

Case Study: Using Spreadsheet to Deploy Chained Business Rules

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Abstract— This paper presents some ideas about business rules and how they are managed. The translation of business rules into electronic format enables the firm to capitalize on its written rules. By encoding electronically these rules, a junior employee could perform the activities which were used to be performed by a senior employee. While there are better software that can be used for this purpose, the ubiquity of Excel spreadsheet makes it a choice as a vehicle for translating these techniques into its proper usage. Further, critical Excel functions were shown on how to manage and encode these business rules into spreadsheet. Eleven functions or techniques of Excel spreadsheet were identified as a key technique in transforming business rules into a viable spreadsheet application. A small case study is shown to illustrate the techniques.

Index Terms— Spreadsheet Application, Business Rules, Business Rules Management Systems, Excel Techniques, Expert Systems, Micro-lending, Knowledge Acquisition.

1 Motivation

The motivation in writing this paper is to be able to highlight the usefulness of three ideas: chained business rules, tabular interpretation of business rules and specific techniques of Excel spreadsheet. These three ideas, when used properly, bring tremendous benefits to business, especially small businesses, as they could make use of the Excel spreadsheet to delegate functions to junior, but trusted, personnel.

2 Review of Literature

2.1 Using Business Rules for Business Intelligence

Mircea et.al asserted the need for business rules in a global economy challenged by many economic difficulties. Business rules “allow automatic data interpretation, definition of performance key indicators, through important redline values and provide solutions for problem solving.” [1] However, Mircea et.al. acknowledged the existence of various meanings of “business rule.”

Ronald G. Ross, as quoted by Mircea et.al. , provided the following definition: “From a business perspective, business rules are literally the encoded knowledge of your business practices, and from an Information Technology point of view, a business rule is an atomic piece of reusable business logic.” (Ross, 2003) [1]

Mircea et.al. went on to define nine categories of proposed rule patterns. These are: 1) terminology definition; 2)relationship of terminologies; 3)classification rules; 4)enumeration of items; 5)simple constraints; 6)list constraint; 7)calculation methodology; 8) inference; and 9)reaction. [1]

From the nine categories, the inference and reaction patterns refer to an IF-THEN construct, a construct that is available in many programming languages. This implies therefore that many of the operations manual key decision elements can be captured into the IF-THEN construct. Once this is done, it will be easier to transfer them into electronic format.

2.2 Business Process Requirements Engineering

Roger et. al propose the formalization of business rules.[2] One very important assertion they made is that quality products could only be attained if the customer’s perspectives are included in the production process. (This idea is well known in the study of quality management like 6Sigma.) Moreover, they explicitly stated that customer’s perspective should be represented among the set of business rules that will drive the business processes.

Further, aside from stating quoting various business rules, Roger et.al propose various aspects and operations that can be done on business rules. For instance, business rules could be a necessity or an obligation. For instance, a “necessity” is that potatoes should be fried. On the other hand, frying the potatoes for 3 minutes plus or minus 30 seconds is an “obligation.”

Operations on the rules like equivalence of rules, merging of rules and sequencing of rules have been presented. Roger et.al concluded that in the definition of rules, four perspectives needed to be included, namely: customer perspective, business perspective, employee perspective and product perspective. Customer perspective defines customer’s perception of required quality levels. The business perspective defines how to supply the needed efforts to satisfy the customer perspective. The employee perspective identifies skills necessary to perform within the business perspective. Finally, the product perspective presents various measures regarding the product specifications. [2]

2.3 Business Rule Management System

Carlo et.al. asserted the various aspects needed for a firm to be innovative in using knowledge which are captured as rules. [3] Taylor discussed that rules could be utilized properly with the use of a Business Rule Management System (BRMS).[4] Taylor defined BRMS to be a “complete set of software components for the creation, testing, management, deployment, and on-going maintenance of business rules in a production operational environment.”[4]

Among other functions, a BRMS could do the following: 1) Business Rules Repository, 2) Design Tools, 3) Rule Management Interfaces, 4) Validation and Verification Tools, 5) Testing Tools, and 6) Business Simulation Tools.

These six capabilities enable the company to transfer “rare” expertise to the rest of the organization. Further, when these rules are electronically captured, the decision maker is able to distance his judgement from his emotions. This emotional distancing enables the decision maker to have a clearer and consistent mind when making a decision. [4]

2.4 Synthesis and Inferences

In general, the IF-THEN construct is a predominant way to represent knowledge. The IF-THEN constructs could then be captured in a tabular format which we could search through. A successive IF-THEN could be captured using several tables, with the left column representing the IFs and the right column representing the THENs.

This observation agrees with Mr. Jan Vanthienen when he wrote that “*tabular models for decisions* is a powerful technique highly relevant for business rules, business processes, business knowledge, and related areas.” [5]

Hence, we could have:

IF SignColor = Red THEN Stop_Car. (1)
 IF SignColor = Green THEN Move_Car. (1)
 IF Car = Stop_Car THEN Open_Radio. (2)
 IF Car = Move_Car THEN Close_All_Phone. (2)

Table1:

SignColor	Action
Red	Stop_Car
Green	Move_Car
...	...

Table2:

Car	Action
Stop_Car	Open_Radio
Move_Car	Close_All_Phone
...	...

At this point, while we agree with Taylor about the need for a BRMS, this paper asserts that Excel Spreadsheet can be sufficiently used as a Business Rule Management System. Many small and medium scale enterprises are already in Excel. It will be a great service to these firms if we could show how some techniques to translate Excel into a viable BRMS.

3 Lists of Important Excel Formulas and Constructs

In using Excel as a Business Rules Management System, we are presenting here various spreadsheets. These techniques are needed in encoding business rules. Jell wrote about the improvements done on Excel by Microsoft. This improvement consists of hiring “two outside math consultancy

firmst to rewrite the algorithms” and then hiring a “third firm to validate which algorithm was the best for each function.”[6] These activities encourage us to believe Excel is a reliable platform for decision support systems. The following identifies the eleven techniques most useful for business rules development.

3.1 List of Options or Possibilities

This is a list of all possible answer to a checklist or question, such as Red, Orange, Yellow, Green, Blue, Indigo and Blue. In other cases, prompt like “Indicate Status of Store Activity” would demand answers from any of the following choices: “Low Count, Medium Count - Staff Relax, Very Dense - Staff Very Tense.”

Describing these situations in one’s own words would make the response accurate, however, from the point of view of the BRMS, using a pre-defined response items would make it more amenable to analysis.

3.2 Drop Down

From the list of options as discussed in topic number 3.1, we indicate here options which will enable to reflect those choices in the spreadsheet.

This is reached from the Main Menu Bar ->Data ->Data Validation, Settings (List) and Source. Here, we access the List of Options or Possibilities. By doing this way, we prevent the possibility of error in spelling by being consistent in how we refer to our answer.

It has to be noted that drop-down list should not exceed nine choices. Beyond nine, the end-user of the system would make it difficult to use the system. However, there are cases when we really need to go beyond nine, for instance, when we have to identify the country of origin of an applicant. In those cases, we probably need to break them into groups using different techniques, such as use of different fonts.

3.3 IF-THEN

The If-Then construct connects a certain situation to another situation. If the linkages are simple, then we can use the following:

IF(A1 = “Yes”, “Yes is the Answer”, “Not Yes is the Answer”)

This construct is actually connecting this paper to BRMS and to expert systems as well. By chaining the responses from one rule to another, we are able to execute the business rules properly.

For example:

Group A:

If wearing_a_pant then applicant_is_a_man.

If wearing_a_trouser then applicant_is_a_woman.

Group B:

If applicant_is_a_man then could_hire_as_driver.

If applicant_is_a_woman then could_hire_as_cook.

Group C:

If could_hire_as_driver then take_garage_test.

If could_hire_as_cook then take_kitchen_test.

By chaining these groups of rules together, we are able to reach Group C.

3.4 AND and OR

There are cases when we have to have all situations available. Having all situations available means we have to use AND. However, if only one needs to be available, then OR would suffice.

AND(A1 = "b", A2="c")

OR(A1="b", A2="c")

Pursuing the example earlier, let us assume that the test for male gender has gone beyond the wearing of a pant to the test of having a short hair and the test for female gender is by wearing an earring then we could modify group A to be:

Group A:

If wearing_a_pant OR having_short_hair
then applicant_is_a_man.

If wearing_a_trouser OR wearing_an_earring
then applicant_is_a_woman.

Let us further assume requires that all male should be able to lift 150 kilograms of dumb bell and all female should be able to cook rice in 20 minutes, then we should modify the business rules as:

Group A:

If (wearing_a_pant OR having_short_hair)
AND (can_lift_150_kilograms)
then applicant_is_a_man.

If (wearing_a_trouser OR wearing_an_earring)
AND (can_cook_rice_20_minutes)
then applicant_is_a_woman.

These constructs of OR and AND improve our capability to capture and encode business rules.

3.5 Vlookup

Since we have a tabular interpretation of the If-Then construct, we then try to get the Then part by the Vlookup construct. The Vlookup has the following syntax: Vlookup(If_value, TabularArea, 2, True_for_Approximate or False for Exact).

However, there are cases when the tabular interpretation is not complete. We then add an error mechanism, like:
= IF(ISERROR(VLOOKUP(F46,MYTABLE1,2,FALSE)),"NO RESPONSE",VLOOKUP(F46,MYTABLE1,2,FALSE))

The presence of the ISERROR ensures that if there is no corresponding ACTION part, then a "NO RESPONSE" will come out.

As we have asserted in the synthesis, several rules of similar structure could be grouped together into a group. For instance,

If Traffic_Light_is_Red Then Stop_the_Car.

If Traffic_Light_is_Green Then Move_the_Car.

If Traffic_Light_is_Orange Then Prepare_to_Stop_Car.

If Someone_Does_Not_Pay Then Call_Police.

While all of these can be captured in one single table of IF (first column) and THEN (second column), the fourth rule does not seem to belong in this group. We then have to set up a different table for that group, if there will be several rules of that type.

3.6 HyperLink and the Hyperlink function

To connect to another sheet or spreadsheet, we could use the hyperlink:

Main Menu - Insert - Hyperlink or

The Hyperlink function is denoted by:

=HYPERLINK("[BOOK.XLSX]SHEET!COLROW")

This capability enables us to bring into the solution set the use of other Microsoft Document such as Word, Powerpoint or even Access. Quite often, many of the forms are needed as part and parcel of a solution set. By incorporating these into the spreadsheet, but located in another workbook, we are able to enhance the solution we provide.

Further, there are cases when solutions or rules are needed to be quoted or analyzed. By the use of the hyperlink, we are able to bring in rules and procedures (or even checklist) into the set of business rules.

3.7 Formulas

Any calculations would use the following: "= A1 + A2." We can always academic-based formulas being used extensively in the industry, for instance the computation of future value (FutureValue = PresentValue * (1 + InterestRate^n), where n is the number of compounding.)

Another formula will be the accounting formula of Asset = Liability + Equity. Computations of Economic Order Quantity of each product can also be done instantaneously.

3.8 Range

Highlighting a certain area and giving it a name would facilitate our efforts. Quite often, we would need to work on a certain range for instance B24:D50 (Cell_B24 up to Cell_D50). Referring to such an area of cells via a cell basis would make its usage harder. By simply identifying it as a cell_range, referring to it in the VLookup and other statistical tool would be easy.

3.9 Concatenation

Concatenation is an alternative to the situation of AND. The syntax is denoted as:

=Concatenate(A1,A2)

For instance, the rule

If having_short_hair
AND (can_lift_150_kilograms)
then applicant_is_a_man.

'can be represented as:

'having_short_hair" "can_lift_150_kilograms"

Hence, we could rewrite it as:

If 'having_short_hair" "can_lift_150_kilograms"
then applicant_is_a_man.

3.10 Cell and Sheet Protection

This technique is used when are about to distribute our work. By protecting the entire spreadsheet, except for a few items, we are enhancing the integrity of our application.

This is achieved by following the navigational sequence.

Main - Review - Protect

However we have to emphasize that before we enable the protection, we should not lock the areas of the spreadsheet where the end-user would want to enter data.

3.11 Cell Coloring

Another approach to enhancing the spreadsheet's utility is to color the cells. This is achieved by the following navigational sequence:

Right Click On The Cell- Fill Color and Right Click - Font Color

A colored cell adds dimension to the cell. A green might require the end-user to key-in a response, while a red would mean the end-user should not touch that particular cell. In fact we can generate different colors based on the value of that cell by using conditional formatting.

4. Case Study: Micro-lending Enterprise

We present here a simple case for a micro-lending business. This spreadsheet is used to guide the lending agents in dealing with its clientele. For business confidentiality agreement, many of the rules were modified. However, the

main essence of using it as an example has remained intact.

Rule1

If the Asset Base is more than \$1000
Then Extend Loan facility of \$100,000

Rule2

If the Asset Base is more than \$5000
Then Extend Loan Facility of \$500,000

Rule3

If the Asset Base is more than \$10,000
Then Extend Loan Facility of \$1,000,000.

Rule4

Asset Base is computed as the latest purchase price recorded *
(1-(currentYear - Latest purchase year)/100)

Rule5

If the Loan Facility is \$100,000
Then ask for a proof of continuity.

Rule6

If the Loan Facility is \$500,000
Then ask for a proof of business employing no less than 10 people.

Rule7

If the Loan Facility is \$1,000,000
Then ask for a proof of business employing no less than 50 people.

Rule8

If there is a proof of business
Then approve the loan.

Rule9

If there is no proof of business
Then ask for cash deposit of 50% of loan.

Rule10

If all requirements are appropriate
Then Approve the Loan
Otherwise Deny the Loan.

4.2 Key Spreadsheet Codes

We simply need three input numerical parameters, namely: Latest Purchase Price (LPP), Last Purchase Year(LPY) and the current year (NOW).

Cell_F38 <- {space for entering Latest Purchase Price, LPP}
Cell_F40 <- {space for entering Latest Purchase Year, LPY}
Cell_F42 <- {space for entering the current year, NOW}

Cell_F44 <- "=LPP * (1 - (NOW - LPY)/100)"
Cell_F46 <- "=Vlookup(F44,LF,2,TRUE)" - where LF is a table consisting of AssetBase and LoanFacility.

LF	
ASSETBASE	LOANFACILITY
0	0
1000	100000
5000	500000
10000	1000000

Cell_F48 <- "=VLOOKUP(F46,REQ,2,FALSE)" - where REQ is a table consisting of Loan Facility and Requirements.

REQ	
LOAN FAC	REQMNTS
100000	PROOF OF CONTINUITY
500000	PROOF OF BUS, EMP >= 10
1000000	PROOF OF BUS, EMP >= 50

Note that Rules 1, 2 and 3 are taken-care of by table LF. Rules 5, 6 and 7 are taken-care of by table REQ. Cell_F44 contains computational rule.

Continuing, Cell_F50 would require an entry of YES or NO regarding whether proof of business were submitted.
Cell_I50 <- "=IF(F50="YES","Y","N")"

Cell_F52 <- "=IF(F50="YES","APPROVE LOAN","ASK FOR 50% DEPOSIT")"
This captures Rule 8 and 9.

Cell_I52 <- "=IF(I50="Y","A","X")"

Cell_54 is a space to input whether 50% deposit were submitted.
This works with Rule 9.
Cell_I54 <- "=IF(F54="YES","Y","N")"

Cell_F56 <- "=IF(I56="D","DENY LOAN","APPROVE LOAN")"
This captures rule 10.
Cell_I56 <- "=IF(AND(I50="N",I52="X",I54="N"),"D","A")"

Cell_F58 is an hyperlink leading towards the proper form.

5. Conclusion

This paper started with the motivation of being able to put together three ideas: chained business rules, tabular equivalence of business rules and specific spreadsheet techniques. These three ideas, when properly put together, can deliver a small and medium scale enterprises oriented Business Rules Management Systems (SME-Oriented BRMS) solution.

It has been noted that the Excel spreadsheet has

grown to be capable of supporting numerous types of applications. It has even been applied to mapping applications.[7] In this paper we showed Excel's viability as a tool in capturing and encoding rules into a spreadsheet solution. This paper listed eleven key constructs of Excel in delivering a usable Business Rules Management Systems. After having explored those eleven building blocks, a modified example (micro-lending) was shown to highlight its applicability.

We have to note that having encoded the business rules in Excel, the end-user did not feel threaten by the computer-based solution. As fear was absent, and thinking that the Excel is an ordinary tool, the process of improvement and refinement of the rules was rapid. Further, information on its improvement was spontaneous as everyone try to help correct the rules.

This validates the research result of Chanin Yoopetch[8] in stating that as far as knowledge acquisition in small firms is concerned, the role of social network and team-work contributes significantly.

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