Business Rules for Business Governance

Naveen Prakash[1], Deepak Kumar Sharma[1,2] and Dheerendra Singh[3]

[1]*Department of Computer Science & Engineering, MRCE, Sector 43, Faridabad, 121001, India*
[2]*Research Scholar, Punjab Technical University, Kapurthala Jalandhar, India*
[3]*Department of Computer Science & Engineering, SUSCET, Tangori, Mohali, India*

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Abstract: To reduce the gap between the business-oriented view of business rules of business people and the technical orientation of technical people, we introduce a Business layer on top of the CIM layer of MDA. This facilitates an investigation into the features of business-oriented business rules. We underpin our work with a four dimensional framework of business rules consisting of the domain, system, representation, and application dimensions. Since our focus is on features of business rules, our interest is the domain dimension. This dimension provides a number of attributes of business rules but we concentrate on the governance/guidance attribute to develop the features needed for capturing this attribute in business rules. We express governance concepts in three levels. The Governance model is the top most level and consists of governance objects, governance criteria, and the governance relationship between these. We obtain BIGm by instantiating the Governance model based on concepts of the Business Motivation Model. Finally, BIGm is instantiated to yield BOGm. We illustrate our business rules with examples from the library management domain.

1 INTRODUCTION

Business rules have been the subject of much research. The MDA (OMG, 2003) framework has been used for organizing business rules(Gaweł, 2012): at CIM we have proposals like SBVR(OMG,2008), RECON (Barkmeyer, 2013), and ACE(ACE, 2003); at PIM we have Rule ML and R2ML; finally at the PSM level we have Java, .Net, and other rule engines etc. Business rules are used for forward engineering of systems in (Kardasis, 2004) and for reverse engineering systems as in (Wang, 2004), (Gang, 2009).

Frameworks for understanding business rules were developed. The framework of (Kardasis, 2004), organizes collection, expression, and structuring of business rules to develop a business rules management system, BRMS. The framework of (Dubauskaitė, 2009) was built to address business rule elicitation. Notice that these frameworks emphasize the Information/software systems perspective of business rules.

In contrast to this technical information system perspective, the Business Rules Manifesto (Ross, 2003) highlights the business view of business rules. This perspective is in ten articles and their clauses.

The Business Motivation Model(OMG, 2011)sees a business rule as a 'directive' that guides and governs courses of action. While not elaborating the nature of this governance, the Model assumes that the representation of business rules is in accordance with SBVR. However, SBVR is positioned at the CIM level of MDA that is information system oriented (Gaweł, 2012).This creates a mismatch between the business level of the Motivation Model and the CIM level of SBVR.

To remove this mismatch, we introduce a Business level above the CIM layer. The Business level facilitates a full investigation of the notion of governance/guidance of the Motivation Model. As a result, we obtain a number of new aspects of business rules from the business perspective.

In an earlier position paper (Prakash,2013), we proposed that the definition of the business layer is 4-dimensional: we identify the features of business rules in the domain dimension, represent them in the representation dimension, develop a BRMS in the system dimension and use rules to develop

applications in the application dimension. The attributes of each dimension were identified in (Prakash, 2013).

This paper constitutes our first attempt to define the Business layer and deals with the 'guides' attribute of the domain dimension (Prakash, 2013). We shall explore the role of other attributes of the domain dimension as well as other dimensions in subsequent work.

As shown in Figure 1, the Business layer sits on top of the CIM layer. The left hand side of the figure shows our approach to populating the Business layer as consisting of three levels of models. The top two levels are the underpinnings of the third layer.
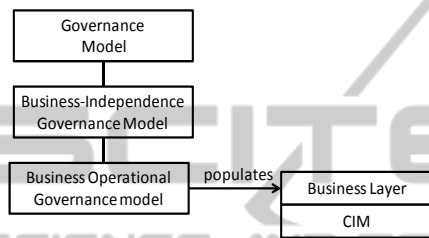

Figure 1: Populating the Business Layer.

At the topmost level, we have a generic model, the Governance Model. This model brings out the essential nature of guidance/governance independent of the nature and level of business rules. To obtain our business oriented governance model, we instantiate the generic model to get a Business Independent Governance model, BIGm. This enables us to define the concepts in terms of which governance in businesses is conceptualized. It is business independent; all businesses that agree to the instantiated concepts can define their governance system. Finally, we will instantiate BIGm with the operational concepts of a business to get BOGm, the Business Operational Governance model.

In the next section, we consider the domain dimension of our framework in detail. In section 3, we describe the Governance Model and explain its salient features. Thereafter, in section 4, we present BIGm. Section 5 contains BOGm along with the typology of business rules.

2 THE DOMAIN DIMENSION

The 4-dimensional framework is generic, it applies to business rules at any level of abstraction, Business, CIM, PIM, or PSM. It identifies the attributes of each dimension. These attributes take on values that determine the exact nature of the business rule. Since our interest is the domain of business rules, we describe here the attributes and values of this dimension.

There are four attributes of the domain dimension (see Figure 2) as follows:

a. Guides: This tells us what the business rule controls. It takes on one or more values from the set {courses of action, enablement of courses of action, event, function, trigger, business process}. According to the Business Motivation Model, a business rule can guide the first two in this set. Therefore, guides = {courses of action, enablement of courses of action}. In case of SBVR, guides ={function}. This is because its logical formulation controls a verb concept and therefore, the function carried out.

b. Contributes: This attribute describes the effect of a business. It takes values from the value set, {business goal, system goal, implementation goal, function goal}. At the business level, a business rule contributes to the achievement of a business goal. Therefore, contributes = {business goal}. On the other hand, at the CIM level, a business rules contributes to a system goal.

c. Role: This attribute tells us the purpose of the business rule. It takes on values from the set {main, exception, error, compensation}. At the business level, we have role = {main, exception}. On the other hand, at PSM, the role attribute will include errors.

d. Cost: This attribute is about the exclusions that a business rule entails. It takes values from {lost opportunity, lost freedom, lost functionality}. At the business level Cost = lost opportunity (Ross, 2003). At the CIM level, SBVR suggests that the cost is loss of freedom.

Attribute	Value
Guides	SET{Course of action, Enablement of course of action, Business Process, Trigger, Event}
Contributes	SET{Business goal, System goal, Implementation goal, Functional goal}
Role	SET{Main, Exception, Error, Compensation}
Cost	SET{Lost opportunity, Lost freedom, Lost functionality}

Figure 2: The DOMAIN dimension.

We illustrate the foregoing with examples from the Library Management domain. The library deals with three broad activities namely, Manage Borrower, Provide Services, and Stock Library material. Manage Borrower involves the registration and

deregistration of Library uses. Provide Services is for issuing, returning, and reserving library material. Finally, Stock Library deals with purchase and inventory control.

From the business perspective, the business rules of the library guide and control these three courses of action and their enablement. Library business rules contribute to the objectives, Meet demand, Ensure Fair and Transparent Material Distribution. Business rules may be main business rules, for example those governing issue and return of material or exceptional, for example, those governing reservation of material when it is not readily available. Finally, there may be lost opportunity because we may constrain our library to be used only by internal users and thereby bar participation in a network of libraries.

3 THE GOVERNANCE MODEL

In the next three sections, we consider populating the business layer. Following the Business Motivation Model (OMG, 2011) we assume that business rules govern the conduct of business. We elaborate this view in the Governance model (see Figure 3). The model consists of

- Governance Object: A governance object is an active business concept. By 'active', we mean that governance objects are executable and are the means to achieve business objectives. Governance objects may be business strategies. Governance objects need to be controlled and deployed in specific business situations.
- Governance Criteria: Define the situation in which a governance object is deployed. This situation may be the satisfaction of a condition. For example, the governance object, Register Borrower, is deployed only upon satisfaction of the criterion that the borrower is a student.
- Governance Relationship: Associates governance objects with their criteria. As shown in Figure 3its cardinality is M:N and that there must be a minimum of one criterion associated with a governance object. This is because uncontrolled execution of a governance object can lead to unforeseen business situations.
- Governance Properties: These are attributes of the governance relationship. Governance properties may elaborate on the nature of the governance, for example, whether it is automatable or manual, or it may specify constraints.
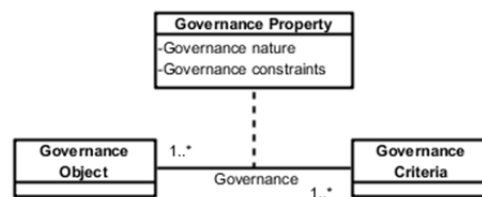

Figure 3: The Governance Model.

The Governance Model makes provision for answering three kinds of questions in a business, namely,

- What is to be governed? Governance objects are to be governed.
- What does governance do? It is the application of governance criteria to governance objects to determine whether the governance object can be executed or not.
- What are the properties of governance? Such properties are governance nature and governance constraints

4 BIGm

There are at least two views of what is a governance object of Figure 3. One is of the Business Motivation Model (OMG,2011) that governance is for the Means aspect of a business. The other view is that governance is for achievement of business ends, its goals and objectives (Rosca, 1997). It is possible to instantiate the governance model with concepts of either of these to achieve two different business independent governance models. Here, we use the concepts of the Business Motivation Model to produce our BIGm.

The Motivation Model provides three major notions in its Means aspect. These are Mission, Courses of action and Directives. Directives govern Courses of action and there are two kinds of directives, business rules and policies. Our interest here is in the former.

We instantiate, see Table I, Governance object by the notion of Means. There are two kinds of means, course of action and enablement. The former itself is of two kinds, strategies and tactics. Courses of action interact with one another through inclusion and enablement. Inclusion implies the existence of complex courses of action whereas enablement says that a course of action is a pre-requisite/trigger for another.

Table 1: Instantiation of Governance Model.

Governance Model	BIGm
Governance Object	Means: Course of action, Enablement
Governance Criteria	Acceptability Criteria
Governance Relationship	Means: Acceptability criteria
Properties	Necessity; Validity

Summarizing, we get:

1. A course of action standing alone: an individual course of action is governed by its own business rule.
2. Let us define a complex course of action as one that includes other courses of action. Evidently, governance for both the included as well as the complex course of action is needed: if a course of action A includes B and C, then all three are separately governed by their own rules.
3. Governance of enablement: let a course of action A enable course of action B. In addition to the individual business rules of A and B, there are business rules governing enablement.

Figure 4 shows the three kinds of means, atomic, complex courses of action as well as enablement.

The Governance model defines governance as the determination of whether a governance object should or should not be done. We model this in Figure 4 by the relationship 'governs' between Acceptability criterion and Means. As shown, there must be at least one acceptability criterion for a means and an acceptability criterion can govern one or more means.
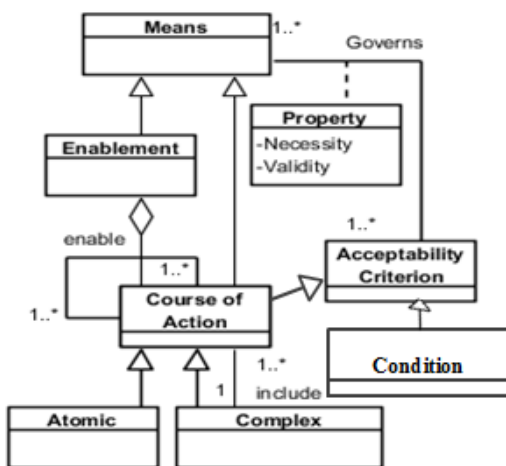

Figure 4: Business Independent Governance Model.

We define two kinds of acceptability criterion, condition and course of action. That is, either condition satisfaction or execution of a course of

action activates a means. Thus, the relationship, governs, takes on the following forms:

- <condition, course of action>
- <condition, enablement>
- <course of action, course of action>

A condition may be the state of the business or an event. For example, let a student approach to library to reissue a book already issued to him. The business rule governing the reissue is that the book will be reissued only if it is not reserved by another borrower. Here, the condition is the state 'not reserved'. Alternatively, a condition may be a temporal event. For example, reissue can be done fifteen days before the end of semester but not after.

We introduce two primitive properties of governs as follows:

- Necessity: Is it necessary to do the governance object or can it be omitted
- Validity: specifies a time for which the governance object is valid.

Necessity

An atomic course of action may be necessary or not in a given business context. If it is necessary, then the course of action must be performed. When a course of action is not necessary then it is optional.

A complex course of action has its own necessity property and each of its components has its own. For example, if A is complex and includes B and C, then it may be possible that necessity of A = yes; necessity of B = yes, and necessity of C = No. Similarly, necessity applies to enablement and course of action A may necessarily enable another course of action B.

Validity

This property imposes a time limit within which a governance object is relevant in the business. For a course of action, it specifies a validity period of the strategy/tactic whereas for enablement it specifies the time limit within which enablement occurs.

Validity has two forms, mandatory or optional. Mandatory validity means that a governance object is performed before expiry of validity or not at all. Optional validity allows violation of validity limit but subject to a penalty decided by the business. This penalty is specified as part of optional validity. We can derive the property of a deadline (Prakash, 2010) from Necessity and Validity. Refer to Table II. The first row of the table shows a hard deadline, it is necessary to perform a governance object but within a mandatory validity. In contrast (second row), a soft deadline occurs when it is necessary to

perform a governance object with optional validity but under a penalty if validity is violated. The third and fourth rows deal with conditional hard and soft deadlines. The governance object is optionally performed and validity applies only if it is performed. Conditional deadlines are so named because they are conditional on the governance object being performed.

Table 2: Types of Deadline.

Necessity	Mandatory Validity	Optional Validity	Deadline
Yes	Yes	No	Hard
Yes	No	Yes	Soft
No	Yes	No	Conditional Hard
No	No	Yes	Optional Soft

Let us illustrate the cases of deadline of Table 2. Assume that a book has been reserved in the library by a borrower. This borrower must issue the book within three days of its return otherwise the reservation is cancelled. In other words, there is a **hard deadline** as follows:

Issue reserved book within 3 days of return.

Now, let us consider a **soft deadline**. In our library, if a book is returned late than a fine is imposed:

Return book within 7 days but impose a fine for late return

We illustrate the remaining two forms of deadline by considering the course of action, Register Borrower:

- Conditional Hard deadline: registration is free up to 31 July. It is possible not to do a registration (unlike the first row) but if done then it must be before 31 July.
- Conditional Soft deadline: registration is free up to 31 July but with a fine after that.

5 BOGm

Whereas BIGm defines the set of concepts for business governance, the Business Operational Governance model, BOGm, considers governance of the business in operation. It deals with the realization, in the business, of BIGm.

The instantiation of BIGm is shown in Table III. However, we introduce in BOGm, the notion of roles found in business process modelling (OMG, 2009) as shown in Figure 5. The Organization Structure Model, OSM, (OMG, 2006) provides a way to associate organization responsibilities with business functions. We intend to use this for business rules elicitation in future work.

Table 3: Instantiation of BIGm.

BIGm Concept	BOGm Concept
Course of action	Business function
Atomic course of action	Atomic business function
Complex course of action	Complex business function
Enablement	Invocation
Acceptance Criterion	Business Criterion
Govern	Business rule

When the business rule cardinality is 1:1 then we get an atomic business function. In other words, if there is exactly one business rule governing a business function then the function is atomic. Further, a function is atomic only if there is exactly one business rule governing it. A complex business function includes other business functions. Therefore, there is more than one business rule associated with it.
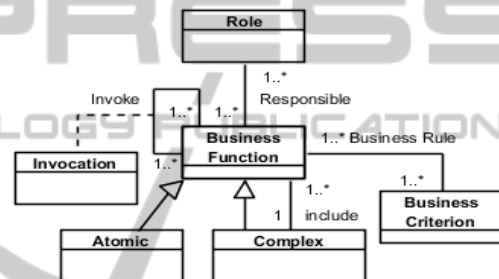

Figure 5: Business Operational Governance model.

Let there be three functions, issue service, return service and reserve service. All these are atomic business functions having business rules as follows:

- if the service request is for issue book then perform the issue service
- if the service request is for return book than perform the return service
- if the service request is for reservation of a book then perform the reserve service.

These three functions are components of a complex business function, provide services which, in turn, is governed by the three business rule of the three atomic functions and any additional rules that may apply to it.

Now, let us consider invocation that relates a business function to another. Given two business functions, Register Student as Borrower and Provide Service, we see a business rule that the latter can only be done after the former. This is a <course of action, course of action> rule of section 3.

Typology of Business Rules

Though BOGm defines business rules, it does so in a global way as an association of criteria with business

functions. We explore the notion of a business rule more deeply here by developing a business rule model.

Figure 6 shows, that the business rules model treats the notion of a business rules as an aggregate of business function and criterion. Criteria can be of two types, condition and business function as shown in Fig. 5.

When a business function executes, then it can be the antecedent of another business function or it can cause a state change. If this state change results in the satisfaction of a condition then another business rule may be activated. We model this latter by the relationship 'affects' between condition and function in Figure 6.

We illustrate the use of affects in an example from the Stock Library course of action. Let there be a minimum threshold for the number of copies of a title that the library must keep. Let us be given a business function, called Condemn Book, to remove unusable/damaged books from the library. Now, we know that not every condemnation of a book results in reordering of material. Rather, reordering happens when quantity on hand, q_o_h, falls below the specified threshold level. Thus, the reordering rule is as follows:

```
IF CONDITION q_o_h.LE. threshold THEN
reorderbook
```

This rule implies that the business relationship between Condemn Book and Reorder Book is lost. The relationship, affects, restores it. Consider the following formulation

```
   IF CONDITION damaged book THEN
condemn book
Affects(condemn book, q_o_h)
   IF q_o_h .LE. threshold THEN reorder
book
```

Notice that the relationship between Condemn Book and q_o_h is articulated by the Affects statement.

Let us now consider the different types of business rules introduced in Fig. 6. In this presentation we tacitly assume the IF-THEN representation of business rules. To distinguish between a condition/function in the IF part we use the two keywords CONDITION and FUNCTION respectively.

5.1 Atomic Business Rules

An atomic business rule is one whose consequent is anatomic business function (see Fig. 4). An example of an atomic business rule is as follows:-

```
IF FUNCTION valid borrower AND number_
issued .LT. max THEN Give Book
```

In this rule, the consequent, Give Book, cannot be decomposed any further.
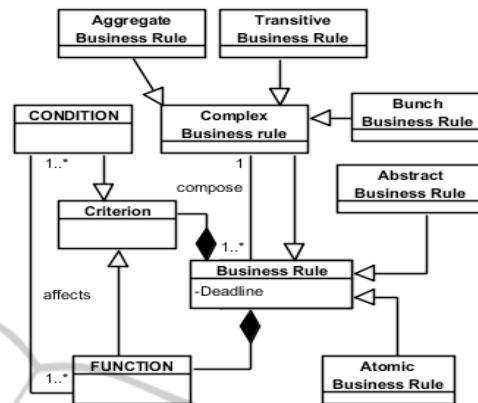

Figure 6: The Model of Business Rules.

5.2 Complex Business Rules

A complex business rule is a meaningful collection of simpler business rules. There are three kinds of complex business rules, namely 1) Bunch, 2) Transitive, and 3) Aggregate.

1. Bunch: A bunch is a named collection of business rules having a common kind of antecedent. For example, consider the collection as follows:

```
BUSINESS RULE NAME: register borrower
   IF   CONDITION   borrower   type   =
'student'   THEN   register   student-
borrower
   IF   CONDITION   borrower   type   =
'teacher'   THEN   register   teacher-
borrower
   IF   CONDITION   borrower   type   =
'administrative'  THEN  register  admin-
borrower
```

All these check the same variable. They form a bunch of business rules named Register Borrower.

2. Transitivity: It is possible to construct complex business rules using the notion of transitivity. There are two ways in which transitivity arises, through FUNCTION–FUNCTION transitivity and through the affects relationship. Let a1, a2, and a3 be business functions then the following holds:

```
   (IF a1 THEN a2) AND (IF a2 THEN a3)
implies (IF a1 THEN a3)
```

The implication, IF a1 THEN a3 is a complex business rule built over two simpler ones. As an example, consider the transitive rule,

```
   IF   FUNCTION   registration   request
THEN provide services
```

Its structure is as follows:

```
BUSINESS RULE NAME: service borrower
  IF FUNCTION registration request
THEN register borrower
  IF FUNCTION register borrower THEN
provide services
```

Second, the notion of transitivity can be extended to include the 'affects' relationship:

```
(IF a1 THEN a2) AND Affects (a2, c2)
AND (IF c2 THEN a3) implies (IF a1 THEN
a3)
```

Again, the implication, `IF a1 THEN a3` is a complex business rule.

3. Aggregate: An aggregate is a named collection of business rules meeting a business governance objective. It is a rather loose collection that is not constrained by the norms of the other complex business rules. So long as the governance objective is met, an aggregate is defined. An example is as follows:

```
BUSINESS RULE NAME:  manage user
  IF FUNCTION registration request
THEN register user
  IF FUNCTION deregistration request
THEN deregister user
```

Manage user is a governance objective and the two rules above are both relevant to this objective. We say that Manage user is an aggregate of Business rules.

5.3   Abstract

An **abstract** business rule is a generalization of other business rules. This generalization can occur when the business object of the antecedent and/or consequent enters into generalization/specialization relationship with other business objects. An example of an abstract business rule is as follows:

```
BUSINESS RULE NAME   :issue book
  IF valid borrower AND number issued
less than maximum THEN give book
Generalization of
  BUSINESS RULE NAME : issue book
student
  IF valid student borrower AND number
issued less than student maximum THEN
give book
  BUSINESS RULE NAME : issue book
teacher
  IF CONDITION (valid teacher borrower
AND number issued less than teacher
maximum) THEN give book
```

Here, the business object, borrower, of the antecedent can be specialized into student borrower and teacher borrower respectively. This gives rise to the two specialized rules.

6   COMPARISON

Our proposal is to introduce a Business level on top of the CIM level. BOGm populates this layer and reveals a number of features of business rules from the perspective of business people.

Table 4 contains a feature analysis of BOGm with SBVR(OMG,2008), ACE(ACE, 2003), and RECON(Barkmeyer,2013) of the CIM level. The first column of this table contains the features of BOGm obtained from Figure 5. The rest of the columns indicate the presence of the BOGm feature in SBVR, ACE, and RECON respectively.

Table 4: Feature analysis of BOGm.

S. No.	BOGm	SBVR	ACE	RECON
1	Atomic business rule	Yes	Yes	Yes
2	Complex Business Rule	No	No	No
2 a	Bunch	No	No	No
2 b	Aggregate	No	No	No
2 c	Transitive	No	No	No
3	Abstract Business Rule	No	No	No
4	Criterion	Yes	Yes	Yes
4 a	Condition	Yes	Yes	Yes
4 b	Function	No	No	No
5	Necessity	Yes	No	Yes
6	Validity	No	Yes	No
7	Deadline	No	Yes	No

It can be seen that BOGm provides a fairly rich variety of business rules: atomic, three forms of complex, and abstract business rules. The complex and abstract business rules are not found in SBVR, ACE, and RECON. To be sure, it is possible in these approaches to separately express the abstract and complex rules comprising the bunches, aggregates and transitive rules. The notion of complex business rules and abstract rules of BOGm provides the hierarchical abstraction that binds these together. However, the hierarchical abstraction of BOGm is missing in SBVR, ACE, and RECON.

Now, let us look at the Acceptability criteria of BOGm business rules (rows 4, 4a and 4b of the Table IV). All approaches have the notion of condition. In SBVR, this is realized through its noun concept and as noun phrase in RECON. Now the BOGm notion of a function as an acceptability criterion is not found in SBVR, ACE or RECON. This is because of the restriction of a criterion being expressed as a noun concept or noun phrase respectively.

The notion of necessity of row 5 of the table is found in all approaches except ACE. It takes on the form of modal operators in SBVR and RECON. There is no notion of obligation in ACE. However, validity (row 5) is not present in SBVR. It is available in ACE . The situation with RECON is that the basic grammar for its vocabulary provides capability for date and time. However, the semantics of these in business rules is not available in (Barkmeyer,2013).

The last row of the table considers the specification of a deadline in business rules of BOGm. This notion is missing in SBVR and RECON but is available in ACE.

7 CONCLUSION

Our proposal is to introduce a business layer on top of the CIM layer. This helps us to focus on the business nature of business rules. We picked up the 'guides' attribute to develop BOGm that populates this layer. This model suggests that business oriented business rules (a) govern not only courses of action but their enablement too, (b) are not only flat but also hierarchically structured, (b) have the notion of validity which coupled with necessity leads to deadlines for business rules. We have shown that whereas necessity is an existing notion, enablement, hierarchical structure, validity and deadlines are specific features of business oriented business rules.

In future, we intend to bring in other attributes of the business layer in BOGm to make it comprehensive. Thereafter, we shall look for a representation system for business oriented business rules and develop a BRMS.

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