What are the deep business semantics of decision rules, decision models, and decision tables? What do they represent from the business (not software) perspective? How can you communicate about them in precise, formal matter? This comprehensive SBVR vocabulary provides in-depth specification in the form of a concept model — a structured business vocabulary — covering all the component concepts. Yes, there is far more going on semantically in decisions than you might have imagined! For one thing, the core is about business questions and business answers. You also need restrictions (rules) for decision tables. Extensive examples help you navigate these and other ideas. A heads-up: This vocabulary is what engineers (not practitioners) need to implement semantically robust tools.

Decision Vocabulary

by Don Baisley, Keri Anderson Healy, and Ronald G. Ross

The purpose of this vocabulary is to address the following special business rule concerns:

- How rules that are specifically based on implications are treated in SBVR.[1] Such rules, called *determination rules,* support inferences.

- How *sets* of complementary determination rules are formed in order to answer a given business question under a variety of circumstances predictable in advance. Such sets of determination rules are often presented in the form of decision tables, and thus are said to support the making of business decisions.

- What effect behavioral rules can have on such *sets* of determination rules.

Determination rules have special structure that other rules do not. Specifically, only determination rules are based on logical implications, which involve antecedents and consequents. This vocabulary addresses the following related questions:

- On what basis do such antecedents and consequents arise?

- How can the special structure of determination rules be used to organize them into collections — e.g., as represented by decision tables?

In short, this vocabulary addresses the fundamental semantics of determination rules.

Cases and Determinations

This vocabulary is illustrated by the following example case:

> For EU-Rent: The one-way rental '123456' placed on 8/16/2014 at 10:39AM London time by Chris Q. Smith requires a drop-off charge to be determined. The appropriate charge is determined based on the facts that the pick-up location of the rental is the Gatwick airport branch and the rental is a local one.

---

[1]Refer to: "SBVR Support for Inference: Logical Effects of Claims of Necessity and Obligation on Implications", by Donald E. Baisley, Keri Anderson Healy, and Ronald G. Ross, *Business Rules Journal*, Vol. 20, No. 4, (Apr. 2019). http://www.brcommunity.com/a2019/b988.html

The sense of a *determination* as used in this vocabulary is *the resolving of a question by argument or reasoning* [MWUD "determination" 2]. A determination is always the actual result of reasoning over rules for some particular case (as for the one-way rental '123456' in the example above). Since evaluation of rules for actual cases arising in the business is outside the scope of SBVR, *determination* is not included as an entry in this vocabulary.

No entry for *case* is included for the same reason. As meant here, a *case* is *a set of circumstances constituting a problem: a matter for consideration or decision* (MWUD 1b).

In general, no entry in this vocabulary should be construed in the sense of actively evaluating or considering actual facts for any specific case. The following are always outside scope:

- Actual determinations for specific real-world cases.
- Evaluations of actual facts and determination rules to reach such determinations.

Questions and Answers

The fundamental semantics of determination rules depends on posing appropriate questions and identifying relevant answers to those questions. For the EU-Rent example above, the underlying business question being asked is *What is the drop-off charge for a given one-way rental?*

- Posed for one-way rental '123456', that question becomes *What is the drop-off charge for the one-way rental '123456'?*
- Suppose the correct answer for that rental according to some determination rule is €75. This answer is given as *The drop-off charge for the one-way rental '123456' is €75.*

In creating determination rules, however, specific real-world cases are always out of scope. Individual cases like rental '123456' are never referenced by such rules. For that reason, questions and answers always involve at least one universally quantified variable. Consequently, the expressions above would be given respectively as:

- *What is the drop-off charge for a given one-way rental?*[2]
- *The drop-off charge for the rental is €75.*[3]

The Structure of Determination Rules

Every determination rule has intrinsic structure involving an antecedent and a consequent.

- The antecedent comprises some particular consideration item(s) for one or more considerations.
- The consequent is a rule-based answer for some business question.

The following diagram illustrates this structure for a determination rule that addresses the business question *What is the drop-off charge for a given one-way rental?* For clarity in illustrating the rule's structure, the rule is expressed in 'if-then' format.

---

[2] In this example question, "a given rental" refers to each rental — that is, the variable is universally quantified. The word "given" is included in this question, and in all others in this Vocabulary, to remove ambiguity that might arise if "a/an" alone were used. "Given" can be omitted if the meaning of a question is clear in context.

[3] The meaning of this second expression is understood only in the context of the first. Apart from the first expression, this second expression has no meaning.
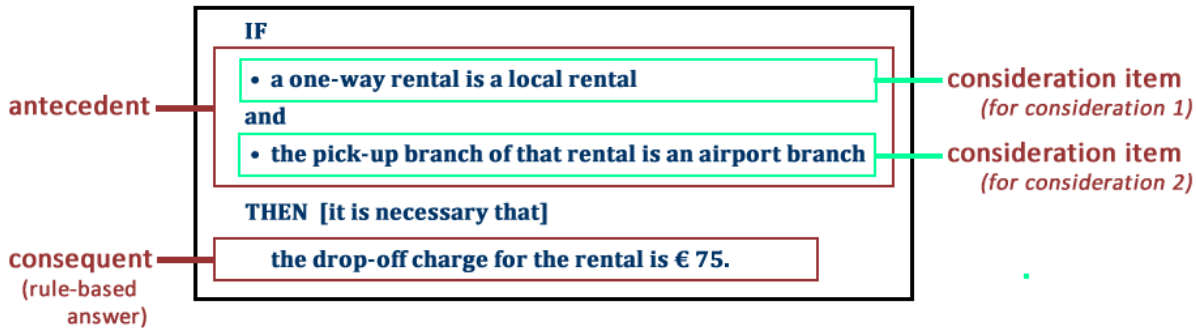
business question

What is the drop-off charge for a given one-way rental?

consideration 1 • *Is the rental local or not?*

consideration 2 • *Is the pick-up branch an airport branch or not?*

one **determination rule** for the business question

IF

• **a one-way rental is a local rental** ———— **consideration item** *(for consideration 1)*

and

• **the pick-up branch of that rental is an airport branch** ———— **consideration item** *(for consideration 2)*

antecedent —

THEN [it is necessary that]

the drop-off charge for the rental is € 75.

consequent — (rule-based answer)

Sample Decision Tables

The decision table below represents the set of EU-Rent determination rules that answers the focal business question *"What is the drop-off charge for a one-way rental?"* — based on the considerations pertaining to the rental being a local rental (or not) and the pick-up branch of the rental being an airport branch (or not). The table is represented in a cross-tab (or intersection) format showing rule-based answers (consequents) in abbreviated form.

What is the drop-off charge for a given one-way rental? ———— **business question**

		pick-up at airport?	
		Yes, at airport	**No, not at airport**
local rental?	**Yes, local**	€ 75	none
	No, not local	€ 325	€ 150

consideration — *pick-up at airport?*

consideration item — *Yes, at airport / No, not at airport*

rule-based answer — *€ 75 / none*

rule-based answer — *€ 325 / € 150*

The decision table below is another representation (one rule per row) of the same set of determination rules presented above.

What is the drop-off charge for a given one-way rental? ———— **business question**

pick-up at airport?	local rental?	drop-off charge
Yes	Yes	€ 75
Yes	No	€ 325
No	Yes	none
No	No	€ 150

consideration

consideration item

rule-based answer

The decision table below is another representation (one rule per column) of the same set of determination rules presented above.

What is the drop-off charge for a given one-way rental? ——— business question
——— consideration

pick-up at airport?	Yes	Yes	No	No
local rental?	Yes	No	Yes	No
drop-off charge	€ 75	€ 325	none	€ 150

consideration item

rule-based answer

Complete Concept Model Diagram for the Decision Vocabulary
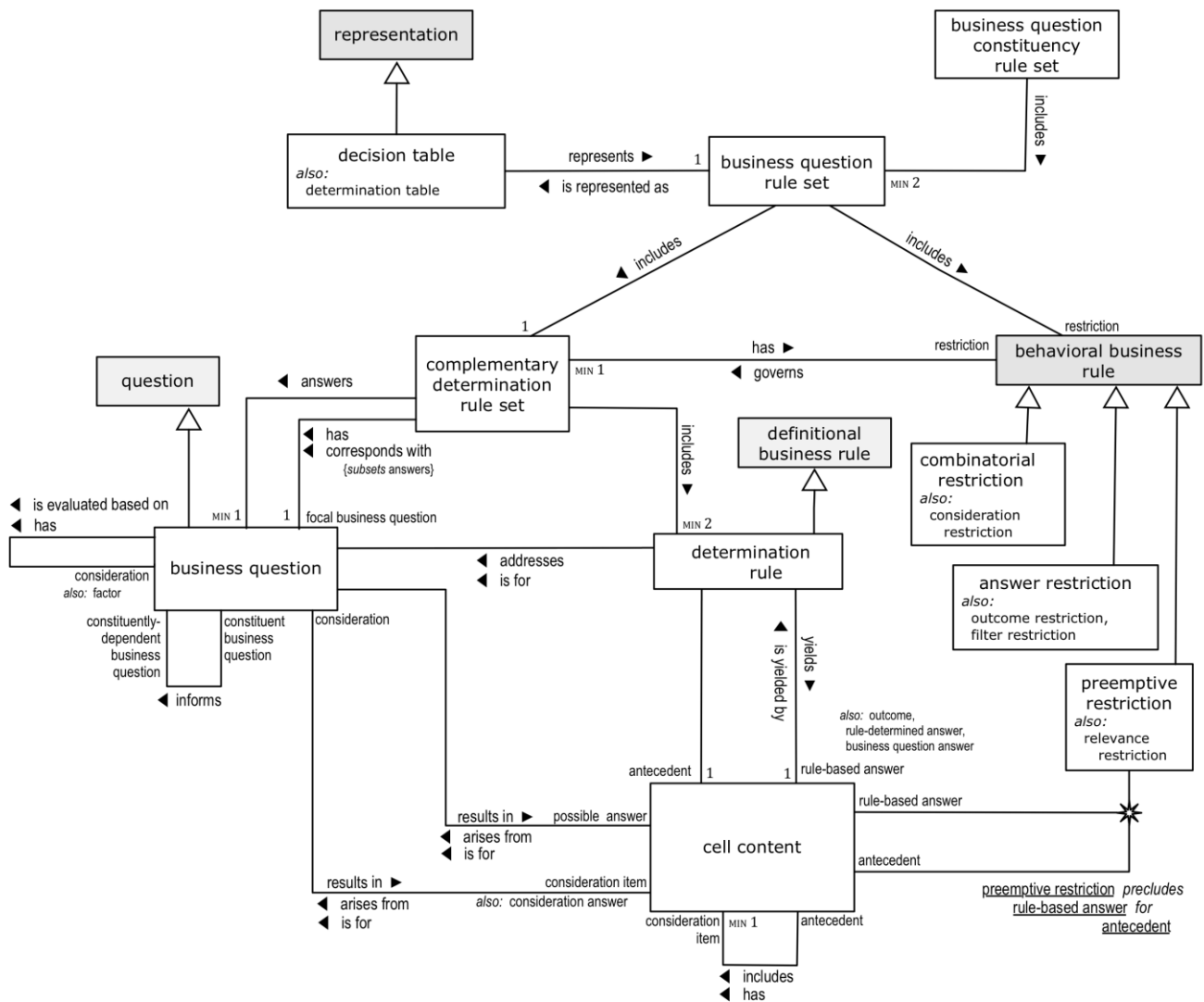
A complete concept model diagram for the decision vocabulary is presented above. The concepts represented in this diagram are defined and illustrated in the sections that follow.
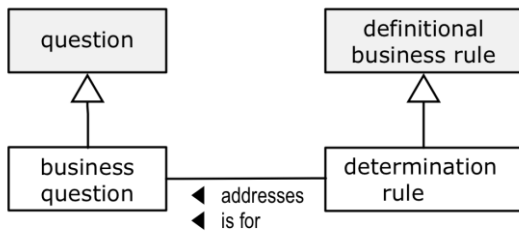
Determination Rules

determination rule

Definition:	definitional business rule that provides a logical basis by which known facts imply other facts
Example:	The EU-Rent determination rule

*"The drop-off charge for a one-way rental
must be deemed € 75
if the rental is a local rental and
the pick-up branch of the rental is an airport branch."*

establishes € 75 as the drop-off charge for a one-way rental for the following facts

- The rental is a local rental., and
- The pick-up branch of the rental is an airport branch.

According to this rule, the drop-off charge for the one-way rental '123456' placed on 8/16/2014 at 10:39AM London time by Chris Q. Smith, which was a local rental and was picked up at the Gatwick airport branch, would be determined to be € 75.

business question

|	
Definition:	question that arises in an authority's activity for cases (situations, sets of circumstances, or matters of concern) of a particular kind, for which a determination (or business decision) is desired
Example:	For EU-Rent: The business question that asks about what the appropriate drop-off charge amount is for a one-way rental; i.e., *What is the drop-off charge for a given rental?*
Note:	In creating decision tables, expressions of business questions are sometimes abbreviated. For example, the EU-Rent business question expressed above might be abbreviated "Drop-Off Charges" and used to name some decision table. Such practice runs a significant risk of failing to communicate true meaning. Accordingly, each example of a decision table presented above is designated by its full business question.

This material may be used freely in developing software tools. Contact an author for permission to publish.

determination rule *addresses* business question

Synonymous Form:	determination rule *is for* business question
Definition:	the determination rule provides a logical basis to imply a rule-based answer for the business question
Dictionary Basis:	to reach a decision about : SETTLE [MWD (6b) 'resolve']
Example:	The EU-Rent determination rule

> *"The drop-off charge for a one-way rental*
>   *must be deemed € 75*
>   *if the rental is a local rental and*
>   *the pick-up branch of the rental is an airport branch."*

addresses the business question: *What is the drop-off charge for a given rental?* E.g., Under the determination rule above, the drop-off charge for the one-way rental '123456' placed on 8/16/2014 at 10:39AM London time by Chris Q. Smith, which was a local rental and was picked up at the Gatwick airport branch, would be € 75.

Possibility:	It is possible that a determination rule *addresses* more than one business question.
Note:	A determination rule can always address more than one business question. For example, the determination rule above can also address the business questions:

1. *What is the drop-off charge for a given one-way rental?*
2. *What is the drop-off charge for a given one-way local rental?*
3. *What is the drop-off charge for a given one-way rental that is picked up at an airport branch?*
4. *What is the drop-off charge for a given one-way local rental that is picked up at an airport branch?*

The determination rule addresses these business questions in the circumstances that the drop-off charge for a given rental is unknown.

Note:	The determination rule above can answer (imply results for) at least one other business question.

Example: *Are certain circumstances precluded for a given rental?*

Circumstances: The drop-off charge for a rental is known — specifically the drop-off charge is € 99.

Inferable Fact: The determination rule above precludes the following combination of facts for the rental:
- The rental is a one-way rental., and
- The rental is a local rental., and
- The pick-up branch of the rental is an airport branch.

The determination rule requires that the drop-off charge for a rental in those circumstances be € 75, not € 99.

Business Questions and Possible Answers
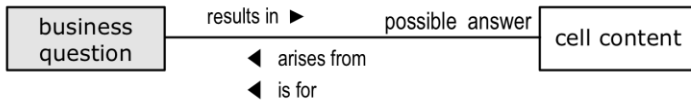
business question *results in* possible answer

Definition:	the business question brings about the possible answer
Synonymous Form:	possible answer *arises from* business question
Synonymous Form:	possible answer *is for* business question

cell content

Definition:	meaning that is expressed in a cell of a decision table
Note:	Instances of cell content, and ANDed combinations thereof, can serve as a logical operands for logical implications.

possible answer

Concept Type:	role
Definition:	cell content that is deemed an appropriate result for a given business question
Example:	For the EU-Rent business question, *What is the drop-off charge for a given rental?,* possible answers include the following:

cell content	as typically abbreviated
The drop-off charge for the rental is €0.	€ 0
The drop-off charge for the rental is €1.	€ 1
…	…
The drop-off charge for the rental is €74.	€ 74
The drop-off charge for the rental is €75.	€ 75
The drop-off charge for the rental is €76.	€ 76
…	…
The drop-off charge for the rental is €149.	€ 149
The drop-off charge for the rental is €150.	€ 150
The drop-off charge for the rental is €151.	€ 151
…	…
The drop-off charge for the rental is €324.	€ 324
The drop-off charge for the rental is €325.	€ 325
The drop-off charge for the rental is €326.	€ 326
…	…

| | Example: | For the shipping-an-order business question, *What method should be used to ship a given order?,* possible answers might include only the following: |

cell content	as typically abbreviated
The method used to ship the order is normal service.	normal service
The method used to ship the order is express service.	express service
The method used to ship the order is special service.	special service

Example: Possible answers for a yes/no business question (e.g., *Should a deposit be charged on a given rental?*) should include only the following:

cell content	as typically abbreviated
A deposit is charged on the rental.	yes, a deposit
A deposit is not charged on the rental.	no, no deposit

Note: The set of possible answers for a business question can be infinite (as for the EU-Rent business question above) or finite (as for the shipping-an-order business question above).

Considerations
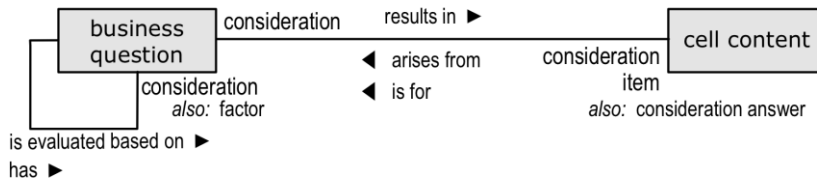
consideration

Concept Type: role

Definition: business question whose answers are instrumental in establishing a result or making a determination in some matter

Synonym: factor

Dictionary Basis: something that is considered as a ground of opinion or action [MWD (3a) 'consideration']

Dictionary Basis: matter weighed or taken into account when formulating an opinion or plan [MWD (2a) 'consideration']

| | Example: | For EU-Rent: the consideration of the type of branch, which can be expressed as follows: |

as a business question	as might be abbreviated
Is the pick-up branch an airport branch or not?	pick-up at airport?

| | Example: | For EU-Rent: the consideration of a given rental being a local rental or not, which can be expressed as follows: |

as a business question	as might be abbreviated
Is the rental local or not?	local rental?

Example: The considerations that would be used in determining the drop-off charge for the one-way rental '123456' placed on 8/16/2014 at 10:39AM London time by Chris Q. Smith, which was a local rental and was picked up at the Gatwick airport branch, are:

- *Is the rental local or not?*

- *Is the pick-up branch an airport branch or not?*

Example: For a marketing campaign: the consideration "*Does a given city have a population of over 1 million inhabitants and at least one professional or major university sports team?*"

Example: For a real estate firm: the consideration of private schools per capita (one factor in ranking mid-sized cities), which can be expressed as the business question "*What is the ratio of private schools per capita for a given mid-sized city?*"

Note: For a set of determination rules (e.g., the rules expressed in a decision table) to be complete with respect to a business question, each consideration used to evaluate that business question must not be more narrowly qualified than the business question itself. Suppose the real-estate company in the example above is interested in evaluating the business question *What is the life-style ranking of a given city?* One of the considerations is "*What is the ratio of private schools per capita for a given mid-sized city?*" This consideration includes the qualification 'mid-sized [city]', which narrows the set of cases that the consideration covers. The business question being evaluated based on that consideration, however, is not qualified as narrowly (i.e., is not also qualified by 'mid-sized'). As a result, the set of determination rules that corresponds to the business question will be incomplete. For instance, large cities and small cities will not be covered by the set of determination rules even though such cities would be within scope of the business question.

factor

See: consideration

business question *is evaluated based on* consideration

Synonymous Form:	business question *has* consideration
Definition:	the consideration is taken into account when answering the business question
Necessity:	Each business question *addressed by* a determination rule *has* at least one consideration.
Note:	A business question can be single consideration or (more often) multi consideration.
Note:	Considerations are not independent meanings. They are always understood in the context of the business question they serve to evaluate. That business question introduces one or more referents. For example, the consideration *"Is the rental local or not?"* refers to the rental from the business question "*What is the drop-off charge for a given rental?"* The referents shared by such questions play a critical role holding together the meaning of a complementary determination rule set, and thus any decision table that represents it.

consideration item

Concept Type:	role
Definition:	cell content that *arises from* a consideration and that can be all or part of an antecedent
Synonym:	consideration answer
Dictionary Basis:	an individual particular or detail singled out from a group of related particulars or details [MWD (2a1) 'item[2]']
Dictionary Basis:	an individual thing (as an article of household goods, an article of apparel, an object in an art collection, a book in a library) singled out from an aggregate of individual things [MWD (2b1) 'item[2]']
Example:	For EU-Rent: the consideration item:

cell content	*as typically abbreviated*
The pick-up branch is an airport branch.	yes, at airport branch

Example:	For EU-Rent: the consideration item:

cell content	*as typically abbreviated*
The pick-up branch is not an airport branch.	no, not at airport branch

Example: The consideration items that would be used in determining the drop-off charge for the one-way rental '123456' placed on 8/16/2014 at 10:39AM London time by Chris Q. Smith, which was a local rental and was picked up at the Gatwick airport branch, are as follows for the relevant considerations:

- For the consideration *Is the rental local or not?*:

cell content	as typically abbreviated
The rental is a local rental.	yes, local

- For the consideration *Is the pick-up branch an airport branch or not?*:

cell content	as typically abbreviated
The pick-up branch is an airport branch.	yes, at airport branch

consideration answer
See: consideration item

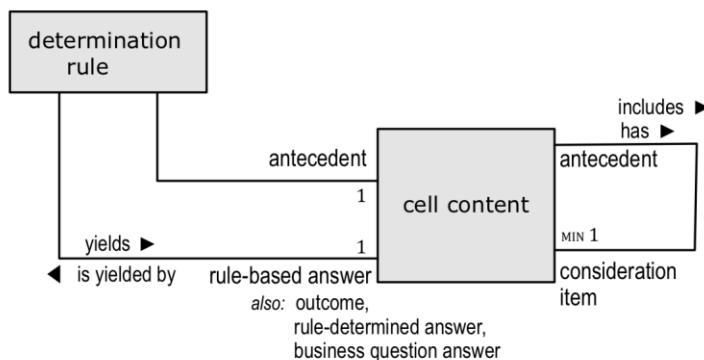## consideration *results in* consideration item
Definition: the consideration brings about the consideration item
Synonymous Form: consideration item *arises from* consideration
Synonymous Form: consideration item *is for* consideration

Elements of Determination Rules

antecedent[4]
Concept Type: role
Definition: cell content or ANDed combination of cell contents that is the condition considered by a logical operation such as an implication (e.g., what is meant by the *p* in "if *p* then *q*")

Possibility: An antecedent can be the combination of one consideration item *arising from* each of two or more distinct considerations, logically ANDed.

---

[4] Based directly on SBVR, Logical Formulation of Semantics (Clause 21).

Example: For EU-Rent: the consideration items of
- The pick-up branch of a rental is an airport branch., and
- The rental is a local rental.

serving as the antecedent in the determination rule

"The drop-off charge for a one-way rental
must be deemed €75
if the rental is a local rental and
the pick-up branch of the rental is an airport branch."

Example: The antecedent that would be used in determining the drop-off charge for the one-way rental '123456' placed on 8/16/2014 at 10:39AM London time by Chris Q. Smith, which was a local rental and was picked up at the Gatwick airport branch, is: *The rental is a local rental AND the pick-up branch of the rental is an airport branch*.

determination rule *has* antecedent

Necessity: Each determination rule *has* exactly one antecedent.

antecedent *includes* consideration item

Synonymous Form: antecedent *has* consideration item

Necessity: Each antecedent *of* a determination rule *includes* at least one consideration item.

rule-based answer

Concept Type: role

Definition: cell content that *is* a consequent *of* the logical implication *of* a determination rule

Synonym: outcome

Synonym: rule-determined answer

Synonym: business question answer

Dictionary Basis: something that follows as a result or consequence [MWD (1) 'outcome']

Note: A rule-based answer is deemed the appropriate result for the business question addressed by a determination rule based on a given antecedent.

Note: Unless a restriction is specified, it is never mandatory that any given possible answer for a business question actually ever be used as a rule-based answer in any determination rule.

Note: Unless a restriction is specified, a determination rule may indicate 'none' as the appropriate rule-based answer. In other words, a determination rule is not required to have any of the possible answers to the business question for its rule-based answer. For example in EU-Rent, 'none' is an acceptable answer for the business question determining the drop-off charge of a one-way rental. However, other than 'none', all other rule-based answers are required to be possible answers.

Necessity: The rule-based answer *yielded by* a determination rule *for* a business question is one of the following:
- a possible answer *for* that business question.
- 'none'.

Example:	For EU-Rent: When the business question *What is the drop-off charge for a given one-way rental?* addresses the consideration items of
	   • The pick-up branch of a rental is an airport branch., and
	   • The rental is a local rental.
	the rule-based answer is:

cell content	*as typically abbreviated*
The drop-off charge for the rental is €75.	€75

Example:	The appropriate answer in determining the drop-off charge for the one-way rental '123456' placed on 8/16/2014 at 10:39AM London time by Chris Q. Smith, which was a local rental and was picked up at the Gatwick airport branch, is:

cell content	*as typically abbreviated*
The drop-off charge for the rental is €75.	€75

Example:	For EU-Rent: When the business question *What is the drop-off charge for a given one-way rental?* addresses the consideration items of
	   • The pick-up branch of a rental is not an airport branch., and
	   • The rental is a local rental.
	the rule-based answer is:

cell content	*as typically abbreviated*
There is no drop-off charge for the rental.	none

Note:	Rule-based answers should not include logicial ANDs. Such compound answers generally do not address the same business question.

outcome
See: rule-based answer

rule-determined answer
See: rule-based answer
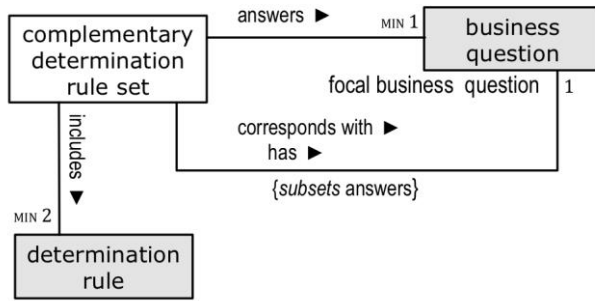
business question answer
See: rule-based answer

determination rule *yields* rule-based answer

Synonymous Form:	rule-based answer *is yielded by* determination rule
Necessity:	Each determination rule *yields* exactly one rule-based answer.

Complementary Determination Rule Sets

complementary determination rule set

Definition:	set of determination rules that provides the definitive set of rule-based answers for a business question based on the same set of one or more considerations
Dictionary Basis:	of, relating to, or suggestive of complementing, completing, or perfecting [MWD (1) 'complementary']
Dictionary Basis:	mutually dependent : supplementing and being supplemented in return [MWD (2) 'complementary']
Example:	The following set of EU-Rent determination rules — answering the business question *What is the drop-off charge for a given one-way rental?* — based on the considerations pertaining to the rental being a local rental (or not) and the pick-up branch of the rental being an airport branch (or not):

> *The drop-off charge for a one-way rental must be deemed € 75*
> *if the rental is a local rental and the pick-up branch of the rental is*
> *an airport branch.*

> *The drop-off charge for a one-way rental must be deemed 'none'*
> *if the rental is a local rental and the pick-up branch of the rental is not*
> *an airport branch.*

> *The drop-off charge for a one-way rental must be deemed € 325*
> *if the rental is not a local rental and the pick-up branch of the rental is*
> *an airport branch.*

> *The drop-off charge for a one-way rental must be deemed € 150*
> *if the rental is not a local rental and the pick-up branch of the rental is not*
> *an airport branch.*

Possibility:	It is possible that a complementary determination rule set *answers* more than one business question.
Note:	A complimentary determination rule set can always answer more than one business question. For example, the complementary determination rule set above can also answer the business questions:

1. *What is the drop-off charge for a given rental?*
2. *What is the drop-off charge for a given one-way local rental?*
3. *What is the drop-off charge for a given one-way rental that is picked up at an airport branch?*

4. *What is the drop-off charge for a given one-way local rental that is picked up at an airport branch?*

Business questions that a complementary determination rule set can answer range from general (such as the first business question above), to very specific (such as the last business question above). Note that the complementary determination rule set cannot always answer the first business question — it can do so only when a given rental is local. However, the complementary determination rule set can always answer the last three business questions above — and in fact, can answer a broader business question than any of them.

Note: The set of consideration items (i.e., antecedent) for each determination rule in a complementary determination rule set is assumed to be unique (non-redundant) and disjoint (non-overlapping) with respect to the set of consideration items in every other determination rule. This assumption eliminates basic opportunities for anomalies among the determination rules to arise (e.g., uncertainty of outcome, conflicts, etc.).

Note: A complementary determination rule set is complete only if a rule-based answer (consequent) is given for every possible antecedent arising from the consideration(s) for the set, except as specifically precluded by restrictions.

complementary determination rule set *includes* determination rule

Synonymous Form: determination rule *is included in* complementary determination rule set

Necessity: Each determination rule that *is included in* a given complementary determination rule set *addresses* the same business questions.

Necessity: Each complementary determination rule set *includes* at least two determination rules.

complementary determination rule set *answers* business question

Necessity: Each complementary determination rule set *answers* at least one business question.

focal business question

Concept Type: role

Definition: business question that is deemed most descriptive for a given complementary determination rule set

Necessity: The focal business question *of* a complementary determination rule set must *be* one *of* the business questions that the complementary determination rule set *answers*.

Note: The focal business question of a complete complementary determination rule set is the *most general* business question that the complementary determination rule set can *always* answer, based on its considerations.

The *most general* business question that a complementary determination rule set can *always* answer based on its considerations is special in that it is highly descriptive of the set. For the complementary determination rule set above, that business question is *What is the drop-off charge for a given one-way rental?*
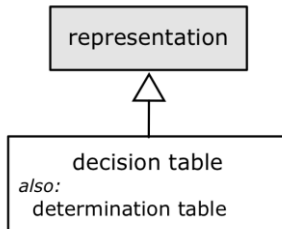
complementary determination rule set *corresponds with* **focal business question**

Definition:	the complementary determination rule set *answers* the focal business question
Synonymous Form:	complementary determination rule set *has* focal business question
Necessity:	Each complementary determination rule set *corresponds with* exactly one focal business question.

Decision Tables

decision table

|	
Definition:	representation of a complementary determination rule set, plus zero or more governing restrictions, by an expression that is based on a tabular form
Synonym:	determination table
Possibility:	It is possible that a business question rule set *is represented as* more than one decision table.
Dictionary Basis:	of, relating to, or arranged in a table; *specifically* : set up in rows and columns [MWD (2a) 'tabular']

determination table

See:	decision table

Restrictions
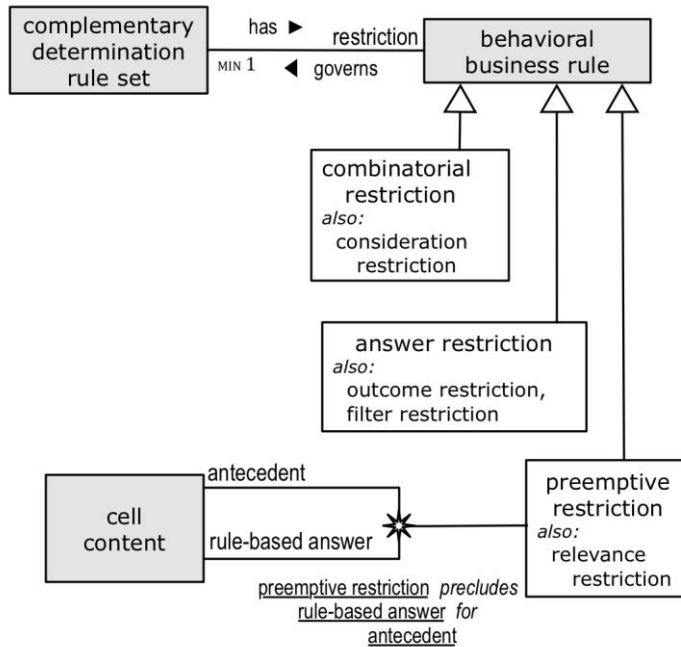
restriction

Concept Type:	role
Definition:	behavioral business rule that *governs* a complementary determination rule set
Dictionary Basis:	a law or rule that limits or controls something [MWD (1a) 'restriction']
Note:	Since complementary determination rule sets have well-defined components, there are only certain ways in which behavioral business rules can affect them, as follows.
	A behavioral business rule can: - preclude any rule-based answer from being given for some consideration item(s). - preclude a combination of consideration items from being considered. - curtail the set of possible rule-based answers for some consideration item(s).
	A behavioral business rule that produces one of these three types of effects is respectively called a: - preemptive restriction - combinatorial restriction - answer restriction.
Note:	A behavioral business rule becomes a restriction because it has one of the three effects above on a complementary determination rule set. The coverage of any behavioral business rule that is a restriction, however, is never limited to any given complementary determination rule set.

answer restriction

Definition: restriction that requires the rule-based answer(s) for one or more antecedents to be based on a particular possible answer, or subset of possible answers, for the business question

Synonym: outcome restriction

Example: For EU-Rent: *The drop-off charge for a one-way rental must be greater than or equal to € 100 if the rental is not a local rental.* Note that the decision tables presented earlier comply with this restriction.

Example: For EU-Rent: *The drop-off charge for a one-way rental must be less than € 500.* Note that the decision tables presented earlier comply with this restriction.

outcome restriction

See: answer restriction

filter restriction

See: answer restriction

preemptive restriction

Definition: restriction that *precludes* an antecedent *from* having a rule-based answer for a given business question

Synonym: relevance restriction

Example: The following three preemptive restrictions apply to the EU-Rent business question *How much is the optional damage coverage surcharge for a given rental?*

* The driver of a rental must be over 25 years old.
* The driver of a rental must be 85 years old or younger.
* The rental period for a rental must not be longer than monthly.

These restrictions disallow any rental for the consideration items; therefore, the business question as posed cannot be answered in those circumstances. To indicate that no rule-based answers are appropriate, the respective cells in the decision table below show "n/a" (*not applicable*).

How much is the optional damage coverage surcharge for a given rental?

	rental period	daily	weekly	monthly	yearly
renter's age bracket	0-25	n/a	n/a	n/a	n/a
	25-29	30%	25%	20%	n/a
	30-49	26%	23%	19%	n/a
	50-59	22%	19%	15%	n/a
	60-69	25%	21%	18%	n/a
	70 -85	30%	26%	22%	n/a
	86+	n/a	n/a	n/a	n/a

Example: The following preemptive restriction applies to the business question *What should be charged for shipping a given order?*:

An order must not be shipped if it weighs more than 100 Kgs.

This restriction indicates that no orders are to be shipped for the consideration items (any order weighing more than 100 Kgs.); therefore, the business question need not be answered in those circumstances. To indicate that no rule-based answers are appropriate, no consideration items over 100 Kgs have been included in the decision table below.

What should be charged for shipping a given order?		weight (wt)						
		0kg ≤wt< 1kg	1kg ≤wt< 2kg	2kg ≤wt< 3kg	3kg ≤wt< 4kg	4kg ≤wt< 5kg	~~	99kg ≤wt< 100kg
zip code	00401	$29	$40	$81	$99	$171	~~	$1,276
	04401	$26	$36	$76	$99	$167	~~	$1,051
	04402	$35	$45	$83	$125	$145	~~	$927
	04730 to 04739	$35	$47	$73	$135	$135	~~	$836
	04740	$19	$25	$35	$62	$89	~~	$799
	~~	~~	~~	~~	~~	~~	~~	~~
	~~	~~	~~	~~	~~	~~	~~	~~
	99928 to 99929	$48	$72	$125	$155	$155	~~	$1,978
	99950	$36	$62	$125	$136	$136	~~	$1,592

Note: The two decision tables above illustrate different ways in which the effect of a preemptive restriction might be shown. The former uses 'n/a' (not applicable); the later simply omits the restricted facts altogether. Omission of restricted facts is not always possible, as the following example illustrates.

Example: The following two preemptive restrictions apply to the business question *What should be charged for shipping a given order?*

An order must not be shipped to zip codes 99928 through 99929.
An order packaged in a tube must not be shipped to zip code 04402.

These restrictions indicate that no orders are to be shipped for the consideration items; therefore, the business question as posed cannot be answered in those circumstances. To indicate that no rule-based answers are appropriate, the respective cells in the decision table below show "n/a" (*not applicable*). The latter restriction would be difficult to illustrate by omission.

What should be charged for shipping a given order?	kind of packaging	
zip code	box	tube
00401	$29	$35
04401	$26	$31
04402	$21	n/a
04730 to 04739	$35	$45
04740	$19	$19
~~	~~	~~
~~	~~	~~
99928 to 99929	n/a	n/a
99950	$36	$37

Note: The consideration item(s) that a preemptive restriction address(es) for a business question is/are definitely within the scope of that business question. The restriction simply precludes any rule-based answer being given for such consideration item(s). In other words, the correct response for the consideration item(s) in the context of the business question is that *no rule-based answer can be given; a rule-based answer is inappropriate*. Any rule-based answer(s) that is/are given for the given consideration item(s) represent violations of the preemptive restriction.

Note: Disallowing any rule-based answer for some consideration item(s) is not the same as prescribing zero or 'none'. The rule-based answers zero or 'none' could be prescribed by an answer restriction, but never by a preemptive restriction.

Note: Although preemptive restrictions are often strictly enforced, they need not necessarily be. Suppose the enforcement level for a preemptive restriction is specified such that the restriction merely acts as a guideline. Then any rule-based answer for the business question produced for any case where the restriction is violated should be accompanied by a caveat warning the answer cannot be considered necessarily valid or final. For example, normally an applicant for auto insurance would be quoted a premium only if the applicant is eligible for coverage. A customer-friendly, web-based application, however, might permit price-conscious consumers to ask about the premium without determining eligibility. Since the rule-based answer produced in such circumstances is not necessarily valid, precautions clearly should be taken. A preemptive restriction can require that when a premium is presented for any case where the applicant's eligibility is unknown (or ineligible) the following legal disclaimer also appears: *"Securing coverage at the given price is subject to eligibility."*

relevance restriction

See: preemptive restriction

preemptive restriction *precludes* rule-based answer *for* antecedent

Definition: the preemptive restriction rules out the antecedent from having a rule-based answer

Necessity: Each preemptive restriction *precludes* any rule-based answer *for* one or more consideration items.

combinatorial restriction

Definition:	restriction that *precludes* a given antecedent that is a combination of one consideration item *arising from* each of two or more distinct considerations, logically ANDed
Synonym:	consideration restriction
Example:	EU-Rent has the following combinatorial restriction:

A sunroof must not be offered in a special options package for a convertible.

In the decision table below, "n/a" (*not applicable*) has been indicated for each cell under the consideration *sunroof* that is opposite the consideration item 'convertible' for the consideration *car type*.

EU-Rent has the following combinatorial restriction:
A trailer hitch must not be offered in a special options package for a convertible or a compact.

In the decision table below, "n/a" (*not applicable*) has been indicated for each cell under the consideration *trailer hitch* that is opposite the consideration item 'convertible' or 'compact' for the consideration *car type*.

How much is the daily rental charge for a given special options package?

| car type	standard shift	sun roof	trailer hitch	heated seats	*daily rental charge*
SUV	yes	yes	yes	yes	€ 125
SUV	yes	no	yes	no	€ 112
convertible	yes	n/a	n/a	yes	€ 135
convertible	no	n/a	n/a	yes	€ 125
convertible	no	n/a	n/a	no	€ 115
sedan	yes	no	yes	no	€ 70
sedan	no	yes	no	yes	€ 65
compact	yes	no	n/a	no	€ 55

Note:	The consideration items of an antecedent subject to a combinatorial restriction pose a circumstance that may be impossible in the real world (e.g., a sunroof on a convertible), and even precluded by some definitional rule, but that does not automatically preclude them from being brought together in a determination rule for the specific purpose of determining some rule-based answer for a business question.[5]

consideration restriction

See:	combinatorial restriction

---

[5] "[In general] there is no point in a behavioral rule that prohibits a logically-impossible situation. However, you might have behavioral rules that reflect a business's need for epistemic commitment. E.g., A spouse must not be named on an insurance application that identifies the applicant as single. That rule is about data consistency. Data are representations of facts, and facts taken together as a model require consistency (regardless of whether they are actually true)." [Don Baisley]

Complete Business Question Rule Sets
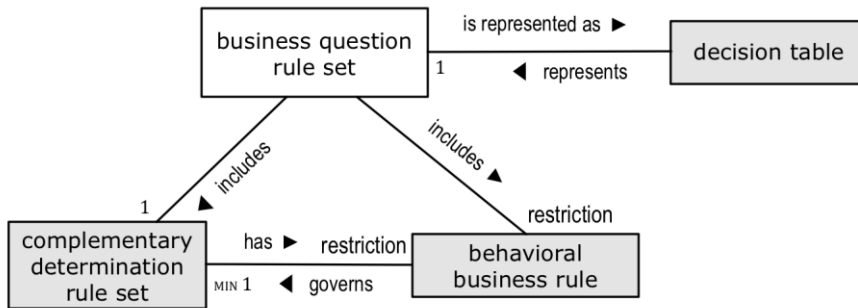
business question rule set

Definition: complementary determination rule set that *answers* a given business question plus all the restrictions that *govern* that complementary determination rule set

business question rule set *includes* complementary determination rule set

Synonymous Form: complementary determination rule set *is included in* business question rule set

Necessity: Each business question rule set *includes* exactly one complementary determination rule set.

behavioral business rule *governs* complementary determination rule set

Synonymous Form: complementary determination rule set *has* restriction

Necessity: Each restriction *is of* at least one complementary determination rule set.

business question rule set *includes* restriction

Synonymous Form: restriction *is included in* business question rule set

Necessity: Each restriction that *is included in* a business question rule set *is* a restriction that *governs* the complementary determination rule set that *is included in* the business question rule set.
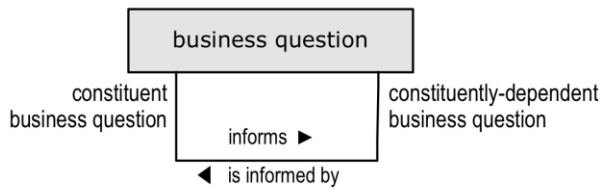
Possibility: It is possible that a business question rule set *includes* no restriction.

decision table *represents* business question rule set

Synonymous Form: business question rule set *is represented as* decision table

Necessity: Each decision table *represents* exactly one business question rule set.

Constituent Dependencies Between Business Questions

Business questions can be related to other business questions in many ways. One specific manner in which they can be related, which is highly relevant to determination rules and determination logic, is *constituent dependency*.

A constituent dependency occurs in the following way. One business question that has its own considerations acts as a consideration of a second business question. For example, the business question *What method should be used to ship a given order?* has the considerations:

- *Is the order a rush order?*
- *Does the order contain any perishable items?*
- *Does the customer hold priority status?*

That first business question serves as a consideration for a second business question, *What should be charged for shipping a given order?* (In this example, the second business question would be presumed to have additional considerations.)

The set of rule-based answers for the determination rules that answer the first business question (say, *normal service, express service,* and *special service*) serves as the set of consideration items for the second business question. In that sense, the first (constituent) business question *informs* that second (constituently-dependent) business question.

Example:
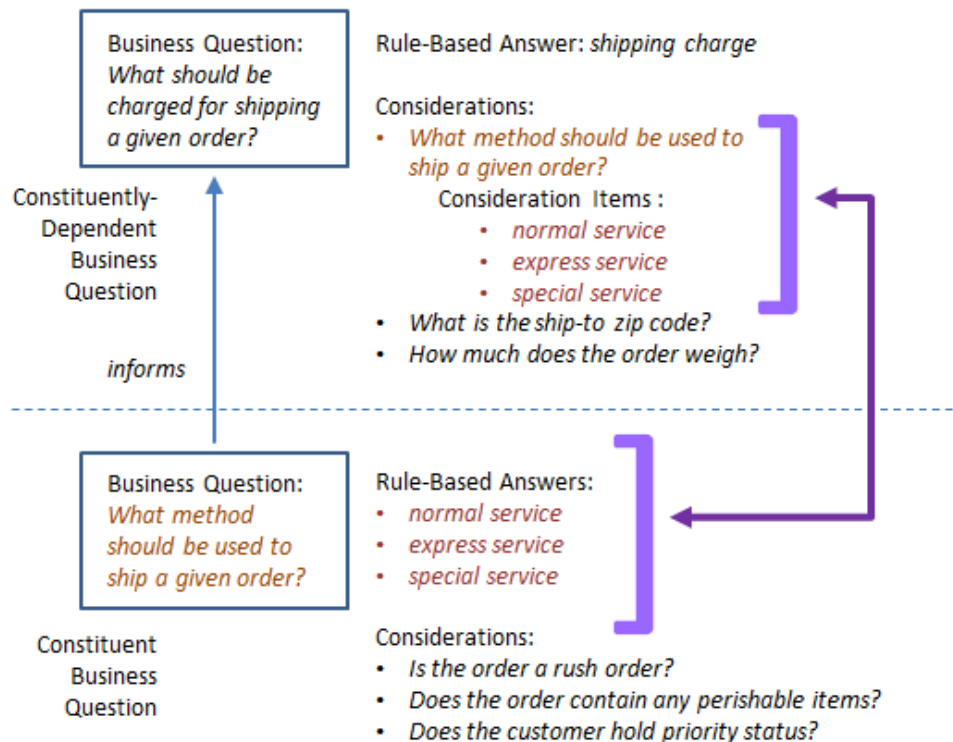
constituent business question *informs* constituently-dependent business question

Definition:	the constituent business question *is* a consideration *of* the constituently-dependent business question *and the* constituent business question *has* its own considerations
Synonymous Form:	constituently-dependent business question *is informed by* constituent business question
Necessity:	All the following *are true* for a complementary determination rule set *that yields* a set *of* rule-based answers *that is* also *the* set *of* consideration items *for* another business question:

- The complementary determination rule set *answers* a constituent business question.

- That constituent business question *informs* a constituently-dependent business question.

- That constituently-dependent business question *is* the *other* business question.

- The constituent business question *is* also a consideration *of* the constituently-dependent business question.

Example:	A first (constituent) business question is *What method should be used to ship a given order?* This first business question has the considerations: * *Is the order a rush order?* * *Does the order contain any perishable items?* * *Does the customer hold priority status?*

The set of rule-based answers appearing in determination rules for this first business question consists of *normal service*, *express service*, and *special service*. This set of rule-based answers provides the consideration items for a second business question, *What should be charged for shipping a given order?* In other words, the business question *What method should be used to ship a given order?* serves as one consideration for the second (constituently-dependent) business question. That business question has other considerations, say:
* *What is the ship-to zip code?*
* *How much does the order weigh?*

Antecedents addressing conjunctions of *shipment method, zip code,* and *weight* are therefore created for the determination rules addressing the second business question. Each of these antecedents includes one rule-based answer from the first business question as a consideration item — i.e., *normal service*, *express service,* or *special service*.

Note:	Constituent dependencies require that considerations be business questions. The business question central to one matter of concern can literally always be a consideration for some other matter of concern (business question).
Note:	Constituent dependencies support direct re-use of *sets* of rules. This might happen as follows: (1) A set of determination rules is developed for one business question. (2) Some other business question is entertained. (3) The original business question (and its set of rules) are 'plugged in' as a consideration for the second business question.

The scope ascribed to a constituent business question must align properly with the scope of the constituently-dependent business question; otherwise, rule-based answers produced using the sets of determination rules together cannot necessarily be trusted.

constituently-dependent business question

Concept Type: role

Definition: business question that *has* a consideration that itself *has* one or more considerations

Example: The constituently-dependent business question *What should be charged for shipping a given order?* has as one of its considerations the business question *What method should be used to ship a given order?* — a constituent business question. This second business question has its own considerations.

* *Is the order a rush order?*
* *Does the order contain any perishable items?*
* *Does the customer hold priority status?*

The determination rules associated with this second business question indicates appropriate rule-based answers for these considerations — specifically *normal service*, *express service*, or *special service*.

This set of rule-based answers also serves as the consideration items for the constituently-dependent business question. In that sense the constituently-dependent business question *is informed by* the constituent business question.
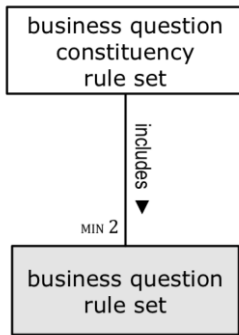
constituent business question

Concept Type: role

Definition: business question that *has* one or more considerations and that is a consideration *of* another business question

Example: The business question *What method should be used to ship a given order?* (which has its own considerations) is one of the considerations of the business question *What should be charged for shipping a given order?* The first business question is thereby a 'constituent' of the latter business question. The set of rule-based answers for the determination rules of the former business question provide the consideration items for that former business question when it serves as a consideration of the latter business question. In that sense the constituent business question *informs* the constituently-dependent business question.

Collections of Business Question Rule Sets for Constituent Dependencies

business question constituency rule set

Definition:	business question rule set that *answers* a constinuently-dependent business question and that does not *answer* a constituent business question, plus every business question rule set that *answers* any constituent business question *of* that constituently-dependent business question, recursively

business question constituency rule set *includes* business question rule set

Synonymous Form:	business question rule set *is included in* business question constituency rule set
Necessity:	Each business question constinuency rule set *includes* at least two business question rule sets.
Necessity:	A business question constinuency rule set may *include* a business question rule set only if the business question rule set *answers* a business question that *is* a constituent business question or a constintuently-dependent business question *addressed by* another business question rule set *included in* that business question constinuency rule set.