Exploiting IBM Watson Analytics to Visualize and Analyze Data from Goal-Based Conceptual Models

Okhaide Akhigbe[1], Susie Heap[1], Daniel Amyot[1] and Gregory S. Richards[2]

[1]School of Electrical Engineering & Computer Science, University of Ottawa, Ottawa, Canada
[2]Telfer School of Management, University of Ottawa, Ottawa, Canada
{okhaide,sheap069,damyot}@uottawa.ca
richards@telfer.uottawa.ca

Abstract. Data visualization tools are gaining popularity in their use for exploring and analyzing data towards improving decision support. When applied to goal-based conceptual models, such tools enable visualizing and analyzing data derived from goal models, including potential relationships between models. This demonstration paper illustrates how goal satisfaction data produced for single and multiple models by the jUCMNav goal modeling tool can be fed to IBM Watson Analytics, a commercial tool, to visualize and analyze different relationships across multiple dimensions (including time and location/organization) in a regulatory context. This combination of tools enables new types of analyses that could not be done before, with little effort required.

Keywords: Data Visualization · Goal Models · Goal-oriented Requirement Language · GoRIM · IBM Watson Analytics · jUCMNav

1 Introduction

There is growing emphasis in academia and industry placed on data visualization, which aims to facilitate identifying and visualizing patterns, trends and correlations that might be missed while dealing with text-based data [1, 2]. In their application to conceptual modeling, data visualization tools can enable the interactive visualization and analysis of data derived from different conceptual models, as well as the exploration of potential relationships between and within the models.

In this context, we introduced the *Goal-oriented Regulatory Intelligence Method* (GoRIM) [3]. GoRIM is a method that uses the same conceptualization (i.e., goal models expressed with the *Goal-oriented Requirement Language* – GRL [4]) to capture regulations and regulatory initiatives/programs. GoRIM also supports the tool-based visualization and analysis of data derived from the evaluated goal models. Here, we demonstrate our use of IBM Watson Analytics [5], a commercial tool, with GoRIM. This tool enables new types of analyses, including the performance analysis of regulations and programs over common business intelligence (BI) dimensions such as time and locations/organizations, and the exploration of correlations between goal models.

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2 Building Goal Models Using GoRIM

Every regulation has a hierarchal structure that organizes its legal text. Each regulation has a part (or chapter), a section (and possibly subsections at different levels) and eventually a rule statement. The structure of goal models also reflects such hierarchy (e.g., through decomposition and contribution links connecting goals), thereby enabling their use for capturing regulations. In GRL, indicators that capture data from compliance activities can also be added to the model of the regulation to enable computing compliance levels. Similarly, regulatory initiatives can be likened to business processes with goals to be achieved, tasks to be done, resources to be used, and indicators that enable assessing the satisfaction levels of the goals. GRL has also been used to model and evaluate business processes [6]. Fig. 1 describes the steps involved in building the goal model of a given regulation using *jUCMNav*, an Eclipse-based tool for modeling and analyzing goal models [7, 8]. As described in [9], a spreadsheet is used to capture informal regulatory text and define hierarchical relationships and supporting indicators. Such spreadsheet can be imported by jUCMNav to build the corresponding goal model, with graphical views for each intermediate goal in the hierarchy.

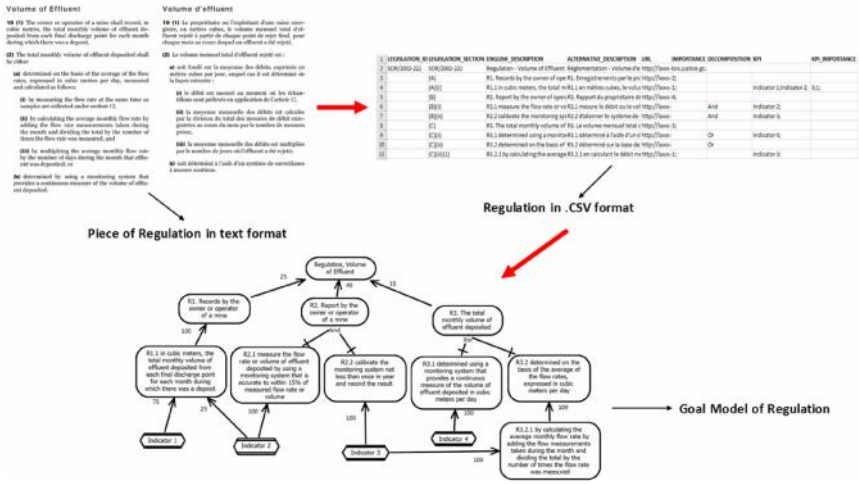

Fig. 1. Conversion of regulatory text to a GRL goal model in jUCMNav (not meant to be read)

3 Goal Model Evaluation and Data Output with jUCMNav

Using GRL evaluation strategies and algorithms [8, 10], the models of the regulation and of the regulatory initiatives used in administering the regulations are evaluated to derive regulatory compliance and performance data respectively. The input to such evaluation step is observations (from inspections, financial results, etc.) feeding the indicators for different regulated parties at different times. The two data sets illustrated (e.g., Fig. 2) are then exported as comma-separated value (CSV) files by jUCMNav. Such files can finally be imported by IBM Watson Analytics [11] for visualization and

analysis. Here, only the evaluation data sets (goal satisfaction levels) are imported. Watson is made aware of model goals, but not of model relationships (not needed).

Evaluated Regulatory Compliance Data

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Month	Year	Province	Regulatio	R1_Owne	R2_Owne	R3_TotalM	R1.1_Mon	R2.1_Vol	R2.2_Calil	R3.1_Daily	R3.2_Daily	R3.2.1_Avg	Monthl
2	April	2014	Manitoba	16	0	50	75	0	50	75	25	75	75	
3	April	2015	Manitoba	33	100	0	25	100	50	0	25	25	25	
4	April	2016	Manitoba	51	100	0	75	100	50	0	25	75	75	
5	April	2014	NovaScoti	100	100	100	100	100	100	100	100	100	100	
6	April	2015	NovaScoti	75	75	75	75	75	75	75	75	75	74	
7	April	2016	NovaScoti	100	50	50	50	50	50	50	50	50	49	
8	April	2014	Ontario	100	100	100	100	100	100	100	100	100	100	
9	April	2015	Ontario	74	75	75	75	75	75	75	75	75	75	
10	April	2016	Ontario	49	50	50	50	50	50	50	50	50	100	
11	April	2014	Quebec	75	75	25	0	50	100	75	0	100	51	
12	April	2015	Quebec	0	0	25	50	75	50	25	50	50	49	
13	April	2016	Quebec	75	75	25	75	50	0	75	50	0	49	

Evaluated Performance Data

	A	B	C	D	E	F	G	H	I	J	K	L
1	Month	Year	Province	Program	P1_Compl	P2_Achie	P1.1_Disc	P1.2_Effl	P2.1_Regu	P2.2_Regu	P1.1.1_Pr	P1.1.2_Progra
2	April	2014	Manitoba	59	49	75	50	50	75	75	50	75
3	April	2015	Manitoba	61	36	100	25	75	100	50	75	25
4	April	2016	Manitoba	64	74	50	75	75	50	50	100	75
5	April	2014	Ontario	25	75	100	25	25	50	75	100	100
6	April	2015	Ontario	75	25	100	75	75	50	50	50	100
7	April	2016	Ontario	25	50	50	25	25	0	100	0	50
8	April	2014	Quebec	75	75	100	50	100	75	75	25	61
9	April	2015	Quebec	0	0	100	50	100	0	25	0	40
10	April	2016	Quebec	50	50	50	25	50	50	50	25	38
11	April	2014	NovaScoti	61	75	50	100	75	25	100	36	61
12	April	2015	NovaScoti	40	25	50	100	0	0	100	0	40
13	April	2016	NovaScoti	38	50	25	50	50	25	50	50	38

Fig. 2. Evaluated regulatory compliance and performance data

4 Visualization and Analysis in Watson Analytics

In our regulatory management context, we want to see how one data set "Program" (*performance levels of a regulatory initiative*) influences another data set "Regulation" (*compliance level of a regulation*). To do this, we join both data sets focusing on columns common to both data sets and the column representing the factors of interest (*year, month, province, program and regulation*). We can then ask Watson Analytics questions such as "`What drives Regulation`". Upon analysis of the data, as illustrated in Fig. 3, Watson Analytics offers a spiral visualization showing the key drivers.

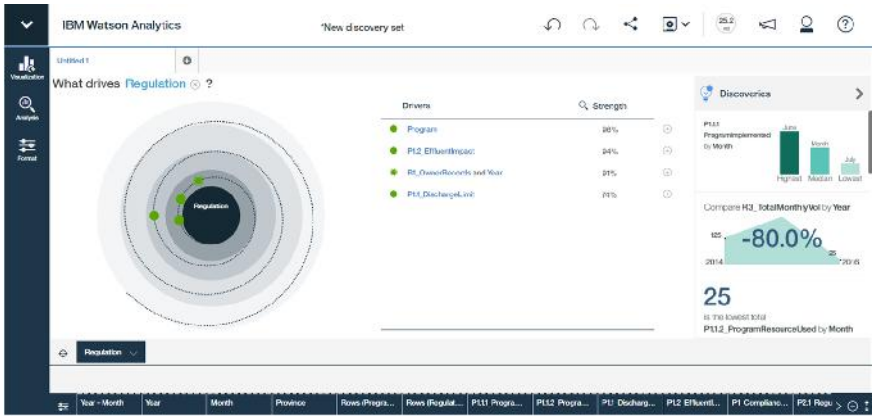

Fig. 3. Spiral visualization showing drivers of regulation from regulatory initiatives

In Fig. 3, the predictive strength of "`P1.2_EffluentImpact`", a column in the "`Program`" table of Fig. 2, is a measurement that helps understand the importance of this column derived for the initiative's goal model in predicting the compliance levels observed in "`Regulation`". The higher this predictive strength, the stronger the impact. Such information is valuable to the regulator in understanding what part of its regulatory initiatives affects the regulation the most, and whether programs are successful in promoting compliance to the regulation within regulated parties.

5 Conclusion and Future Work

This demonstration paper shows how IBM Watson Analytics can be used to visualize and analyze data derived from goal-based conceptual models of regulations and regulatory initiatives. While we are still exploring the capability of this approach using synthetic data, plans are underway to use real data and engage regulators actively in exploring the capability of Watson Analytics for regulatory management. This will facilitate drawing inferences directly related to hard-to-analyze performance-related questions of interest to regulators and indicate the usefulness of goal-based conceptual models in this GoRIM context. We hope this paper will raise the interest of the community in exploring such tools to visualize and explore goal model data in other contexts.

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