system certification	Allows you to evaluate the context of objective 4 in the case where the water supply activity is certified with ISO 14001 or similar.	Is there a certificate? (yes or no)	(ERSAR, 2011)

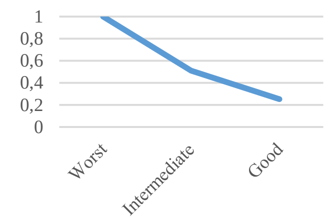
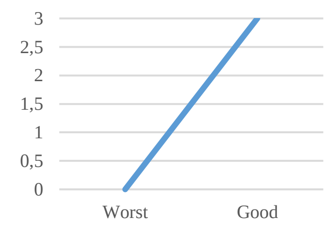
APPENDIX VI – DETAILS REGARDING THE 1ST STAGE OF DELPHI TECHNIQUE

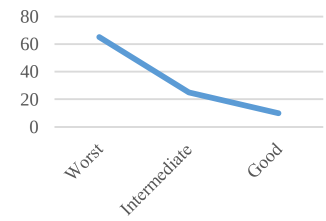
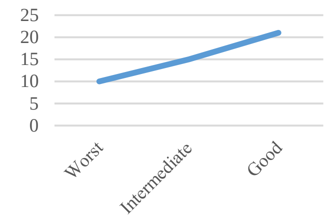
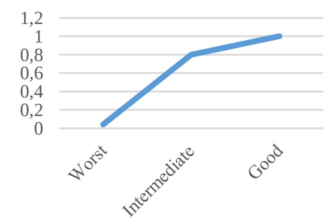
Design	Panelists (no.)	Questions (no.)	Pre-test (days)	1st/2nd and 3rd round (days)	Aim	Measure of consensus		Selection of impacts
						Rounds (no.)	IQR*	
Modified Delphi	48	40	5	40/20/5	To check the degree of importance between each pre-selected impact/descriptor and the main objectives from Law no. 194/2009	Research indicated that three iterations are typically sufficient to identify points of consensus	IQR of 1.5 or less is found to be a suitable consensus indicator for 5-unit scales	Mode and median ≥ 3.00 and average ≥ (average/ each objective)

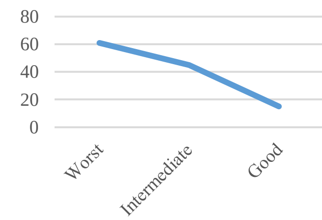
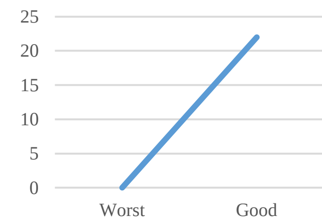
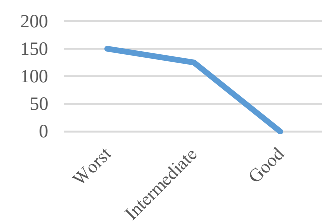
*IQR = Interquartile range

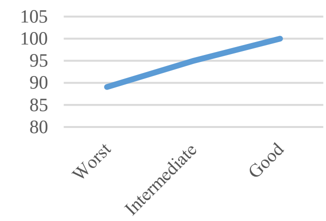
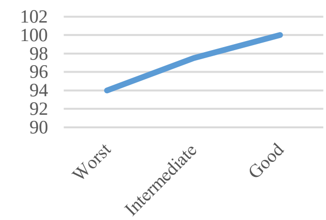
APPENDIX VII – CRITERIA, SCALE AND VALUE FUNCTION

Criteria	Scale	Value Function
Physical accessibility	69–100 Worst–Good	
Safe water	94.50–100 Worst–Good	

Criteria (Cont.)	Scale	Value Function
Affordability level	0.25–1.00 Good–Worst	
Governance	0.00–3.00 Worst–Good	
Coverage of total costs	0–1.05 Worst–Good	

Criteria (Cont.)	**Scale**	**Value Function**
Non-revenue water	10–65 Good–Worst	
Financial autonomy	10–21 Worst–Good	
Mains rehabilitation	0.04–1.00 Worst–Good	

Criteria (Cont.)	**Scale**	**Value Function**
Mains failures	15–61 Good–Worst	
Risk sharing	0–22 Worst–Good	
Real water losses	0–150 Good–Worst	

Criteria (Cont.)	Scale	Value Function
Fulfilment of the water intake licensing	89–100 Worst–Good	
Sludge disposal	94–100 Worst–Good	

APPENDIX VIII – DETAILS REGARDING THE 2ND STAGE OF THE DELPHI TECHNIQUE

Design	Type	Panelist (no.)	Questions (no.)	Pre-test (days)	1st/2nd and 3rd round (days)	Type of question	Aim	Measure of consensus Rounds (no.)
Argument Delphi	Swing-weights Different perspective: customers, municipalities and concessionaires Panelists should represent the research issue from different perspectives	15 (6) [5] {4}	15	5	10/10/5	If there is an alternative that had the worst score for all impacts analyzed; given the opportunity to only replace the evaluation of the dimensions of the worst value for the best among the alternatives, in which dimension/impact you improve?	To develop relevant arguments and expose underlying reasons for different opinions on a specific single issue	Research indicated that three iterations are typically sufficient to identify points of consensus

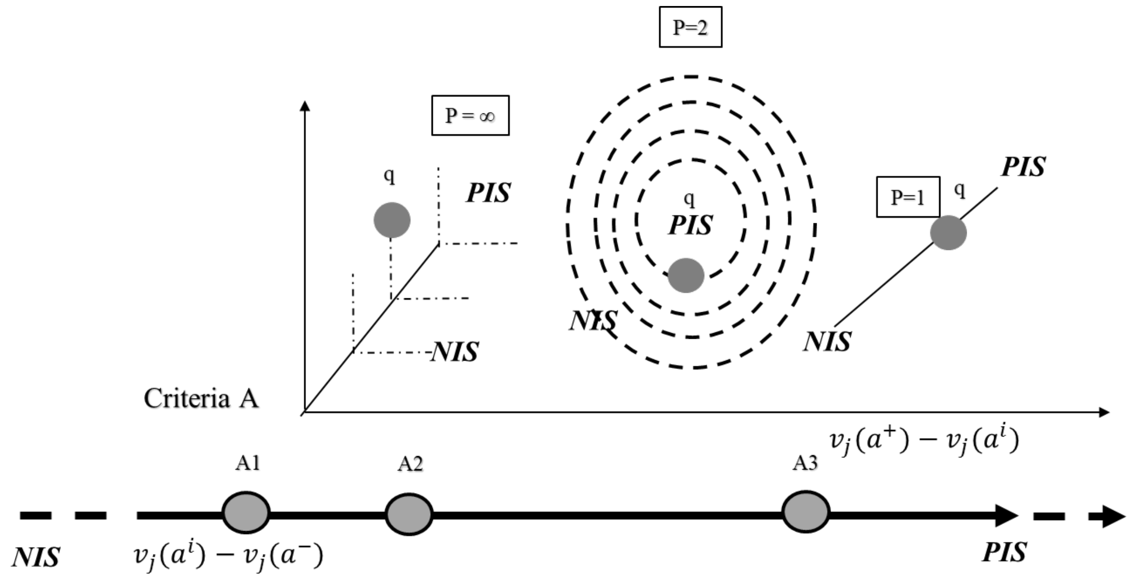
APPENDIX IX – OBJECTIVES, CRITERIA AND SOURCE

Objectives	Ref C_i	Criteria
Protect the customer's interest	$\mathbf{C_1}$	**Physical accessibility**
	$\mathbf{C_2}$	**Safe water**
	C_3	Tariffs
	$\mathbf{C_4}$	**Affordability level**
	C_5	Reply to written suggestions and complaints
Ensure the governance by transparency dimension	C_6	**Transparency**
Promote the economic-financial, operational and infrastructural sustainability	C_7	**Coverage of total costs**
	C_8	**Non-revenue water**
	C_9	**Equity-to-assets ratio**
	C_{10}	Investment per households
	C_{11}	Adequacy of treatment capacity
	C_{12}	**Mains replacement**
	C_{13}	**Mains failures**
	C_{14}	Adequacy of human resources
	C_{15}	Environmental (Earnings before interests, taxes, depreciation and amortization) *
	C_{16}	Work safety system certification
	C_{17}	Quality management system certification
	C_{18}	**Risk share**
Protect the environment based on natural resources conservation actions	C_{19}	**Real water losses**
	C_{20}	**Fulfilment of the water intake licensing**
	C_{21}	Standardized energy consumption
	C_{22}	**Sludge disposal**
	C_{23}	Annual water consumption per capita or per accommodation
	C_{24}	Environmental management system certification

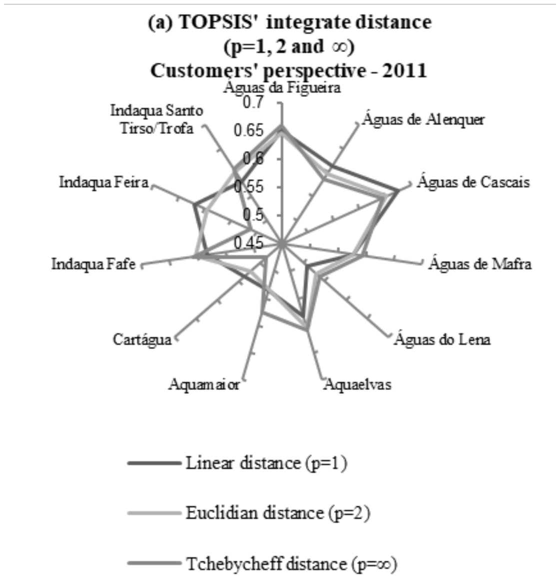
References

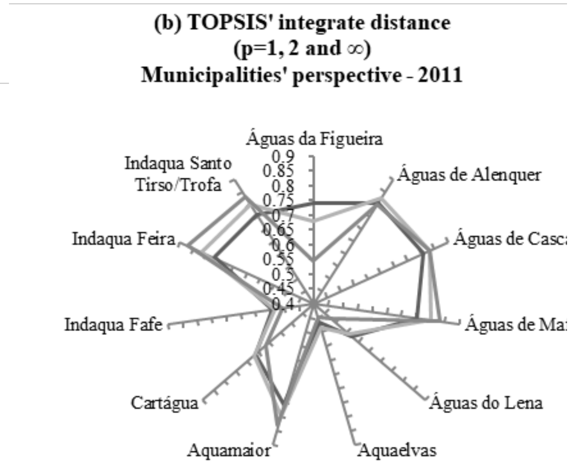
ERSAR (2011). Guia de Avaliação da qualidade dos serviços se Águas e Resíduos prestados aos utilizadores (Guideline to Evaluate the Quality of Water Services Provided to Customers). Manual of performance indicators, Lisbon.

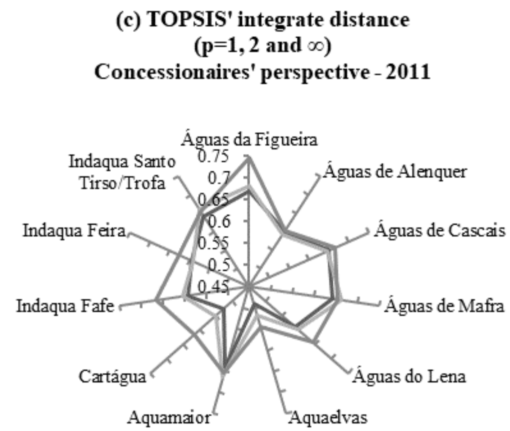
APPENDIX X – TOPSIS COMMON INTEGRATE DISTANCES



APPENDIX XI – TOPSIS' DISTANCE ACCORDING TO THE DIFFERENT PERSPECTIVES: (A) CUSTOMERS, (B) MUNICIPALITIES AND (C) CONCESSIONAIRES







APPENDIX XII – EFFECT’S LEVEL OF “DO NOTHING” SCENARIO VERSUS LAW No.194/2009

Concessionaires	**Level of effect**			
	Adaptation year	**Customer’s perspective**	**Municipalities’ perspective**	**Concessionaires’ perspective**
AdF	2012	☺	☺	<u>☺</u>
AdA	2011	<u>☹</u>	<u>☺</u>	☺
AdC	2012	<u>☹</u>	<u>☹</u>	<u>☹</u>
AdL	2010	☺☺	☺☺	☺☺
Aquaelvas	2012	☺	☺	☹
Aquamaior	2011	☺	☺	☺
Cartágua	2012	<u>☺</u>	☺	☹
Indaqua Fafe	2010	☺☺	☺☺	☺☺
Indaqua Sto. Tirso/Trofa	2011	☺	☺	☺
Indaqua Feira	2010	☺	☺	<u>☺</u>
Águas de Mafra	2012	☹	<u>😐</u>	☹

Legend:

Very good☺☺, Good☺, Neutral😐, Poor☹

1<☺≤20%; ☺☺>20%; -10%≤☹<0; -20%<☹☹<-10%

Disparity between Law no. 194/2009 and “do nothing scenario” <u>☺</u> (+) and <u>☹</u> (-)

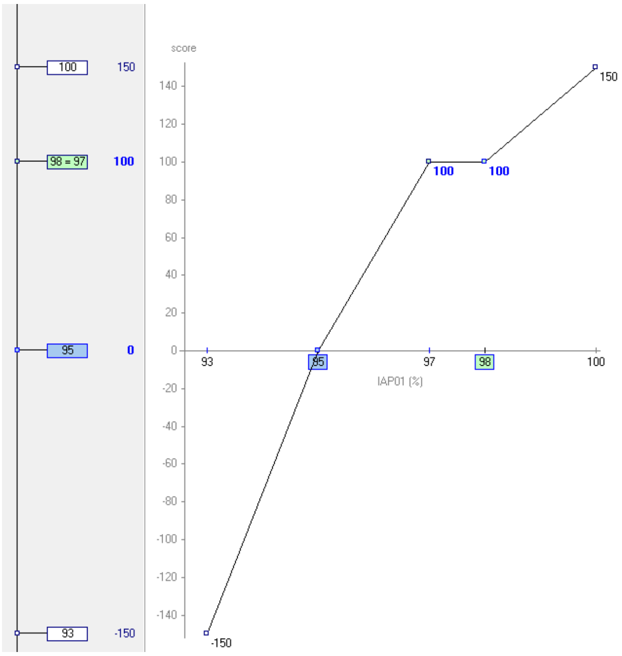
APPENDIX XIII – DIMENSIONS AND CRITERIA

- (Re)thinking Brasilia's Water Services "New Targets" using RIA TOOL
  - Service provider (customers' interest)
    - **Physical accessibility (PA)**
    - **Affordability level (AL)**
    - **Continuity of service (CS)**
    - **Quality of supplied water (QSW)**
    - **Complaints about WWW services (CWWWS)**
  - Infrastructural sustainability
    - **Adequacy of treatment capacity (ATC)**
  - Environmental sustainability
    - **Standardised energy consumption (SEC)**
    - **Water losses in the distribution system (WLDS)**
    - **Fulfilment of the water intake licensing (FWIL)**
    - **Sludge disposal (SL)**

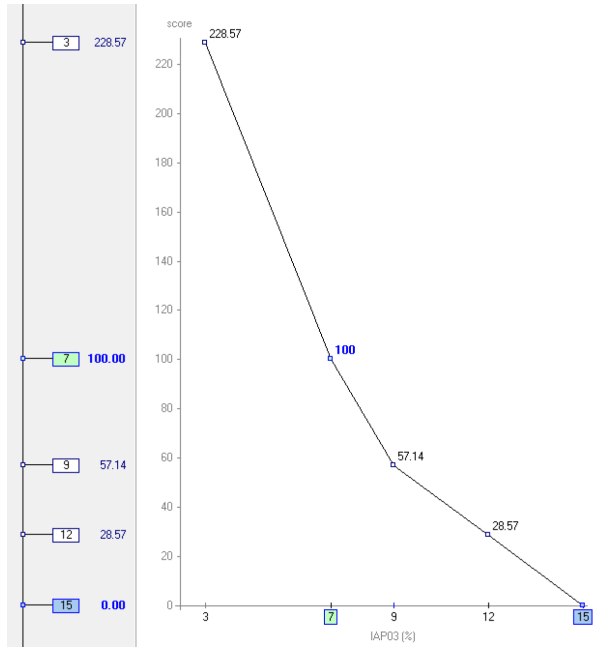
APPENDIX XIV – PERFORMANCE PROFILES FOR ALL OPTIONS

Options	PA	AL	CS	QSW	CWWWS	ATC	SEC	WLDS	FWIL	SL
NPC 2018	97.2	4.46	95.1	0.94	0.36	86.9	0.35	34.7	84	100
NPC 2020	96.7	4.37	94.5	0.69	0.26	88.8	0.34	35.7	86.6	100
ST	95	7.5	90	2	3	55	0.6	24.3	50	75
LT	99	5	99.9	1	1	65	0.4	23.3	100	100

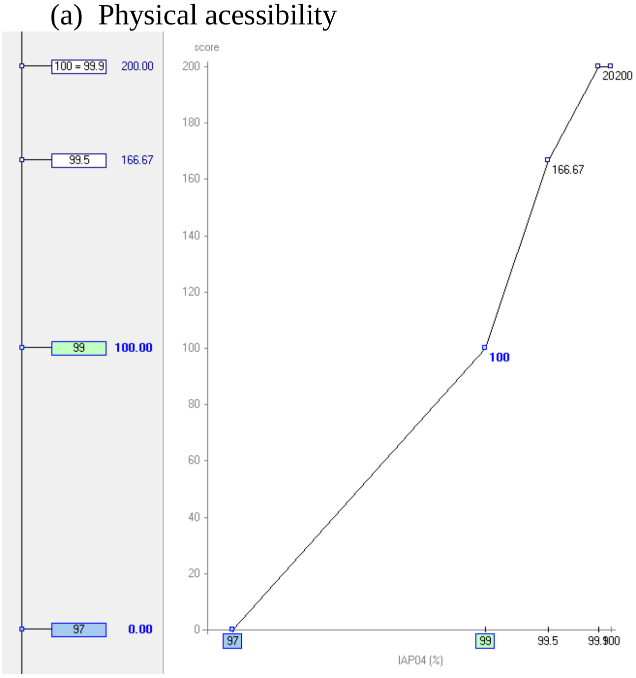
APPENDIX XV – VALUE FUNCTION OF EACH CRITERION (CUSTOMERS' PERSPECTIVE)



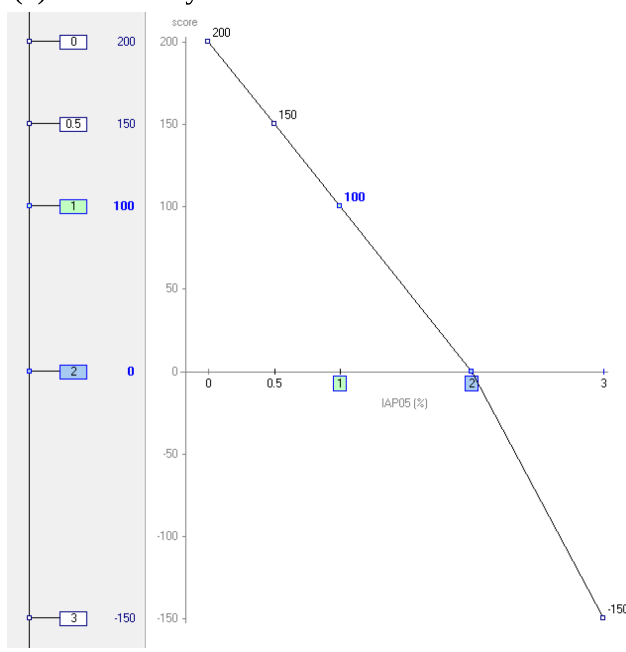
(a) Physical acessibility



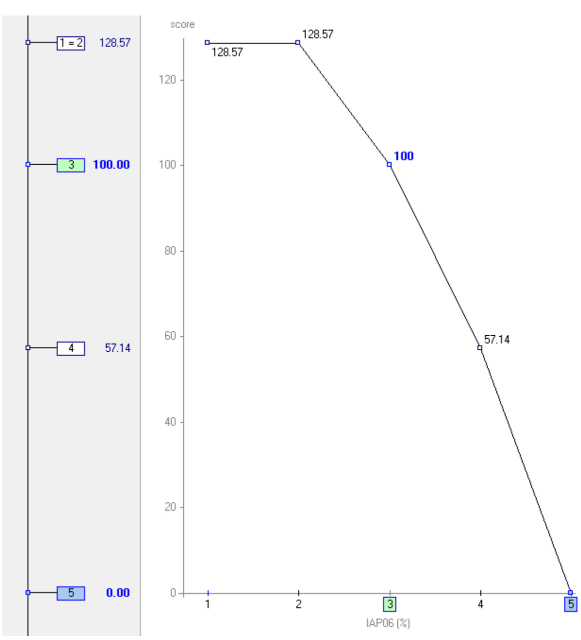
(b) Afordability level



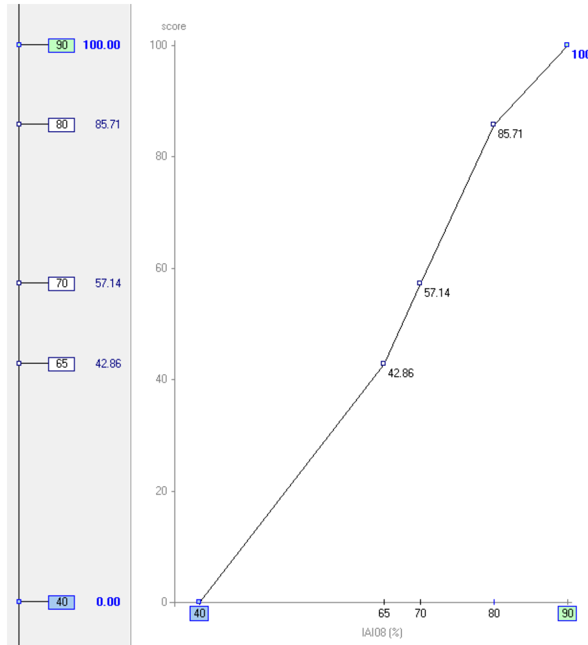
(c) Continuity of service



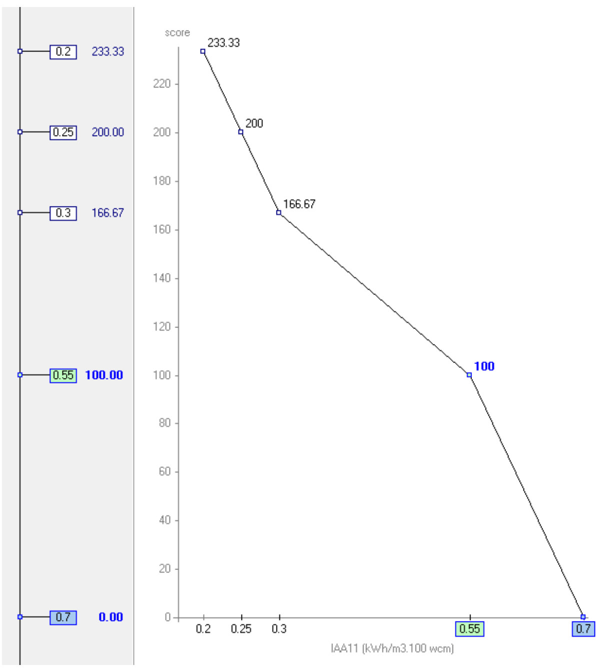
(d) Quality of supply water



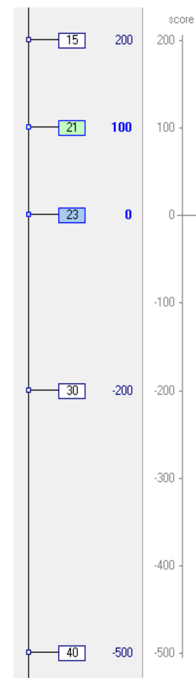
(e) Complaints about WWW services



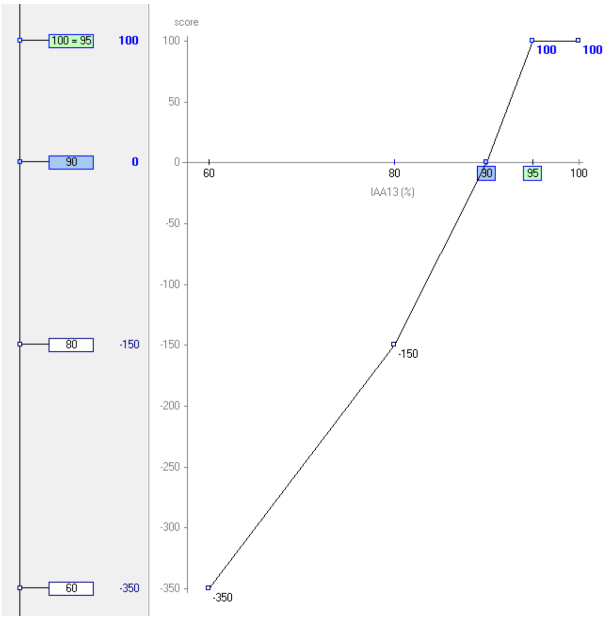
(f) Adequacy of treatment capacity



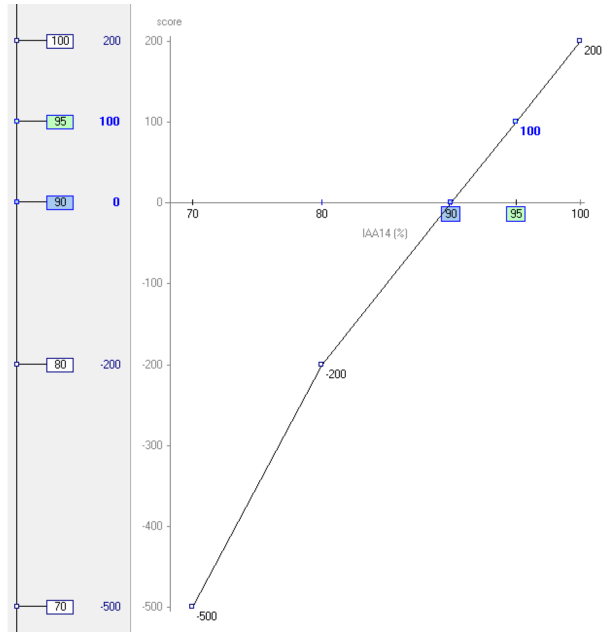
(g) Standardised energy consumption



(h) Water losses in the distribution system

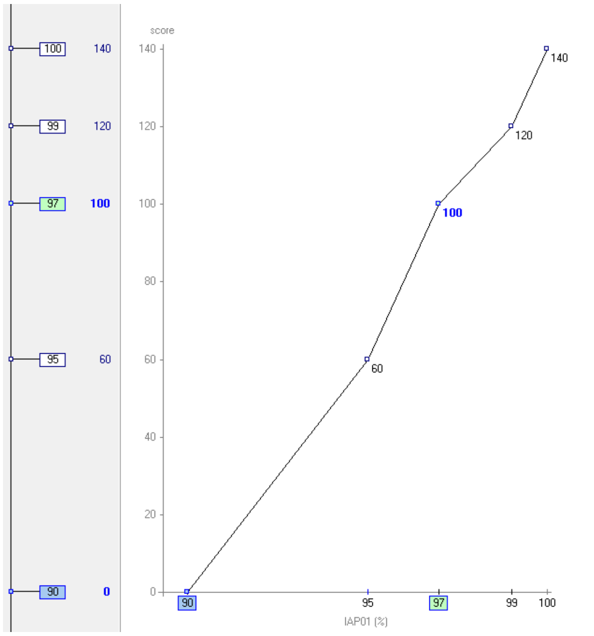


(i) Fulfilment of the water intake licensing

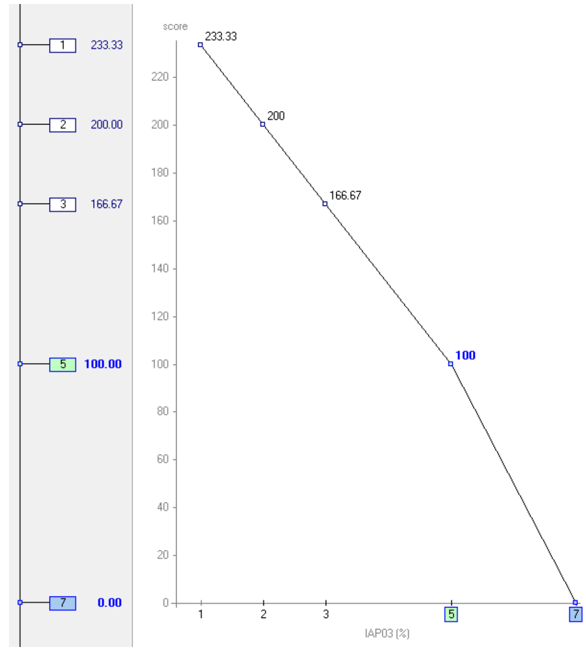


(j) Sludge disposal

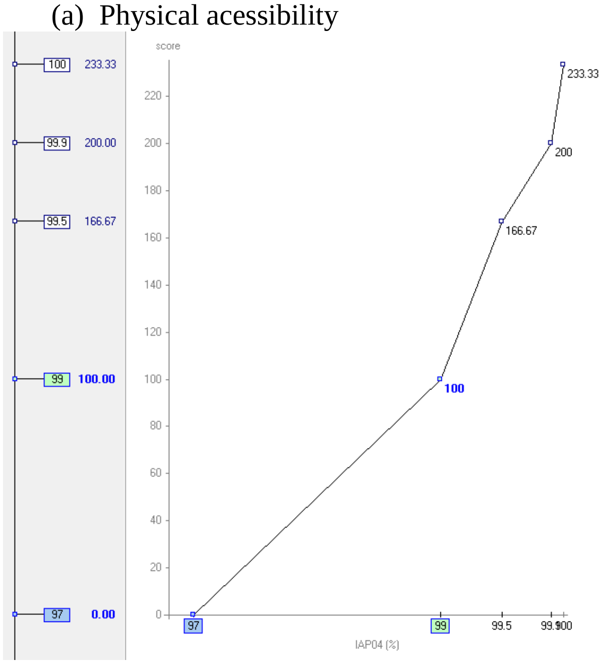
APPENDIX XVI – VALUE FUNCTION OF EACH CRITERION (REGULATORS' PERSPECTIVE)



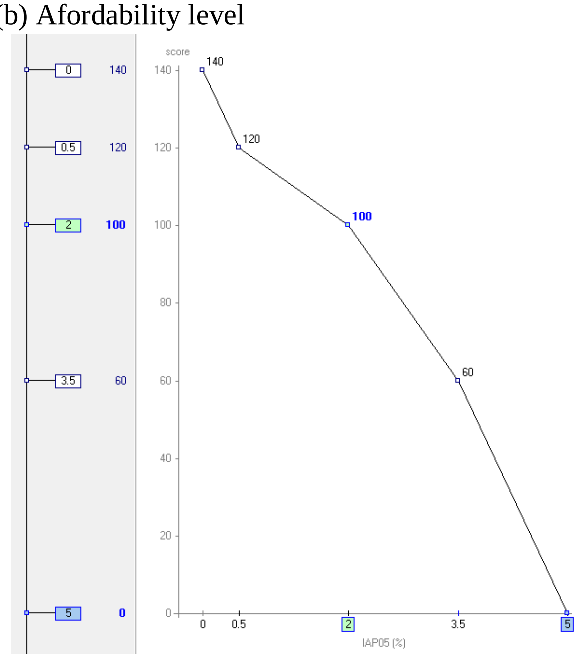
(a) Physical acessibility



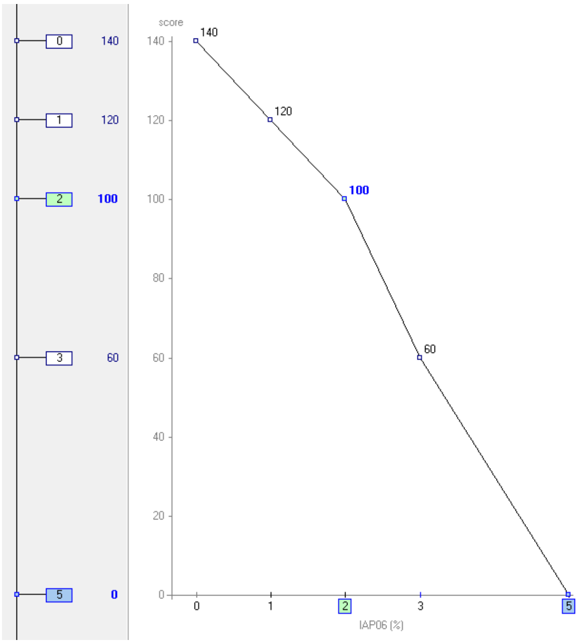
(b) Afordability level



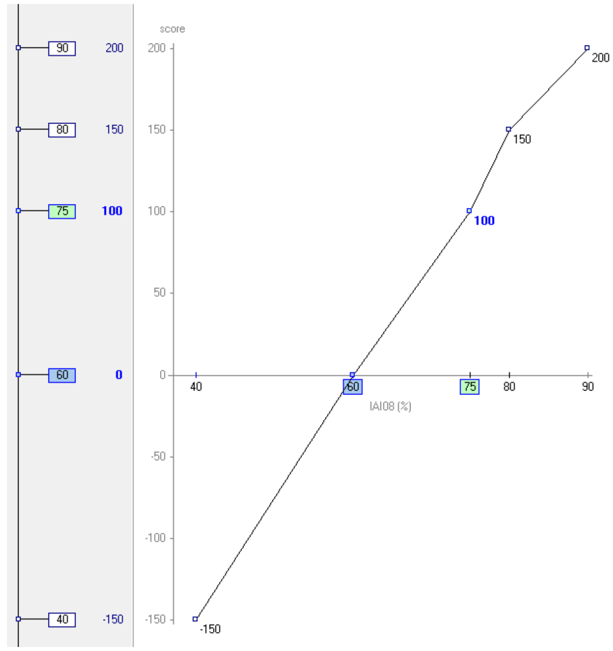
(c) Continuity of service



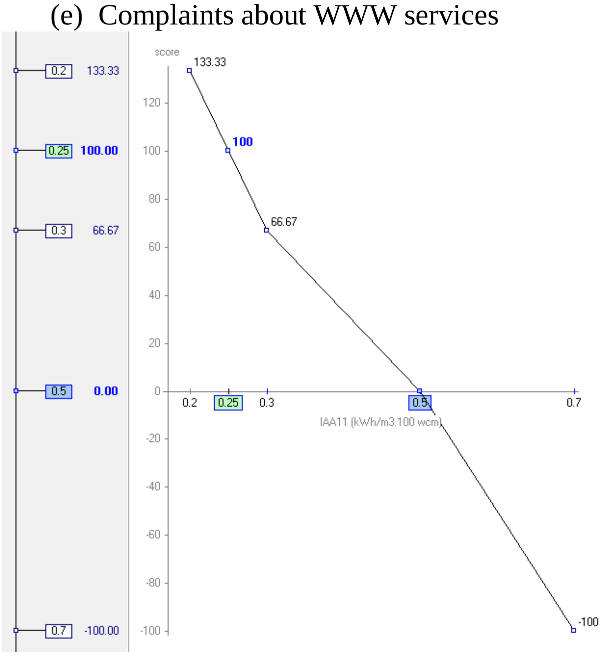
(d) Quality of supply water



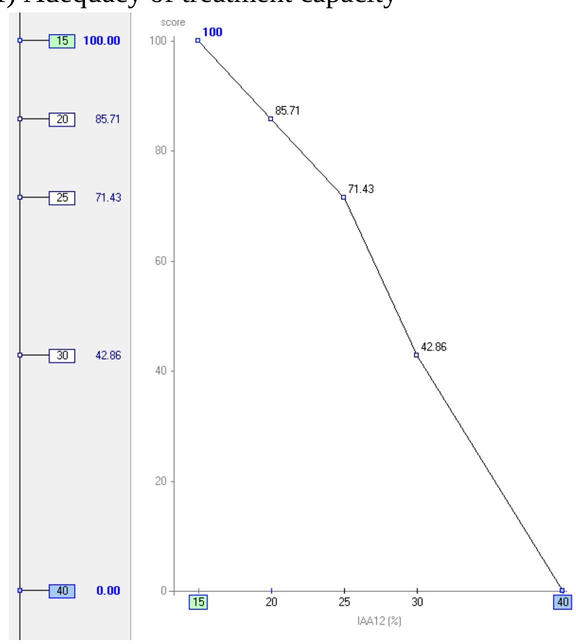
(e) Complaints about WWW services



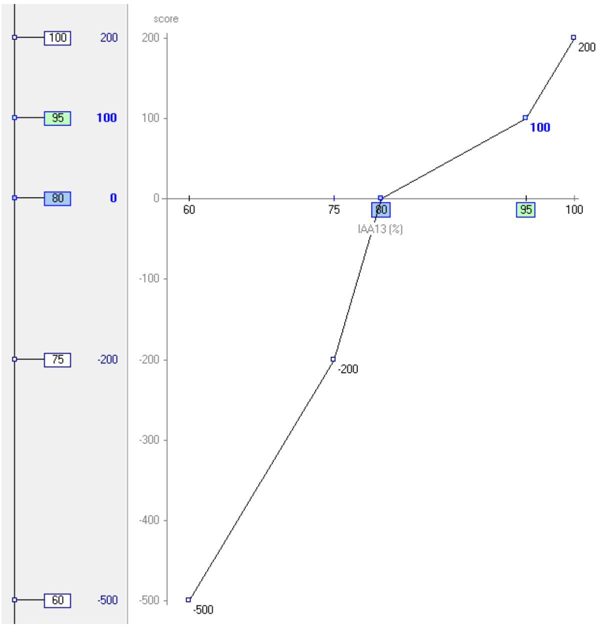
(f) Adequacy of treatment capacity



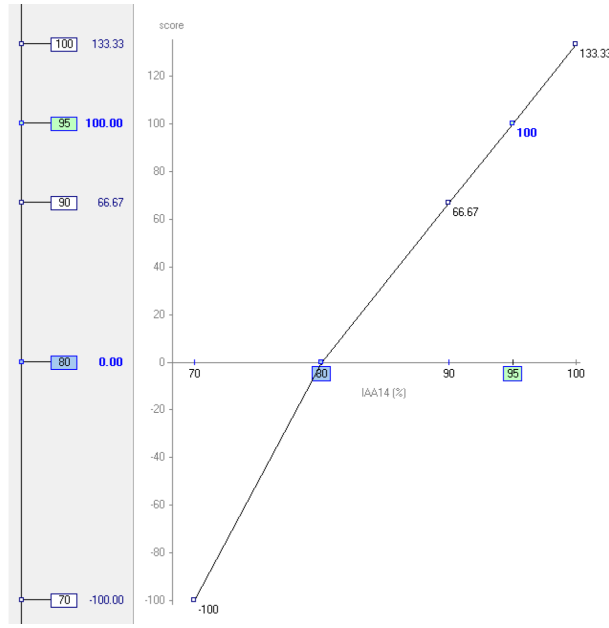
(g) Standardised energy consumption



(h) Water losses in the distribution system

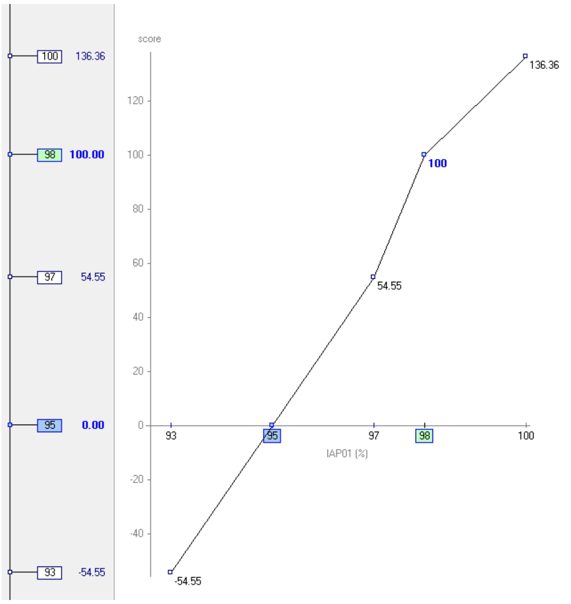


(i) Fulfilment of the water intake licensing

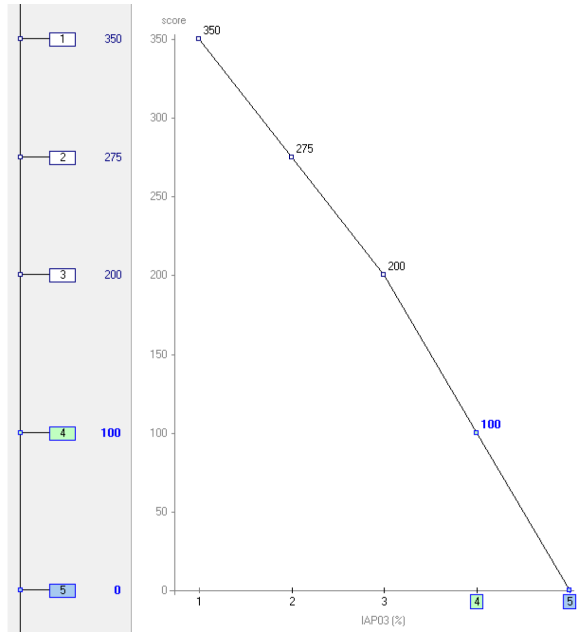


(j) Sludge disposal

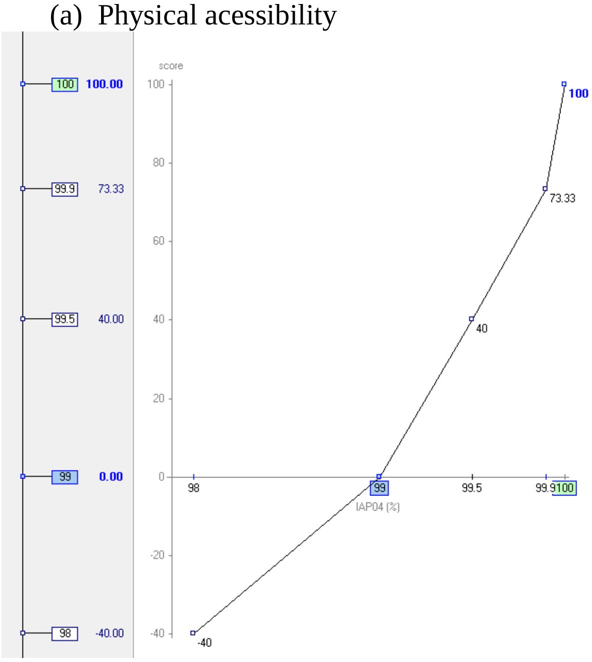
APPENDIX XVII – VALUE FUNCTION OF EACH CRITERION (PROVIDERS' PERSPECTIVE)



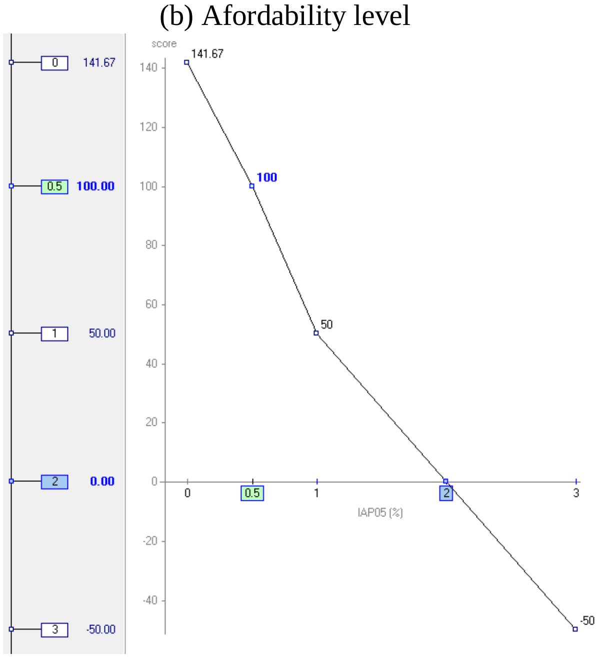
(a) Physical acessibility



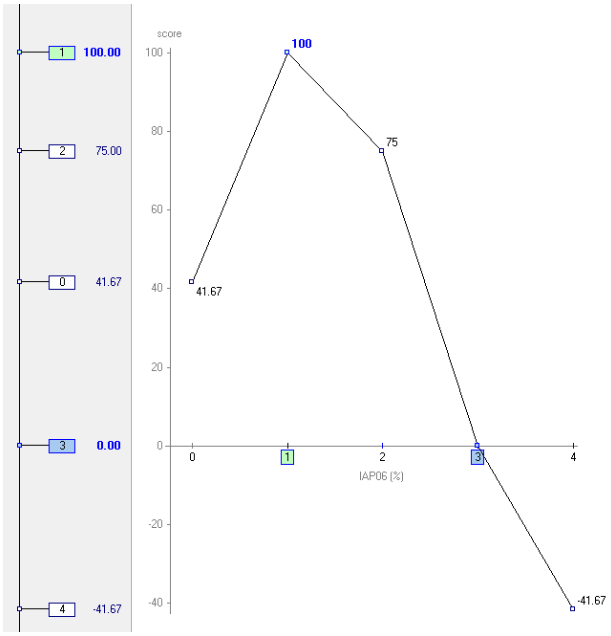
(b) Afordability level



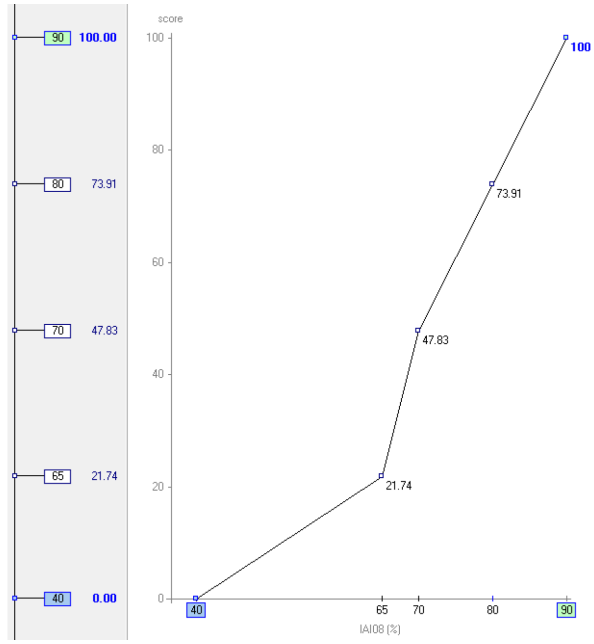
(c) Continuity of service



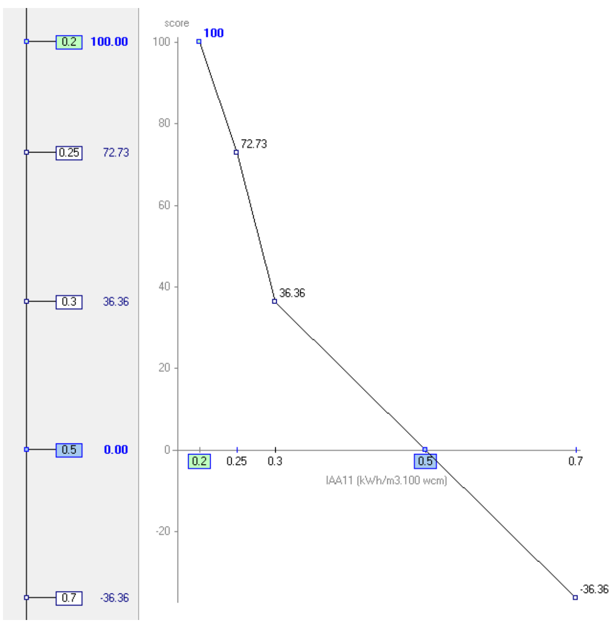
(d) Quality of supply water



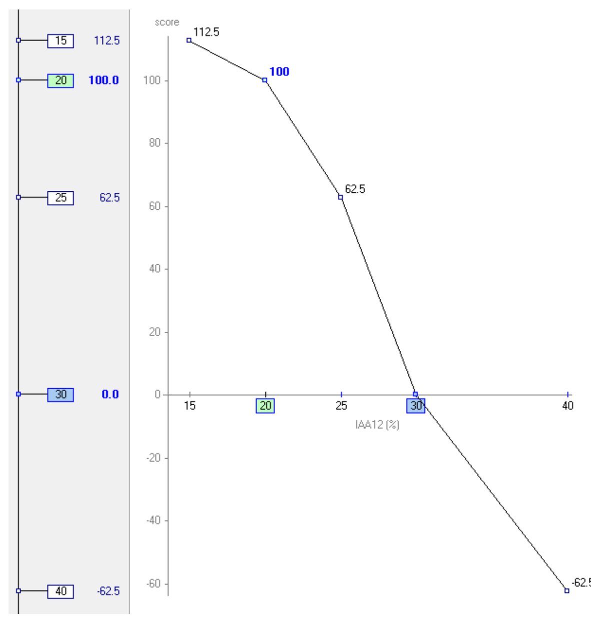
(e) Complaints about WWW services



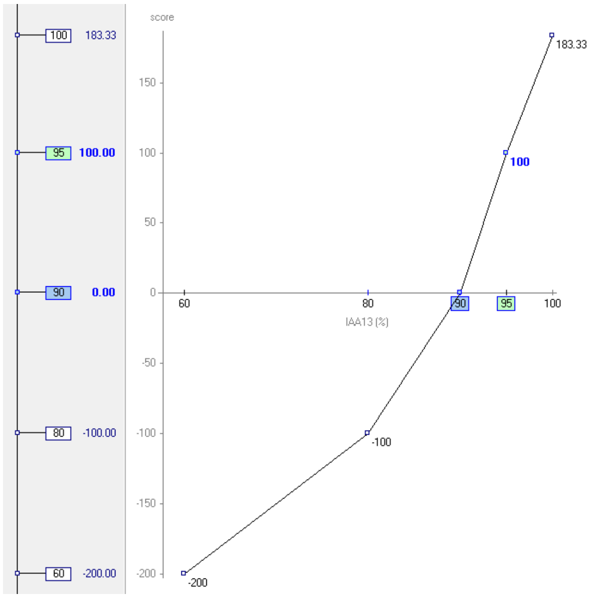
(f) Adequacy of treatment capacity

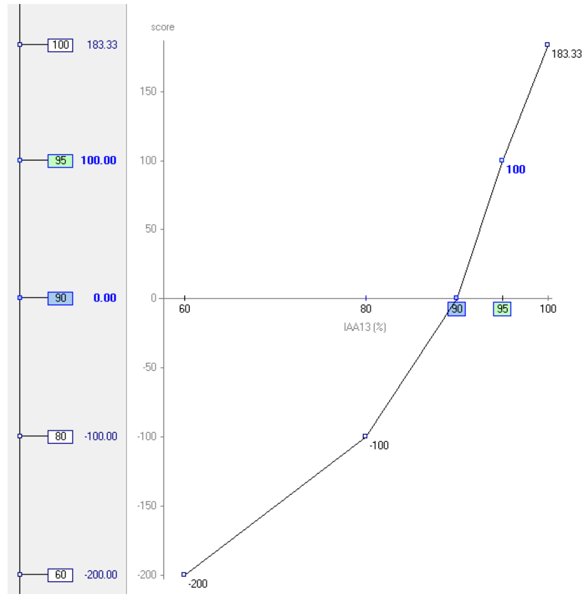


(g) Standardised energy consumption



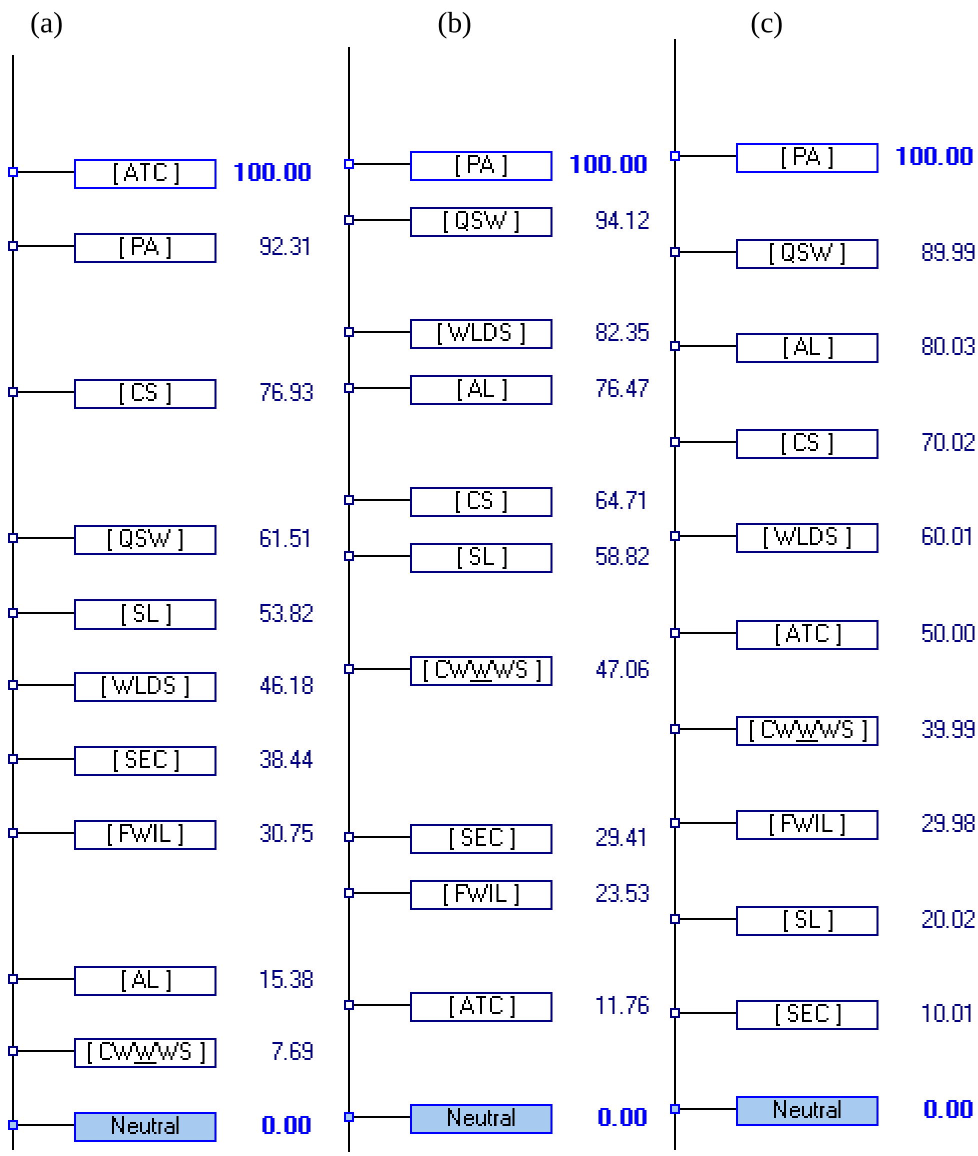
(h) Water losses in the distribution system



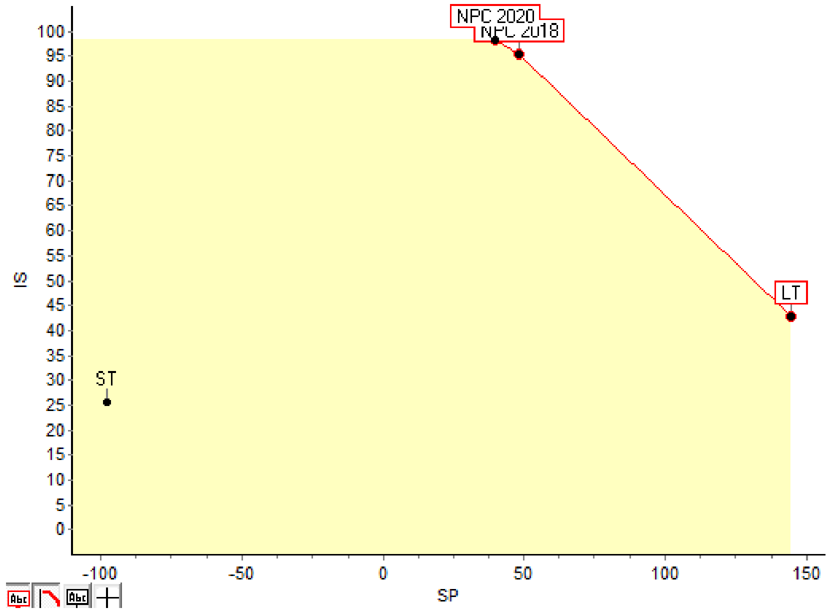


(i) Fulfilment of the water intake licensing (j) Sludge disposal

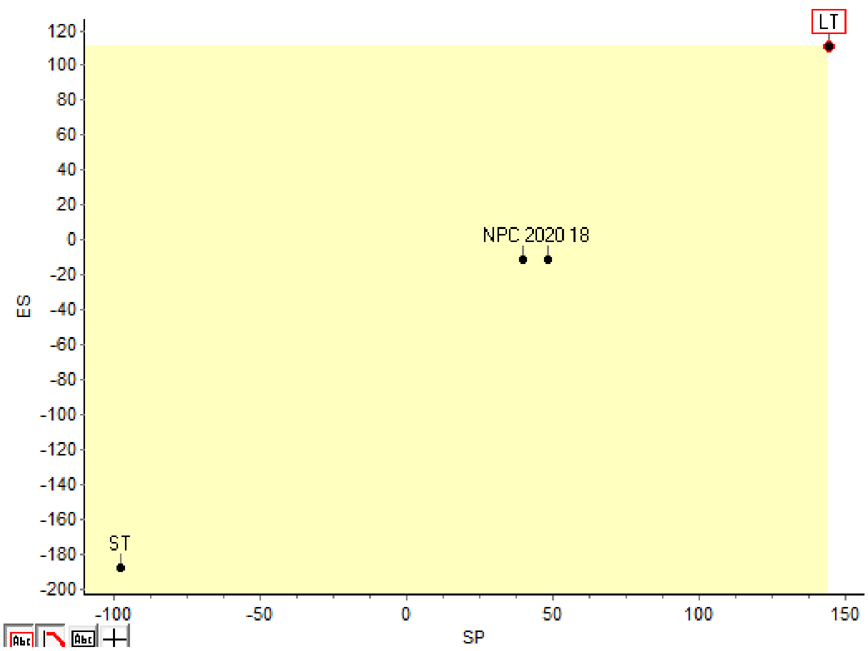
APPENDIX XVIII – WEIGHTING RESULTS (A) CUSTOMERS, (B) REGULATOR'S, (C) PROVIDER'S PERSPECTIVE



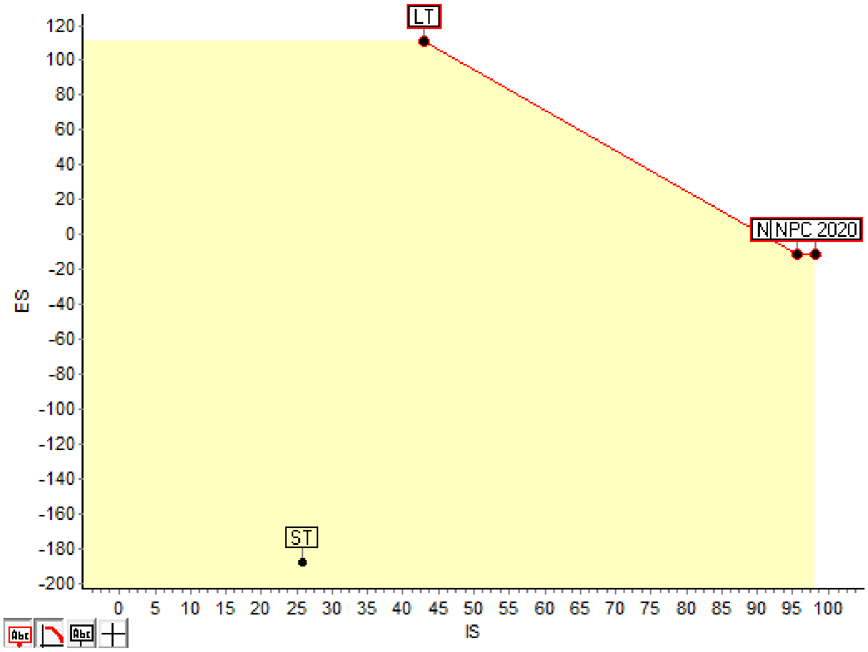
APPENDIX XIX – EFFICIENT FRONTIER BETWEEN DIMENSIONS ASSESSED (CUSTOMERS' PERSPECTIVE)



(a) Service provider and Infrastructural sustainability

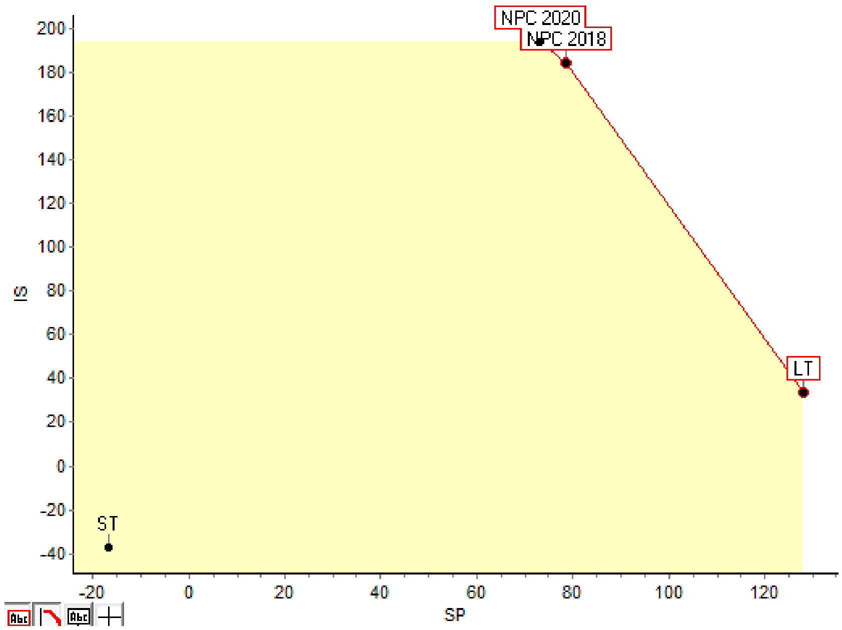


(b) Service provider and Environmental sustainability

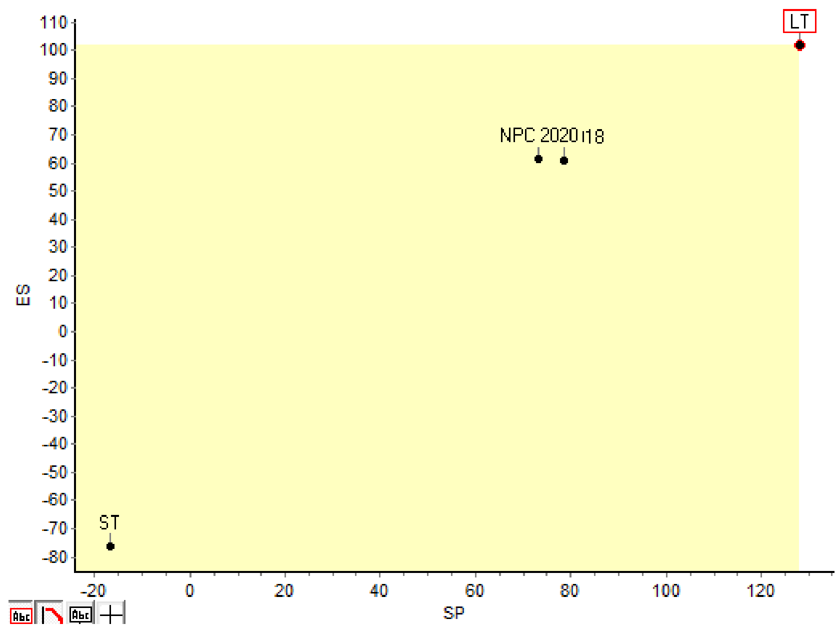


(c) Infrastructural sustainability and Environmental sustainability

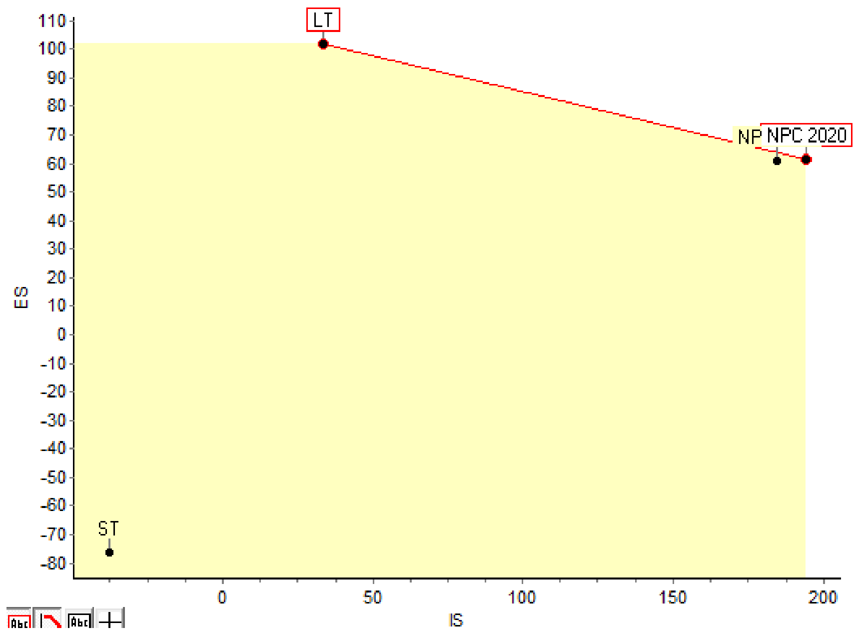
APPENDIX XX – EFFICIENT FRONTIER BETWEEN DIMENSIONS ASSESSED (REGULATOR'S PERSPECTIVE)



(a) Service provider and Infrastructural sustainability

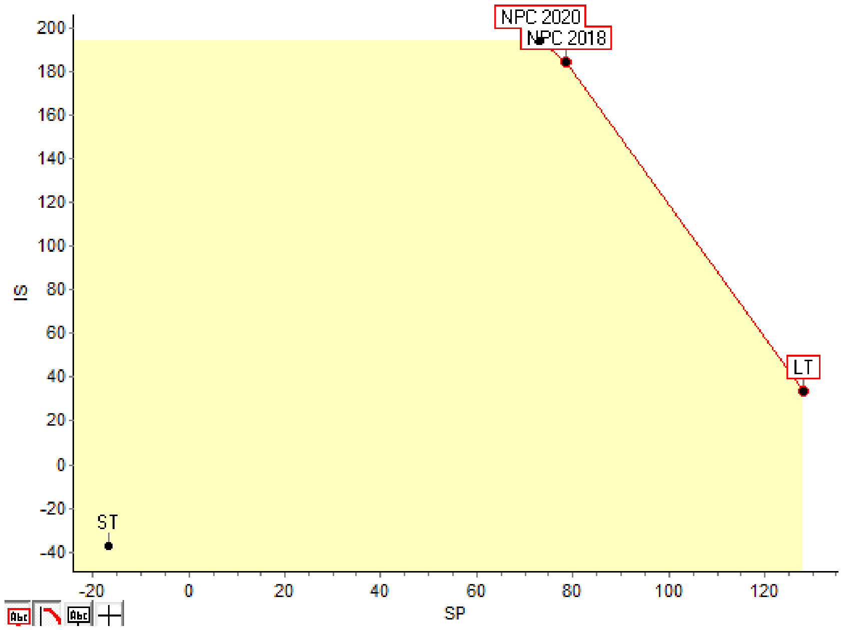


(b) Service provider and Environmental sustainability

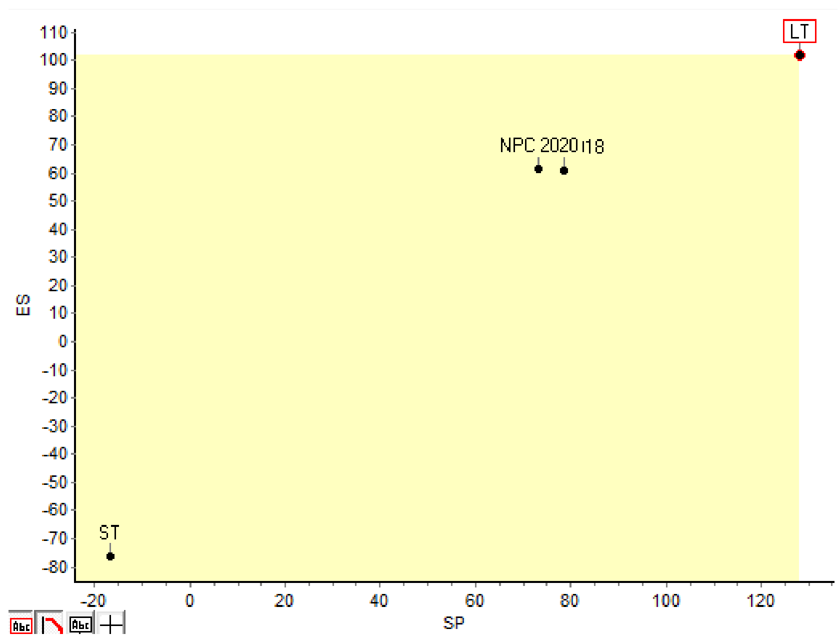


(c) Infrastructural sustainability and Environmental sustainability

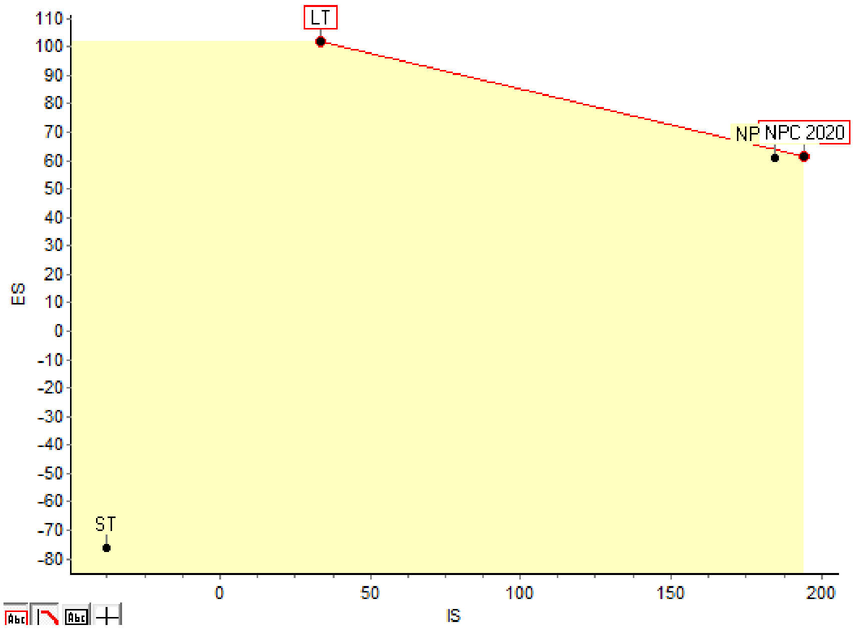
APPENDIX XXI – EFFICIENT FRONTIER BETWEEN DIMENSIONS ASSESSED (PROVIDER'S PERSPECTIVE)



(a) Service provider and Infrastructural sustainability



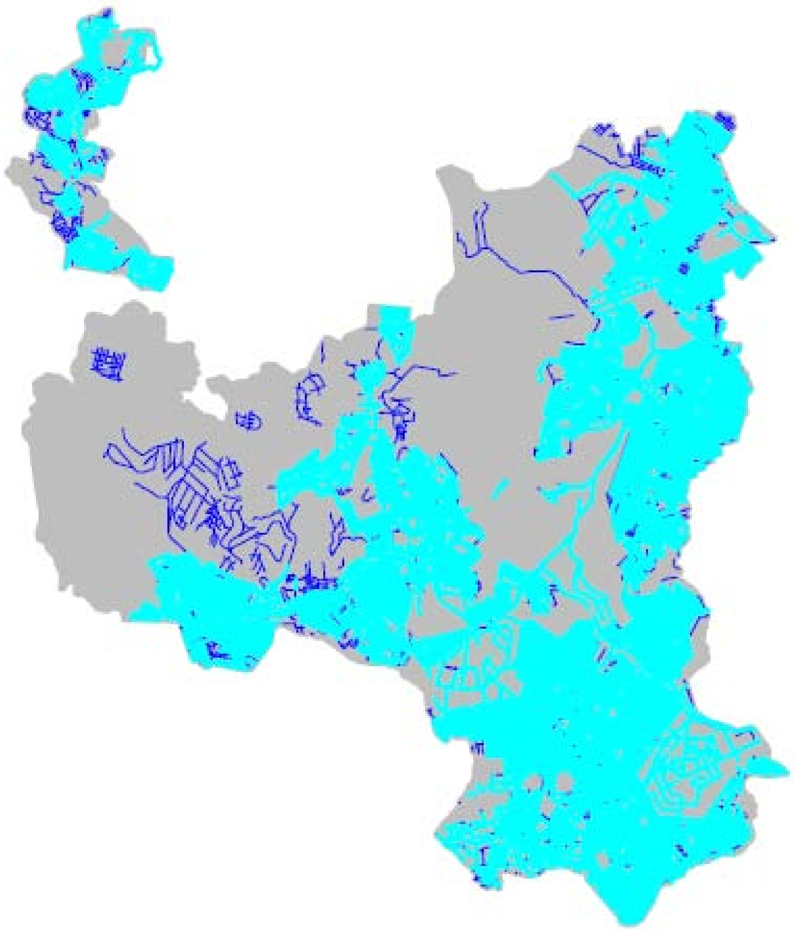
(b) Service provider and Environmental sustainability

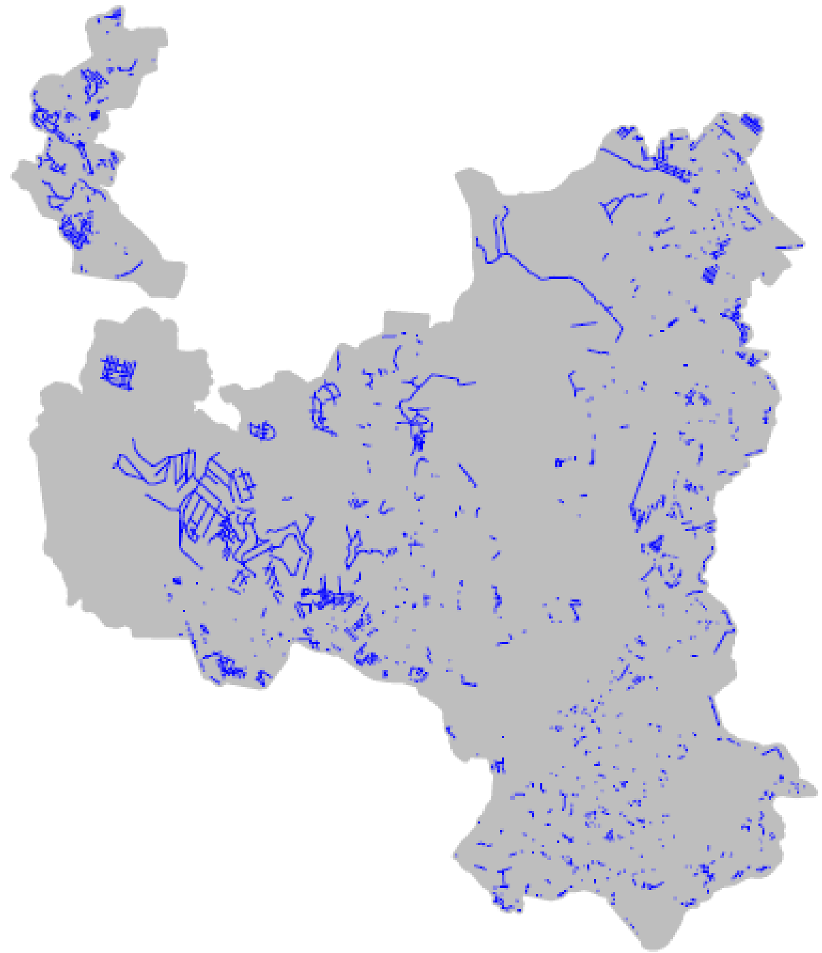


(c) Infrastructural sustainability and Environmental sustainability

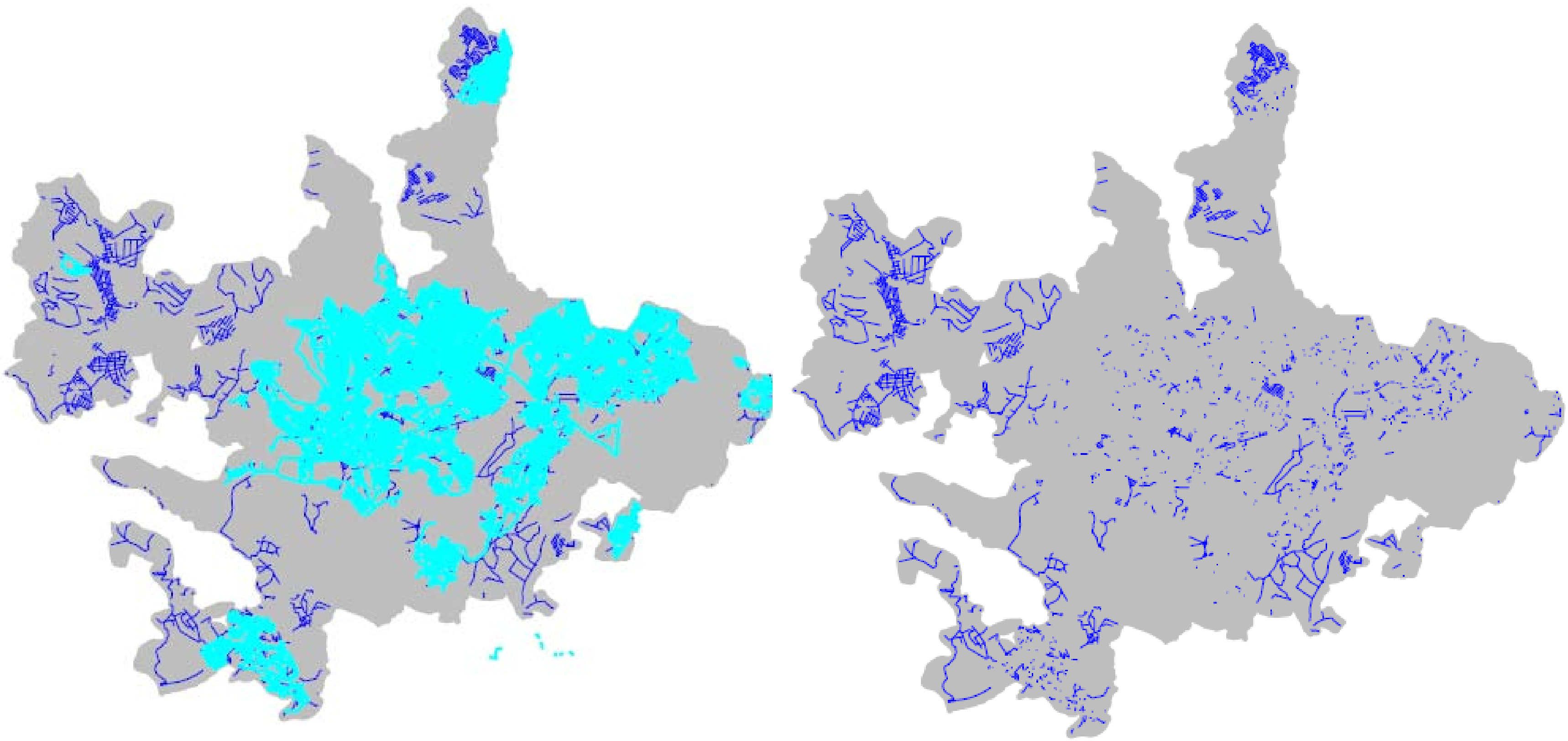
APPENDIX XXII – AREA COVERED AND NON-COVERED IN THIS RESEARCH: (A) CONTAGEM, (B) BETIM AND (C) BELO HORIZONTE

(a)

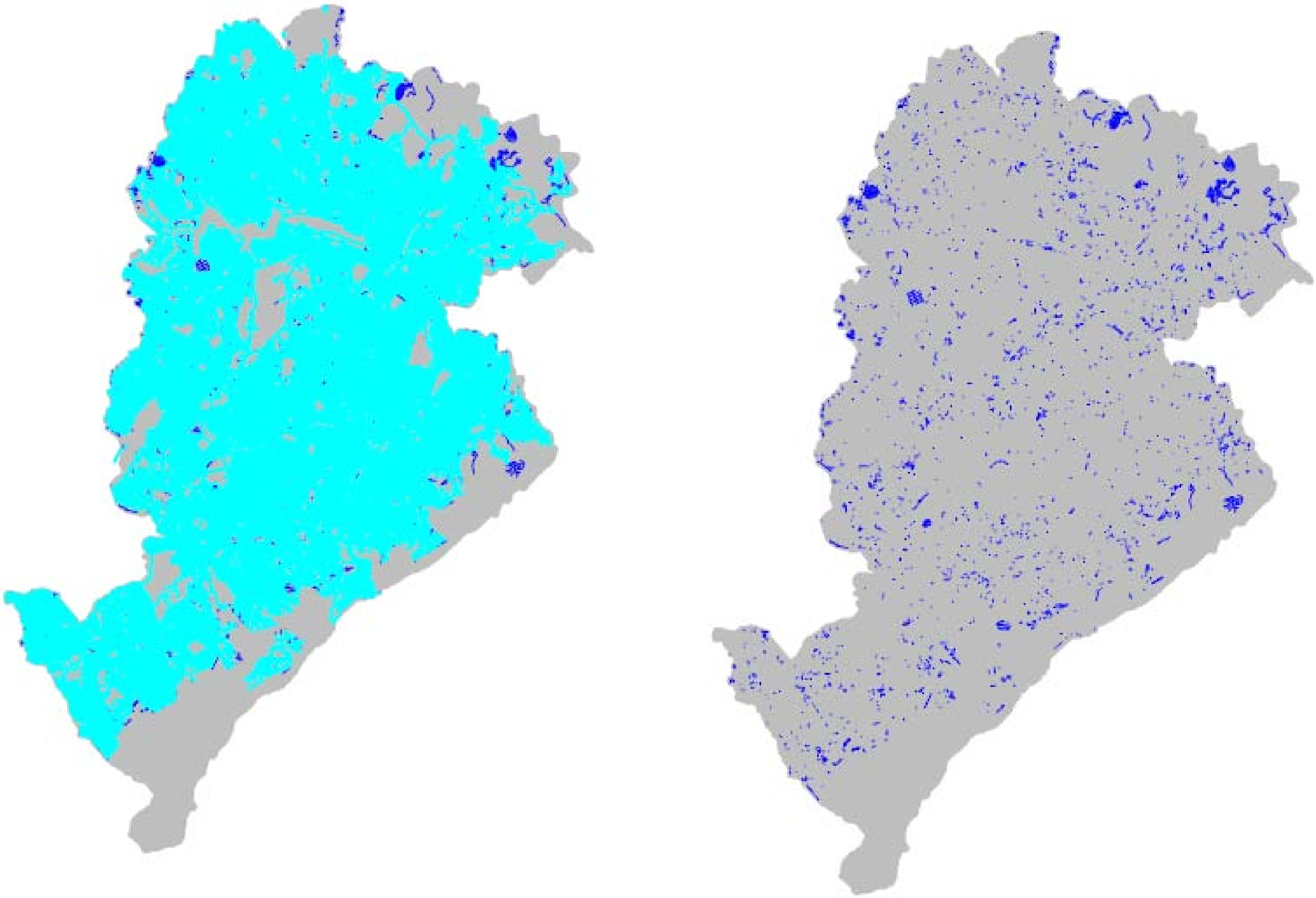




(b)

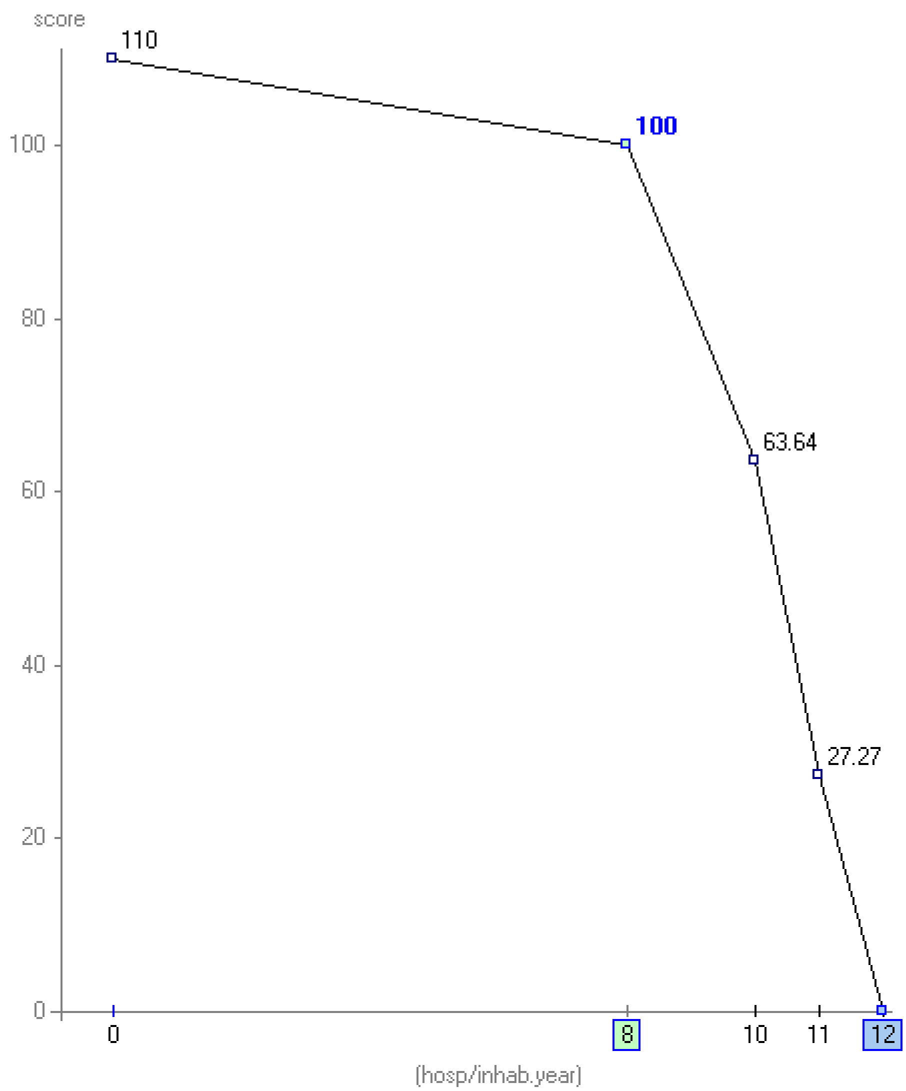


(c)

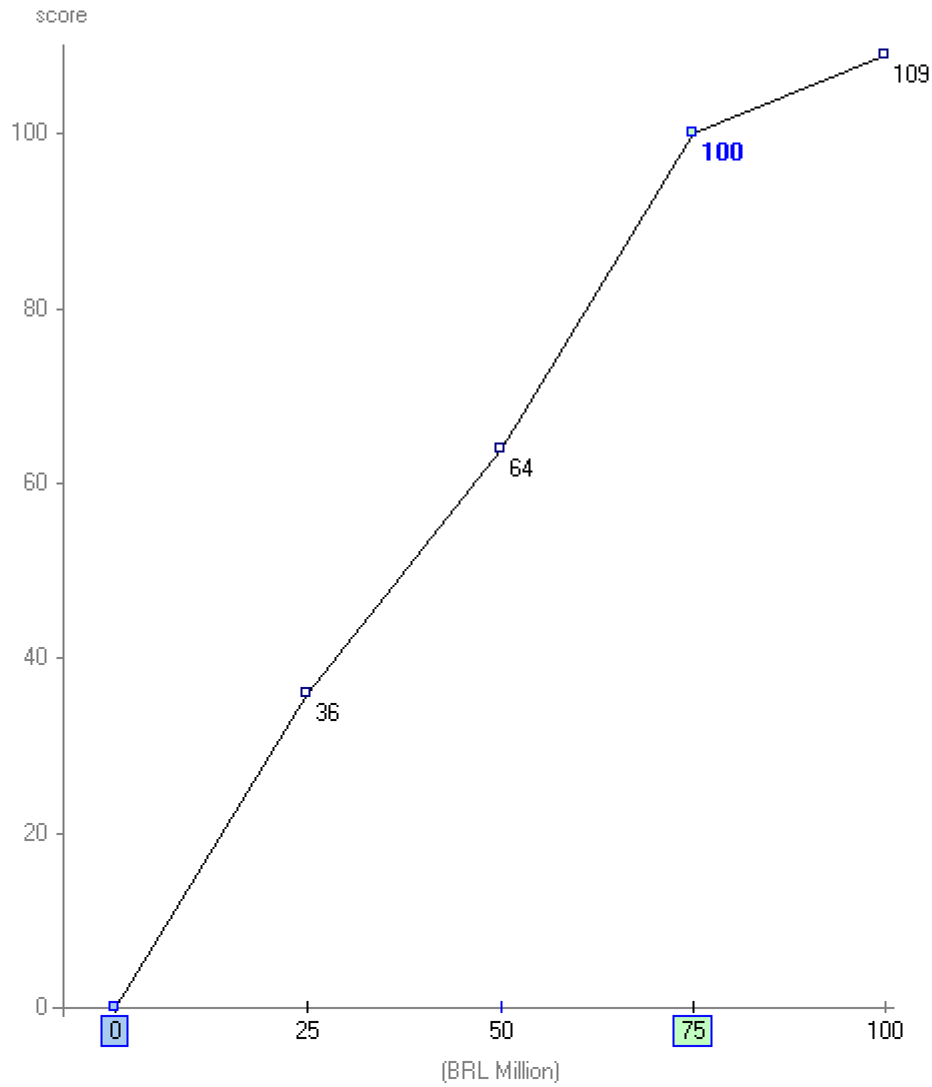


APPENDIX XXIII – VALUE FUNCTIONS FOR EACH CRITERION ADOPTED IN A SUCH ANALYSIS: (A) MORBIDITY AVOIDANCE, (B) INCOMES, (C) INFRASTRUCTURE, (D) SLUDGE

(a)



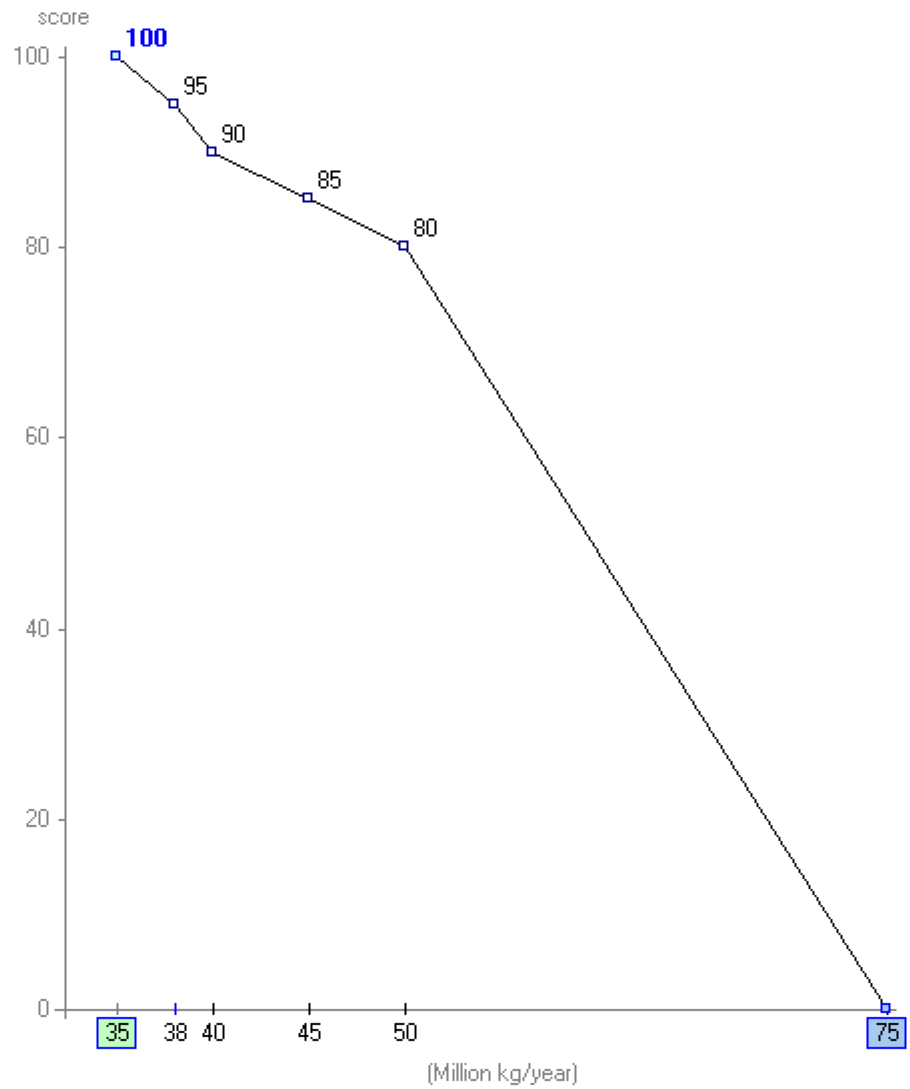
(b)



(c)


score
120
100
80
60
40
20
0
120
100
57.15
28.56
0
100
200
300
400
Infra (BRL (x10^6))

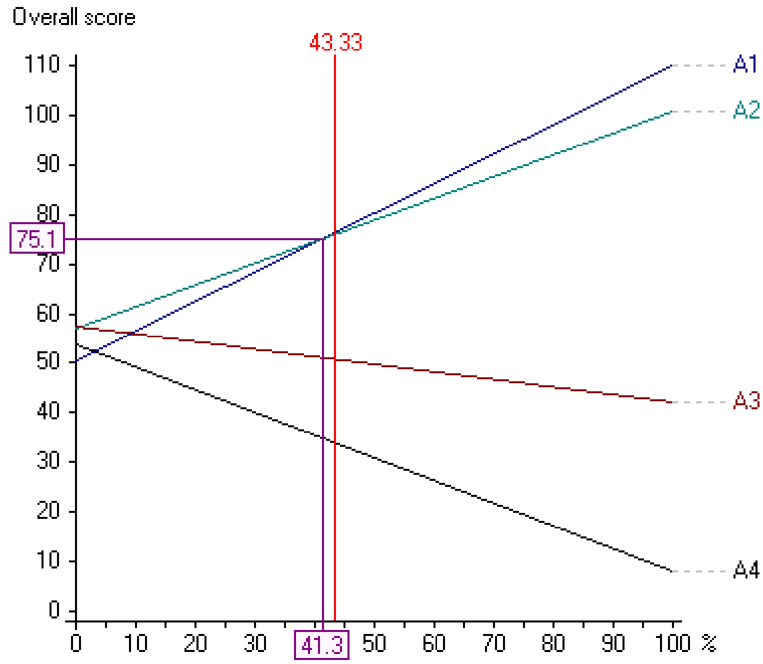
(d)



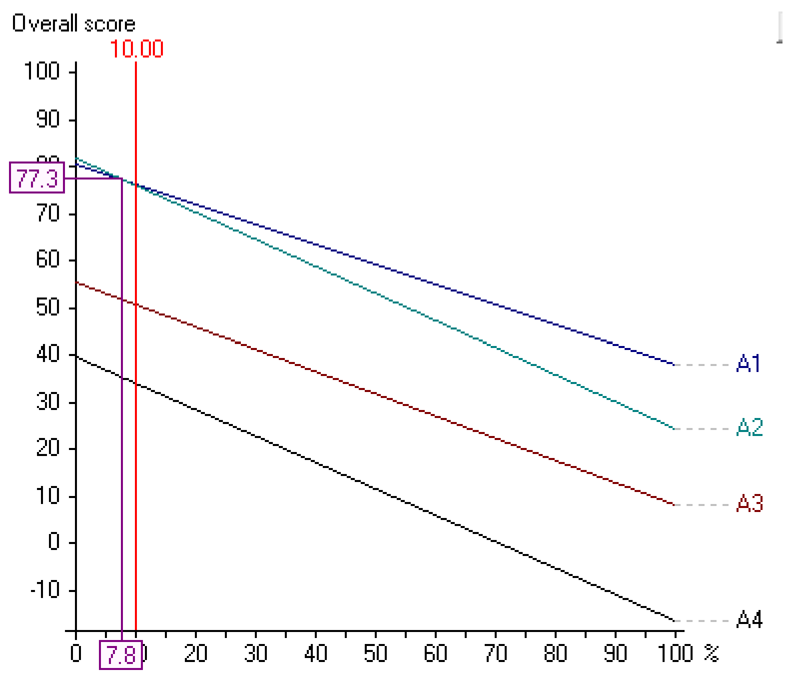
score
100
95
90
85
80
100
80
60
40
20
0
35
38
40
45
50
75
(Million kg/year)

APPENDIX XXIV – SENSITIVITY ANALYSIS ON WEIGHTING: (A) (CSO_1), (B) CSO_2, (C) CEC_1, (D) CEC_2, (E) CEN_1

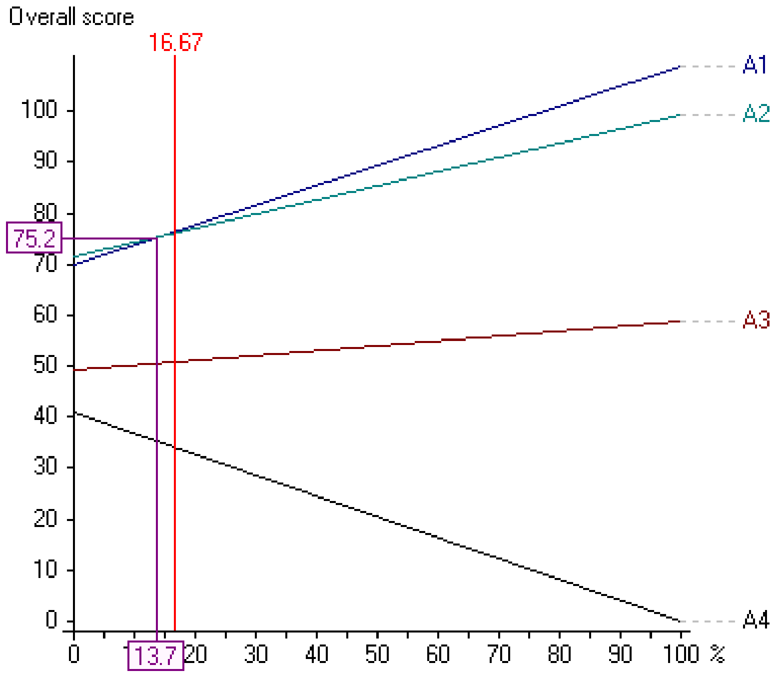
(a)



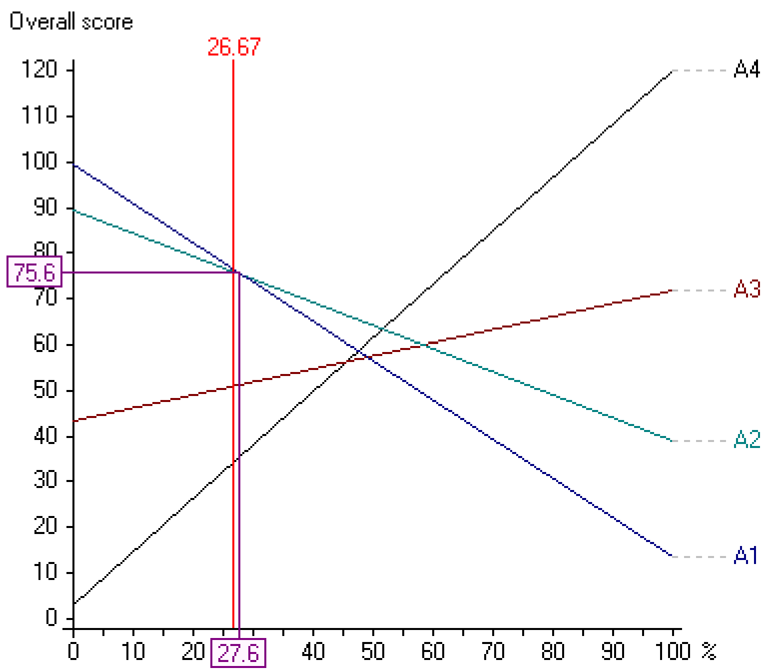
(b)



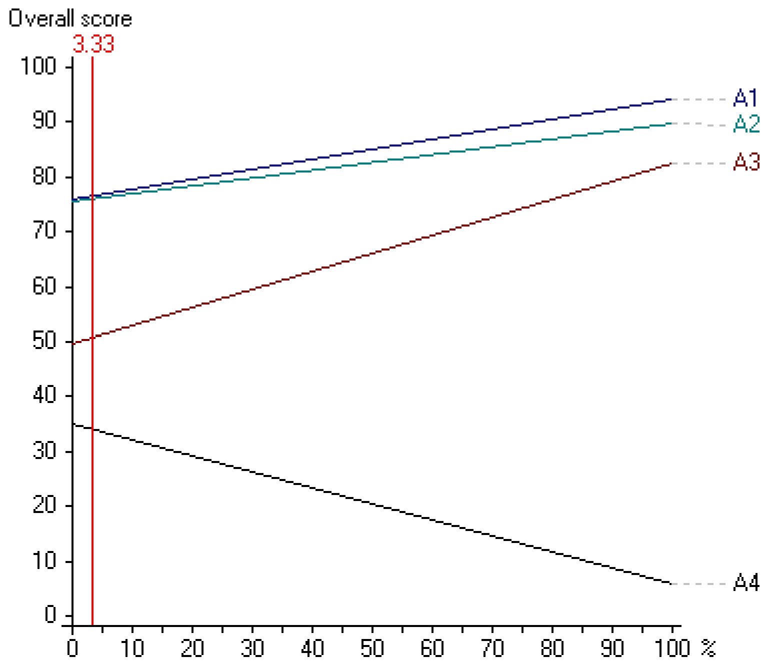
(c)


Overall score
16.67
75.2
13.7
A1
A2
A3
A4
0
10
20
30
40
50
60
70
80
90
100
%

(d)


Overall score
26.67
75.6
27.6
A4
A3
A2
A1
0
10
20
30
40
50
60
70
80
90
100
110
120
%

(e)


Overall score
3.33
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100 %
A1
A2
A3
A4

APPENDIX XXV – ROBUSTNESS LOCAL AND GLOBAL ANALYSIS: (A) ORDINAL, MACBETH AND CARDINAL AND (B) CARDINAL CHANGING UNCERTAINTY

(a)

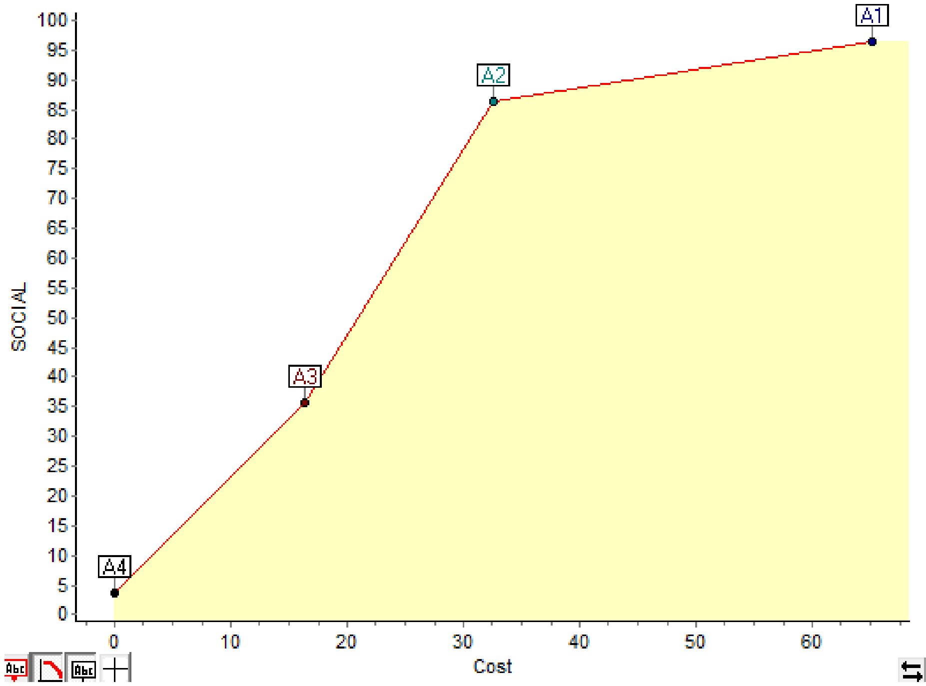
	[all upper]	A1	A2	A3	A4	[all lower]
[all upper]	=	+	+	▲	+	▲
A1		=	+	+	+	▲
A2			=	+	+	▲
A3				=	+	▲
A4					=	+
[all lower]						=

(b)

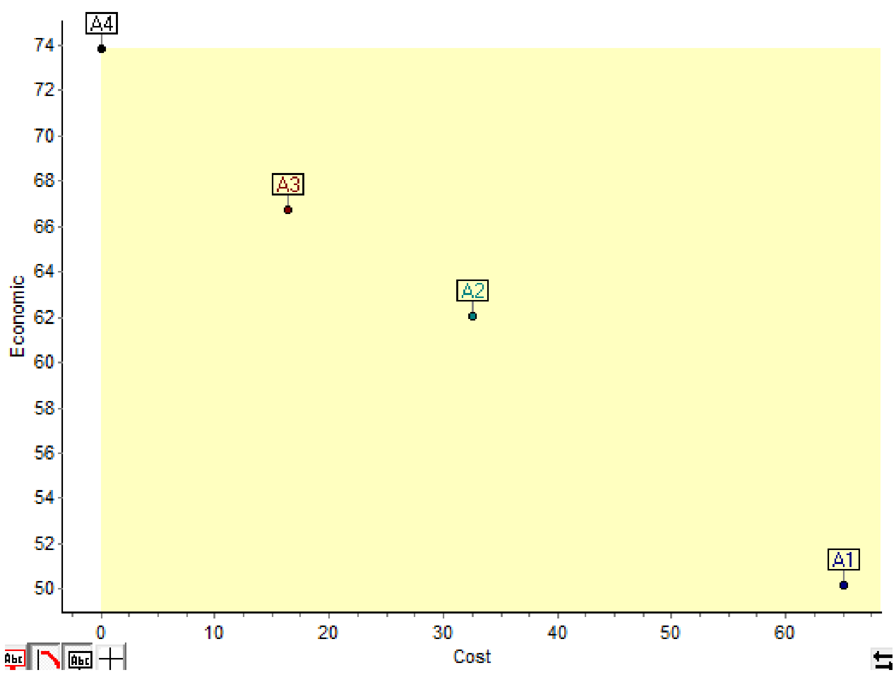
	[all upper]	A1	A2	A3	A4	[all lower]
[all upper]	=	?	+	▲	+	▲
A1	?	=	?	+	+	▲
A2		?	=	+	+	▲
A3				=	+	▲
A4					=	+
[all lower]						=

APPENDIX XXVI – COST-BENEFIT ANALYSIS OF EACH POLICY OPTION IN TERMS OF PROPOSED OBJECTIVES: (A) SOCIAL NODE, (B) ECONOMIC NODE AND (C) ENVIRONMENTAL NODE

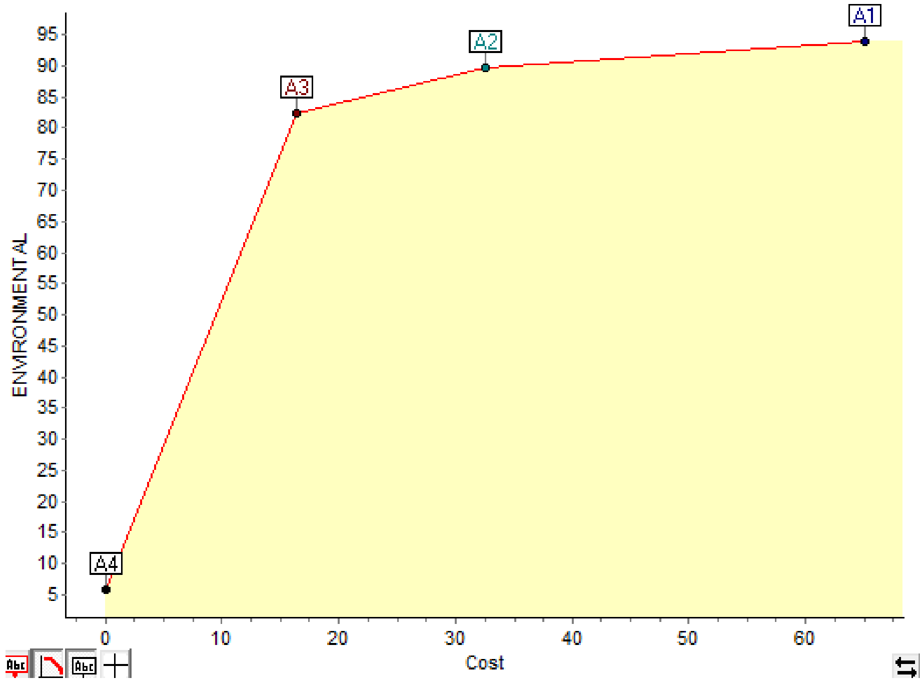
(a)



(b)



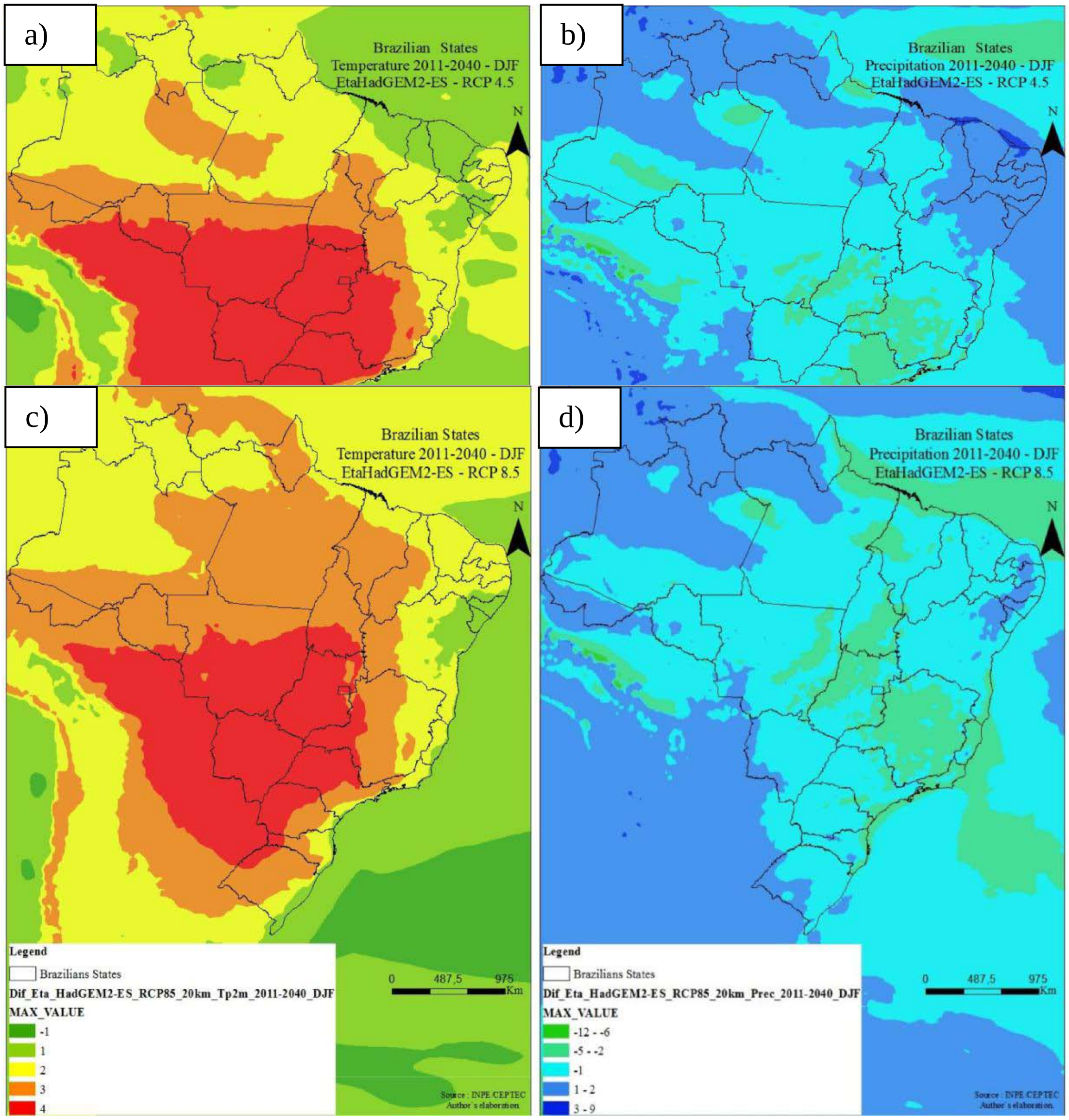
(c)



A1
A2
A3
A4
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
ENVIRONMENTAL
0
10
20
30
40
50
60
Cost

APPENDIX XXVII – CLIMATE CHANGE SCENARIOS DOWNSCALED TO BRAZIL (ETA HADGEM2-ES 4.5 AND 8.5, 2011-2040)

Temperature (a and c) and precipitation (b and d) (2011-2040). (Source: INPE 2014, authors' elaboration)

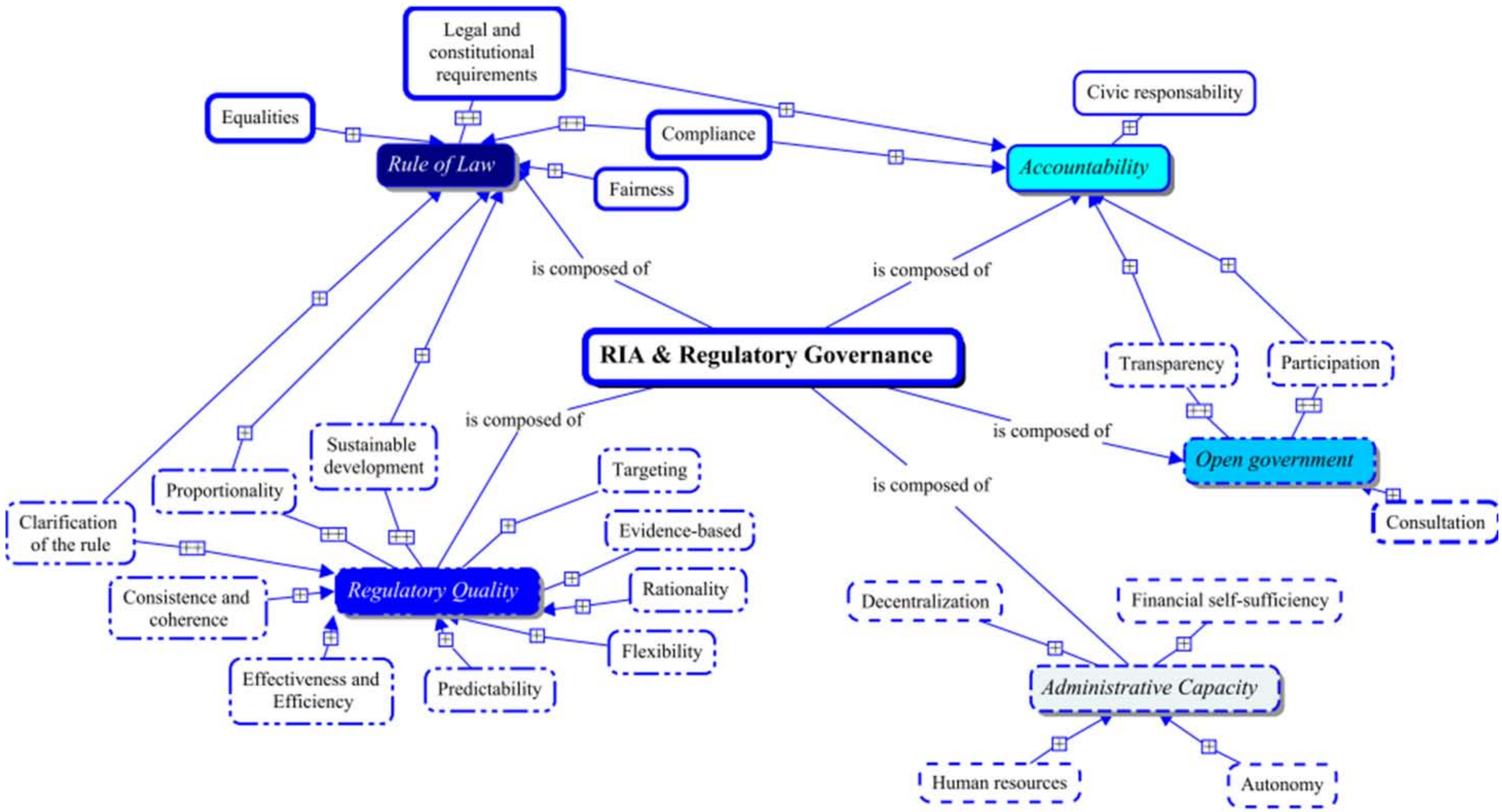


APPENDIX XXVIII – TABLE OF PRINCIPLES EXTRACTED FROM THE LITERATURE

Principles **Source**	**Ballantine (2014)**	**Howell (2016)**	**Vecchione (2016)**	**Blanc and Ottimofiore (2016)**	**Alemanno (2016)**	**Jacobs (2016)**	**Macrae (2016)**	**Schwartz (2016)**	**Anne, Mewese and Voorst (2016)**	**Dunlop and Radaelli (2016)**	**Harrington, Heinzerling and Morgenstern (2009)**	**Morrall (1997)**	**Ellig (2013)**	**UK better regulation (1998)**	**European commission (2015)**	**(Adelle et al., 2015)**	**(Araral and Wang 2013)**	**(Asquer 2012)**	**(Berg 2013)**	**(Bovaird and Loffler 2003)**	**(Callahan 2007)**	**(Enderlein, Walti and Zurn 2010)**	**(Majone 1996)**	**(OECD 2007)**	**(Jordana and Levi-Faur 2004)**	**(King 2007)**	**(Kirkpatrick and Parker 2004)**	**(Lobel 2012)**	**(Meuleman 2014)**	**(Minogue and Cariño 2006))**	**(OECD 2012)**	**(UN 2008)**
Transparency	+	+	+	+	+			+			+			+	+	+			+	+	+		+	+	+	+	+	+		+	+	+
Accountability			+		+		+		+	+	+			+					+	+	+	+		+	+	+	+		+	+	+	+
Participation	+	+	+	+	+			+			+				+	+			+	+	+							+	+		+	+
Consistency and coherence													+		+				+					+			+		+	+	+	
Effectiveness and Efficiency													+											+					+			+
Predictability																			+							+			+			
Proportionality														+	+									+						+		
Rationality													+										+		+					+		
Targeting													+	+		+								+						+		
Administrative capacity												+			+	+													+			
Clarification of the rule																+	+		+													
Equalities													+							+		+										
Fairness													+																+			+
Flexibility													+			+		+														
Legal and constitutional requirements																						+		+								

Principles source (cont.)	Ballantine (2014)	Howell (2016)	Vecchione (2016)	Blanc and Ottimofiore (2016)	Alemanno (2016)	Jacobs (2016)	Macrae (2016)	Schwartz (2016)	Anne, Mewese and Voorst (2016)	Dunlop and Radaelli (2016)	Harrington, Heinzerling and Morgenstern (2009)	Morral (1997)	Ellig (2013)	UK better regulation (1998)	European commission (2015)	(Adelle et al., 2015)	(Araral and Wang 2013)	(Asquer 2012)	(Berg 2013)	(Bovaird and Loffler 2003)	(Callahan 2007)	(Enderlein, Walti and Zurn 2010)	(Majone 1996)	(OECD 2007)	(Jordana and Levi-Faur 2004)	(King 2007)	(Kirkpatrick and Parker 2004)	(Lobel 2012)	(Meuleman 2014)	(Minogue and Cariño 2006))	(OECD 2012)	(UN 2008)
Regulatory quality	+	+				+		+		+		+		+																+		
Autonomy																			+													
Civic responsibility																					+											
Compliance																										+						
Decentralization																												+				
Financial self-sufficiency																		+														
Interpersonal																					+											
Political and economic integration																						+										
Rule of law									+											+												
Sustainable development																+																+
Consultation																																
Economic integration																																
Evidence-based													+																			

APPENDIX XXIX – CRP AND ITS NORMATIVE COMPONENT



APPENDIX XXX – CRPS AND DESCRIPTORS

Core regulatory Principles	Code	Criteria	Descriptors	Based questions	Measure	Impact level (Description of possible impacts ordering them in an ordinal scale. The replies to all questions can be made with a complete, partial or no fulfilment.)	Direction
Accountability (Regulator must be able to justify decisions, and be subject to public scrutiny and judicial review)	g_1	Evaluation of the regulators	Allows to evaluate the context of the accountability principle regarding the occurrence of an evaluation in which regulators are submitted	1. Appeal rights for parties in regard to the defense of law requirements (process and substance). 2. Existence of reporting and audit obligations from the regulatory entity. 3. Oversight or performance reviews through evaluations and hearings. 4. Ethical and procedural obligations.	Ordinal	I fulfilment of all features (1 to 4) II fulfilments of features 1, 2 and 3 III fulfilment of at least 2 features of all possibilities IV fulfillment of at least 1 feature of all possibilities	Maximize
Administrative capacity (Regulator should be appropriately resourced and organized to perform regulatory functions)	g_2	Human resources	Allows to evaluate the context of the administrative capacity principle regarding the no. of employee and	Budget in the period of analysis No. of effective employee	Ordinal	V (>2,0) the relation between Budget and No of effective employee and IV (1,5-2,0) III (1,0-1,5) II (0,5-1,0) I (0-0,5)	Maximize
	g_3	Expenditure restraint	Allows to evaluate the context of the administrative capacity principle regarding the presence of any expenditure restraint (human resources, current expenses, investment and others)	1. Constraints on the regulator expenses 2. Constraints on the regulator human resources 3. Constraints on the regulator investment 4. Constraints on the regulator “others” 5. No expenditure restraints	Ordinal	V fulfilment of all features IV fulfilments of features 1 and 2 III fulfilment of feature 3 II fulfilment of feature 4fulfilment of feature 5	Minimize

Core regulatory Principles (cont.)	Code	Criteria	Descriptors	Based questions	Measure	Impact level	Direction
Open government (Regulator must adhere to principles of open government, including transparency and participation in the regulatory process to ensure that regulation serves the public interest)	g_4	Local availability information	Allows to evaluate the context of the open government principle in terms of the local availability of regulatory decision and consultation process	1. Management and financial information (e.g. budget). 2. Minutes of the directors' board and other boards. 3. Performance self-evaluation. 4. Development/ Strategic plan. 5. Legislation and sector information. 6. Information on the regulated entities. 7. Decision and regulatory opinions. 8. Economic regulatory activities. 9. Quality of service regulatory activities. 10. Consultations and hearings. 11. Supervision and auditing activities. 12. Major Staff information.	Ordinal	I fulfilment of all features II fulfilments fulfilment of at least 12 features of all possibilities III fulfilment of at least 9 features of all possibilities IV fulfilment of at least 6 features of all possibilities V all other combination that do not fill more than 4 features of all possibilities	Maximize
	g_5	Frequency of information	Allows to evaluate the context of the open government principle in terms of updating frequency of regulatory decision and consultation process	Frequency 1. Always 2. 5x/year 3. 4x/year 4. 3x/year 5. 2x/year 6. Others 7. no	Ordinal	I fulfilment of features 1 to 6 II fulfilment of feature 1 III fulfilment of features 2 and 3 IV fulfilment of feature 4, 5 and 6 V fulfilment of feature 7 VI fulfilment of feature	Maximize

Core regulatory Principlse (cont.)		Criteria	Descriptors	Based questions	Measure	Impact level	Direction
Open government (Regulator must adhere to principles of open government, including transparency and participation in the regulatory process to ensure that regulation serves the public interest)	g_6	Public participation	Allows to evaluate the context of the open government principle in terms of the open public participation based on (i) formal consultation, (ii) during the consultation process and(iii) at the end of the process	1. The existence of formal consultation processes as public hearings (Existence). 2. The existence of formal consultation processes as the participation on consultation responses (Existence + Answers) 3. The existence of formal consultation processes and comments on consultation responses. (Existence + Answers + final comments from stakeholders) 4. Is there any advisory board (with stakeholders' representation)?	Ordinal	I fulfilment of all features II fulfilments of features 1, 2 and 3 III fulfilment of at least 2 features of all possibilities IV fulfillment of at least 1 feature of all possibilities	Maximize
Regulatory quality (Regulation should be embedded in the planning and policy cycle, targeted, evidence-based, coherent, unbiased, comprehensive and proportionate	g_7	Policy coherence	Allows to evaluate the context of the regulatory quality principle in terms of the needs to guarantee clear and political coherence of the decision-making	1. Are there any preferable treatment regarding any type of regulated operators? 2. Is the regulatory activity similarly applied through time? 3. Are the regulatory	Ordinal	I fulfilment of all features II fulfilments of at least 3 features of all possibilities III fulfilments of at least 2 features of all possibilities IV fulfilment of at least 1 of all	Maximize

				interventions proportionating to its obligations? 4. Are the costs of such interventions identified and minimized?		possibilities V No fulfilment (partial or complete) of a single feature	

Core regulatory Principlse (cont.)	Code	Criteria	Descriptors	Based questions	Measure	Impact level	Direction
Rule of Law (Regulator must ensure the effectiveness of systems for the review of the legality and procedural fairness of regulations)	g_8	Legal coordination	Allows to evaluate the context of the rule of law principle regarding the occurrence in any legal document the attribute of legal coordination	1. Is it established in law, and other formal documents, the coordination (frontier activities defined and aligned) with the competition regulatory authority (or related entities)? 2. Is it established in law, and other formal documents, the coordination (frontier activities defined and aligned) with the consumer associations or NGOs (or related entities)? 3. Is it established in law, and other formal documents, the coordination (frontier activities defined and aligned) with the Environment regulatory authority and/or related/other entities? 4. How are the legislative responsibilities aligned?	Ordinal	I fulfilment of all features II fulfilments and partial fulfilments of at least 2 features of all possibilities III fulfilments and partial fulfilments of at least 1 feature of all possibilities	Maximize
	g_9	Power to	Allows to evaluate the	1. To compel the	Ordinal	I fulfilment of all	Maximize

		access the data-base	context of the rule of law principle regarding the regulators ‘power to access the data-base		provision of needed information		features II fulfilments and partial fulfilments of at least 1 III No fulfilment (partial or complete) of a single feature	
	g_{10}	Power of assurances’ decision	Allows to evaluate the context of the rule of law principle regarding the monitor and assurance’s decision consider its capacity to apply penalties and sanctions	1.	To monitor and enforce its decisions and non-conformity with sanctions when needed (enjoys judicial power)	Ordinal	I fulfilment of all features II fulfilments and partial fulfilments of at least 1 III No fulfilment (partial or complete) of a single feature	Maximize

APPENDIX XXXI – SCENARIO RESULTS (EXTRACTED FROM MCDA (ULAVAL)

$\gamma = 0.6$

Statistics :

<min,max>	#	%
<2,3>	2	8.6957%
<3,3>	6	26.0870%
<3,4>	10	43.4783%
<4,4>	3	13.0435%
<5,5>	1	4.3478%
<5,6>	1	4.3478%

ACTION	Minimum	Maximum
ARSEC - Public services Regulator of Cuiabá	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
ARSI - Water, Sanitation and Infrastructure Regulator of Espirito Santo State	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
ARES - PCJ rivers Water basins Regulator	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
ARSBAN - Water and Sanitation Regulator of Natal	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
ARSAE-MG - Water and Sanitation Regulator of Minas Gerais State	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
AGERB - Public services regulator of Buritis	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
ARSAL - Public services regulator of Alagoas State	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
AGEPAN - Public services Regulator of Mato Grosso do Sul State	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
AGIR - Public Services Intermunicipal Regulator	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
ARIS - Water and Sanitation Intermunicipal Regulator_1	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
AGR - Water and Sanitation Regulator of Tubarão	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
AR-ITU - Public Services Regulator of Itu	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
ARCE - Public Services Regulator of Ceará	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
ARSETE - Public Services Regulator of Teresina	C_4 Moderate CRPs level	C_4 Moderate CRPs level
AGER - Public Services Regulator of Erechim-RS	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
ARSEP - Public Services Regulator of Rio Grande do Norte State	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
ARSEMA - Public Services Regulator of Maranhão State	C_2 Incipient CRPs level	C_3 Minimum CRPs level_1
AGENERSA - Water, sanitation and energy Regulator of Rio de Janeiro State	C_4 Moderate CRPs level	C_4 Moderate CRPs level
AGERGS - Public Services Regulator of Rio Grande do Sul State	C_5 Good CRPs level	C_5 Good CRPs level
AGEAC - Public Services Regulator of Acre State	C_2 Incipient CRPs level	C_3 Minimum CRPs level_1
AGERSA - Public Services Regulation of Cachoeiro do Itapemirim	C_4 Moderate CRPs level	C_4 Moderate CRPs level
ADASA - Water, Sanitation and Energy Regulator of Distrito Federal	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
ARSESP - Water, Sanitation and Energy Regulator of São Paulo State	C_5 Good CRPs level	C_6 Best practice_1

$\gamma = 0.65$

Statistics :

<min,max>	#	%
<2,3>	2	8.6957%
<3,3>	6	26.0870%
<3,4>	7	30.4348%
<4,4>	6	26.0870%
<5,5>	1	4.3478%
<5,6>	1	4.3478%

ACTION	Minimum	Maximum
ARSEC - Public services Regulator of Cuiabá	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
ARSI - Water, Sanitation and Infrastructure Regulator of Espirito Santo State	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
ARES - PCJ rivers Water basins Regulator	C_4 Moderate CRPs level	C_4 Moderate CRPs level
ARSBAN - Water and Sanitation Regulator of Natal	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
ARSAE-MG - Water and Sanitation Regulator of Minas Gerais State	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
AGERB - Public services regulator of Buritis	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
ARSAL - Public services regulator of Alagoas State	C_4 Moderate CRPs level	C_4 Moderate CRPs level
AGEPAN - Public services Regulator of Mato Grosso do Sul State	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
AGIR - Public Services Intermunicipal Regulator	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
ARIS - Water and Sanitation Intermunicipal Regulator_1	C_4 Moderate CRPs level	C_4 Moderate CRPs level
AGR - Water and Sanitation Regulator of Tubarão	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
AR-ITU - Public Services Regulator of Itu	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
ARCE - Public Services Regulator of Ceará	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
ARSETE - Public Services Regulator of Teresina	C_4 Moderate CRPs level	C_4 Moderate CRPs level
AGER - Public Services Regulator of Erechim-RS	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
ARSEP - Public Services Regulator of Rio Grande do Norte State	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
ARSEMA - Public Services Regulator of Maranhão State	C_2 Incipient CRPs level	C_3 Minimum CRPs level_1
AGENERSA - Water, sanitation and energy Regulator of Rio de Janeiro State	C_4 Moderate CRPs level	C_4 Moderate CRPs level
AGERGS - Public Services Regulator of Rio Grande do Sul State	C_5 Good CRPs level	C_5 Good CRPs level
AGEAC - Public Services Regulator of Acre State	C_2 Incipient CRPs level	C_3 Minimum CRPs level_1
AGERSA - Public Services Regulation of Cachoeiro do Itapemirim	C_4 Moderate CRPs level	C_4 Moderate CRPs level
ADASA - Water, Sanitation and Energy Regulator of Distrito Federal	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
ARSESP - Water, Sanitation and Energy Regulator of São Paulo State	C_5 Good CRPs level	C_6 Best practice_1

$\gamma = 0.7$

Statistics :

<min,max>	#	%
<2,3>	1	4.3478%
<3,3>	7	30.4348%
<3,4>	2	8.6957%
<4,4>	11	47.8261%
<5,5>	2	8.6957%

ACTION	Minimum	Maximum
ARSEC - Public services Regulator of Cuiabá	C_4 Moderate CRPs level	C_4 Moderate CRPs level
ARSI - Water, Sanitation and Infrastructure Regulator of Espirito Santo State	C_4 Moderate CRPs level	C_4 Moderate CRPs level
ARES - PCJ rivers Water basins Regulator	C_4 Moderate CRPs level	C_4 Moderate CRPs level
ARSBAN - Water and Sanitation Regulator of Natal	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
ARSAE-MG - Water and Sanitation Regulator of Minas Gerais State	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
AGERB - Public services regulator of Buritis	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
ARSAL - Public services regulator of Alagoas State	C_4 Moderate CRPs level	C_4 Moderate CRPs level
AGEPAN - Public services Regulator of Mato Grosso do Sul State	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
AGIR - Public Services Intermunicipal Regulator	C_4 Moderate CRPs level	C_4 Moderate CRPs level
ARIS - Water and Sanitation Intermunicipal Regulator_1	C_4 Moderate CRPs level	C_4 Moderate CRPs level
AGR - Water and Sanitation Regulator of Tubarão	C_4 Moderate CRPs level	C_4 Moderate CRPs level
AR-ITU - Public Services Regulator of Itu	C_3 Minimum CRPs level_1	C_4 Moderate CRPs level
ARCE - Public Services Regulator of Ceará	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
ARSETE - Public Services Regulator of Teresina	C_4 Moderate CRPs level	C_4 Moderate CRPs level
AGER - Public Services Regulator of Erechim-RS	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
ARSEP - Public Services Regulator of Rio Grande do Norte State	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
ARSEMA - Public Services Regulator of Maranhão State	C_3 Minimum CRPs level_1	C_3 Minimum CRPs level_1
AGENERSA - Water, sanitation and energy Regulator of Rio de Janeiro State	C_4 Moderate CRPs level	C_4 Moderate CRPs level
AGERGS - Public Services Regulator of Rio Grande do Sul State	C_5 Good CRPs level	C_5 Good CRPs level
AGEAC - Public Services Regulator of Acre State	C_2 Incipient CRPs level	C_3 Minimum CRPs level_1
AGERSA - Public Services Regulation of Cachoeiro do Itapemirim	C_4 Moderate CRPs level	C_4 Moderate CRPs level
ADASA - Water, Sanitation and Energy Regulator of Distrito Federal	C_4 Moderate CRPs level	C_4 Moderate CRPs level
ARSESP - Water, Sanitation and Energy Regulator of São Paulo State	C_5 Good CRPs level	C_5 Good CRPs level