

Principle-based approach in Enterprise Architecture practice; finding the sweet spot.

In the regulation and legislation world, especially in the finance industry and government, the practice of principle-based approaches has been introduced in the UK in the 1990's (1). In 2001 the Financial Services Authority (FSA) in the UK introduced 11 high-level Principles for firms, based on the former regulatory system. For Insurance companies Solvency II was introduced as a principle-based legislation in 2009. Governments use principle-based approaches in framework legislation such as the dutch 'Wet milieubeheer' (environmental law) and 'Wet maatschappelijke ondersteuning' (law for social support).

The opposite of a principle-based approach is a rule-based approach. Examples of a rule-based regulation are the Sarbanes-Oxley Act in the US on governance and accounting for public organisations, and the dutch law 'Algemene wet bestuursrecht' (General Administrative Law Act). Rule-based approaches are characterized by a deeper level of detail.

In enterprise architecture (EA) practice as well, a debate is going on about the desired level of detail of architecture principles. Some architects argue we should move from a rule-based architecture to a principle-based architecture. Why, and what exactly is the difference between the two, is not entirely clear, however. There is no readily available literature on the topic. In contrast, the differences and respective merits of principle-based versus rule-based approaches in regulation and legislation are extensively discussed in various papers (see reference list for some examples). In this paper we, therefore, apply these insights to the enterprise architecture (EA) practice. It appears that much of the insights from the field of regulation are valid for the field of EA as well, and that similar conclusions can be drawn.

This paper gives more insight in the differences between principle-based and rule-based architecture approaches as well as the implications of choosing one over the other. The objective of this paper is to provide a sound basis for organisations to develop a well-informed perspective on how to effectively apply architecture principles within their own specific context.

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Architecture Principles

Architecture is commonly regarded as providing guidance to design. In general, architecture methods agree that architecture possesses two instruments to provide this guidance: principles and models. Usually, no explicit distinction is made between principles and rules. Both are referred to as architecture principles. Bouwens (2) states that principles and models are complementary, since models are a visual expression of principles. In this paper we restrict our discussion to the use of architecture principles (and rules).

According to Greefhorst and Proper (3) architecture principles have received insufficient attention over the last years, even though they are frequently used in practice. Reasons for this are the lack of attention by architecture frameworks and methods on how to create and use architecture principles, and, until recently, a lack of research and studies on principles. In their paper they present a conceptual framework for principles. This framework first of all distinguishes scientific principles from normative principles:

Scientific Principle: a law or fact of nature underlying the working of an artefact.

Normative Principle: declarative statement that normatively prescribes a property of something.

Architecture principles are a specific form of normative principles. They guide/direct the enterprise by normatively restricting design freedom. In essence, normative principles are choices made by an organisation that inform and support the way in which an enterprise sets about to fulfil its mission (TOGAF).

In addition, Greefhorst and Proper (3) identify a life cycle in the creation of normative principles. Principles tend to start as a Credo: a fundamental belief, used to express an architecture vision. These type of principles are too abstract to practically limit design freedom. To do the latter, they need to be reformulated as a Norm; a rule of conduct, a reformulated credo in such a way that compliance to it can be assessed. Greefhorst et al. distinguish levels of specificity in principles. Norms are more specific than credo's. Summarizing the work of Greefhorst et al, we can conclude that principles can have various levels of specificity, where more abstract principles can be operationalized into various more specific principles. They do not explicitly address a distinction between principles and rules within the context of EA.

Rules versus Principles

Lately, within the field of EA the distinction between principle-based architecture and rule-based architecture has emerged as a topic. However, the topic has not been elaborated on yet in academic or practitioner's publications. Therefore, we turn to the literature from the field of regulation and combine the insights gained there, with the notion that architecture principles may differ in level of specificity. For purposes of clarity, from now on, we will use the term directives if we want to refer to both principles and rules without distinguishing between the two.

The difference between a principle and a rule, as distinguished in the literature on regulation, can be illustrated by the following examples from the context of speed limits;

Speed as a principle: Each road will be assigned a maximum speed that fits and ensures required safety levels.

Speed as a rule: maximum speed in urban areas is 50 km/h, outside urban areas 80 km/h, and on highways 130 km/h.

In practice it is not always clear-cut whether a directive is a rule or a principle. Some principles become more 'rule-like' when specific quantification is added as a norm or a best practice is added as a pattern of implementation. On the other hand, rules can be more 'principle-like' if it focuses more on less-detailed qualitative aspects and the outcomes that must be achieved. Burgemeestre et al. (4) refer to Verheij who claims that principles and rules have the same logical structure but show different behaviour when applied in practice. Based on research in law and accounting this is confirmed by the conclusion that principles and rules are extremes on a continuum.



Fig. 1: the continuum of directives

Rules and principles also differ in the manner in which they are applied. Whereas rules require less interpretation to be implemented, they heavily restrict the level of freedom for a systems design. Principles on the other hand need more interpretation and need to be tailored more into a design and design instructions before they can be implemented. Principles give more freedom to

systems design and can result into different designs within the same architecture.

The trick is to find the sweet spot on the continuum; what style fits your situation? The effectiveness of a directive is influenced by the difference between the desired and the actual position on the continuum.

Principle-based Architecture (PBA) versus Rule-based Architecture (RBA)

Many organisations use architecture to guide their design and implementation. In practice we recognize the different levels of specification; from credo to rule:

1. (credo): We have a centralized customer view
2. (norm): All data-classes (like 'customer') have 1 source application to maintain and deliver it's data
3. (rule): When customer data is needed in a process, the application retrieves it real-time via a SOAP-webservice from our central customer application "Customer-system". Changes to the customer data are made by the "Customer-system" application only.

Some organisations use principles in a more fundamental way and leave the details to system design teams (principle-based approach), other organisations centrally define an extensive list of detailed rules (the rule-based approach). In practice both approaches occur, and frequently a combination of principles and rules is found in one and the same set of architecture directives. The difference between PBA and RBA is that a principle-based architecture moves away from centrally defined detailed statements (rules) to more fundamental normative principles.

To avoid discussions on classification of the individual directives being either principle-based or rule-based and change the formulation of single directives to become more principle-like or rule-like, it is better to look at the characteristic of the architecture, i.e. the whole set of directives. Probably the set will turn out to be a mixture of principles and rules, with a bias to one end or the other.

Based on experiences in the regulation context Burgemeestre et al. (4) uses 7 dimensions to determine the primary nature of a directive framework. These seem to be applicable to an architecture as well. The dimensions (translated into an architecture context) are the following:

1. **Temporal dimension;** rules clearly define the boundaries before translation to a specific design and implementation, principles are audited after a design is proposed. Typically rules need to be changed when fundamental changes in the design approach are required, therefore rules tend to change more often than principles.
2. **Conceptual dimension;** principles are characterized as general, universal and abstract, whereas rules are specific, particular and concrete.
3. **Functional dimension;** this considers the relative discretionary powers of the participants in the architecture process. Rules are defined by the architect, principles leave more room for interpretation to both designers and (controlling) architects.
4. **Representation dimension;** principles are declarative representations, they focus on outcomes. The amount of documents is relatively small. Rules are procedural descriptions, i.e. by what actions an outcome should be achieved. This usually leads to a relatively large set of documents containing rules and patterns for different contexts.

5. **Knowledge dimension;** applying rules requires relatively little knowledge of the applicant. Knowledge of the rule itself and the concepts used to implement the rule suffices. Applying principles requires more knowledge, such as knowledge of the context in which the principle is applied and other relevant principles.
6. **Exception handling dimension;** rules do not allow exceptions in the implementation, they are strict and every implementation must adhere to the rule. Principles do not prescribe precisely, but point in a certain direction. Therefore, they allow a form of reasoning and may be defeasible, i.e. exceptions may occur without the principle becoming invalid.
7. **Conflict resolution dimension;** principles and rules need different processes to solve potential conflicts about their application. For principles different conceptual explanations can occur of how they are to be applied in design and implementation. There must be a process in place to address conflicts that may occur between the authority that is responsible for the principle or rule and the team that uses it. This process needs to weigh the various perspectives based on some kind of priority, order or weight. Sometimes the principle itself can be under discussion. For rules no conceptual conflicts are possible. If a team is breaking a rule, an escalation ensues, in which either the team is forced to adhere to the rule, or deviation is allowed. The choice is often primarily based on cost and benefits.

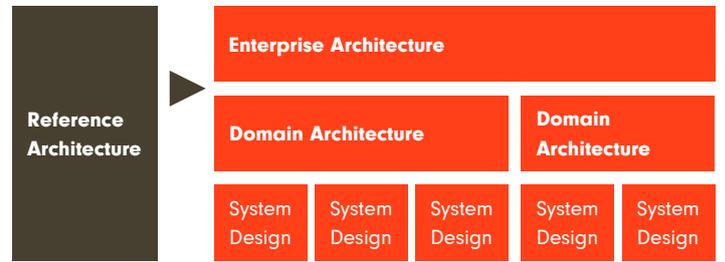
To determine if a set of directives is predominantly rule-based or principle-based, it can be checked against these seven dimensions, as illustrated in table 1.

Dimension	Typical principles	Typical Rules
Temporal	After design/last longer	Before design/need to change for fundamental design changes
Conceptual	General/universal/abstract	Specific/particular/concrete
Functional	Large discretionary power	Little discretionary power
Representation	What	How
Knowledge	Relatively much	Relatively little
Exception handling	Allow exceptions (defeasible)	All or nothing (strict)
Conflict resolution	By weight (trade-off)	No conflicts possible, escalation to force adherence or exception

Table 1: Characterization of a set of directives (an architecture)

Different levels of architecture

Many organisations distinguish various levels of architecture. Besides an enterprise architecture, organisations may recognize a Reference Architecture that drives the branch, as well as domain architectures that have part of the organisation as their scope. These domain architectures inherit from the enterprise architecture, including the directives that must ensure the cohesion of the architecture as a whole.



2: Levels of architecture

The choice for RBA or PBA can be made for each level and each domain, and should be made with care. Because domains have a more specific scope, the sweet spot can be located further to the rule-side of the continuum than in the enterprise architecture. Different domains can have different sweet spots.

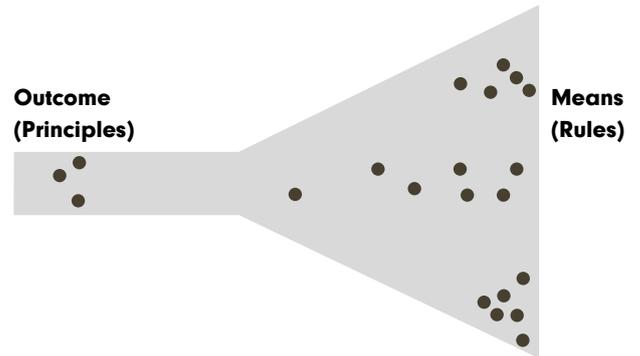


Fig. 3: Different sets of rules for different parts of the organisation

Conditions for using PBA or RBA

There is no a priori reason to prefer principle-based architecture over rule-based architecture or the other way around. Depending on the exact circumstances one or the other may be the best choice. Important aspects in this respect are:

- Level of empowerment
- Task complexity
- Way of working
- Escalation mechanism



Level of empowerment

Making decisions based on principles requires another kind of knowledge than making decisions based on rules.

To apply principles to one's own tasks, one needs to possess enough knowledge of the context to be able to determine how to interpret and translate the principles. Applying rules is easier, as they are more specific. In a rule-based architecture, the contextual knowledge needed to apply the principles, is located with the architects who define the rules. In a principle-based architecture, this knowledge has to reside with the decision-makers and developers that are designing specific solutions.

A principle-based architecture requires a higher level of empowerment throughout the organization than a rule-based architecture. This is because in a rule-based architecture, the knowledge to interpret and translate principles to a specific context is done centrally. This implies that the requisite knowledge and decision-making power is concentrated in a limited number of people. A principle-based architecture, on the other hand, requires many more employees to possess the knowledge and skills to translate the principles to their own circumstances. It provides less clarity than a rule-based architecture and leaves matters open to interpretation. This requires a sufficient degree of trust by management and architects in the competences of the average employee.



Task complexity

Rules are well-suited to express specific knowledge. Principles are better suited to express intentions and desired outcomes. In rules, more explicit and detailed knowledge is contained. A question that pops up is whether the nature of the task that an organisation has to perform influences the suitability of one over the other. Architectural directives can be regarded as means of sharing knowledge throughout the organisation. The knowledge-based view of the firm is a research field that concerns itself with knowledge integration in organisations. Therefore, we turn to this theory for insights. Grant (1996) distinguishes four mechanisms for integrating knowledge (5): rules and directives, sequencing, routines and group problem solving and decision making. Grant argues that rules and directives (i.e. written down directions) are suitable for communicating explicit knowledge among specialists and between specialists and non-specialists. Rules and directives are useful for tasks that are well-defined and to a great extent predictable. Group problem solving and decision making requires active interaction between participants and is needed for non-standardized tasks that are complex and unpredictable. Translating this to principles and rules, we may conclude that the more detailed knowledge expressed by rules is comparable to rules and directives and thus is useful for providing direction to relatively standard, predictable tasks. Principles, which are less precise, indicating desired outcome rather than the means to achieve that outcome, require more interaction and discussion in their application. They are the first choice when the organisation has to deal with complex and unpredictable tasks.



Way of working

Many organisations are making the transition from a waterfall approach to an agile, interactive way of working. Superficially, one might think that a principle-based approach best suits the agile way of working, while a rule-based approach might fit a waterfall approach. This is not necessarily the case, however. Both traditional development teams and scrum teams have to work within architectural directives. A scrum team may have more responsibility concerning functionality building and design decisions, and it may have to make a lot of decisions going along, but it still has to ensure its deliverables fit in the overall architecture. With more (rule-based) or less (principle-based) specific guidelines to do so. That is in essence not different from the traditional development teams. In theory, both a principle-based and a rule-based approach can be combined with either way of working.

However, the change to an agile way of working is often accompanied by a wish to empower employees. And with empowerment goes principle-based rather than rule-based, as we saw above. That is why a principle-based approach may be the preferred approach in agile environments.

Thus, which architecture approach is to be preferred seems to depend more on the level of empowerment and complexity of the task, than on the choice between waterfall and agile per se.



Escalation mechanism

Whenever direction-setting is in order, it is necessary to think about how to deal with compliance issues. Both principles and rules are meant to be adhered to by the organization at large. And in both cases, disagreements may arise regarding the nature and feasibility of adherence in specific circumstances. The way an organization deals with this kind of discussion is relevant for the suitability of a principle-based or rule-based architecture approach. Rule-based architectures provide more detailed guidance. Compliance-issues will usually be more clear-cut. Discussions will

deal with matters of feasibility, rather than interpretation. Decisions have to be made whether deviation from a rule is allowed. Arguments will be put on the table trading off costs and benefits. A situation of negotiation may arise, in which costs and benefits are weighted and a decision is made based on this. Escalation can be implemented by putting the decision to a management board. In a principle-based architecture approach, discussions will more often deal with differences in opinion about how to interpret and translate certain principles in a specific context. The principle itself is subject to debate, and opinions may differ regarding whether certain design choices represent a deviation or a different interpretation. This is not a straightforward debate about costs and benefits, but a more fundamental discussion about the ambitions and values of the organization.

Why or when to opt for Principle-based?

Realizing the differences between PBA and RBA provides the organisation with a choice. As said before there are several reasons to change the characteristic of a set of directives. Black et al. refer to studies by the FSA (1) that identify 3 possible strategies as reasons to choose a principle-based approach:

Prioritize



Rules becoming unwieldy;

the amount of rules becomes too large and too complex to manage. In most cases, having a central set of detailed rules that includes the entire enterprise will not work.

What to do with rules



Outcomes-based regulation;

outcomes-based regulation entails a shift from description of the "How" to the 'What' and 'Why', mainly to separate the level of concern. In financial regulation it is based on the idea that firms and their management are better placed than regulators to determine what processes and actions are required within their businesses to achieve a given regulatory objective. Translated to architecture this strategy fits an organisation in which local teams are better placed than architects to determine the design and implementation required to achieve a business objective. It could be a strategy to implement PBA to stimulate the responsibility of teams.

Rules require life cycle management



Increasing senior management responsibility;

within the Financial regulation the move to principle-based was used to entice senior management to take responsibility by "intensified reliance" on senior management. A well-known example of this is Solvency II. In an architecture practice this strategy can be described as evolving architecture into a competence of the organisation. Implementing the architecture will become a result of team-effort instead of the architect's effort.

Most important is that choosing PBA or RBA should match the organisation's situation; find the sweet spot!

Implementing PBA

Suppose an organisation determines a desired sweet spot at the PBA-side of the continuum, while the character of the existing architecture is RBA, what does that mean for the existing rules; will they be abandoned? This depends on the reasons behind the move to PBA. If the move is made because the existing rule-books are experienced to be ineffective, too complex to use or maybe even unaccepted by the organisation, the answer is probably yes. The best approach in this case is to create a new set of principles, starting with the areas where the need for guidance is highest. If however the reason to migrate to PBA is the wish to change the distribution of responsibility within the organisation, the best approach is probably to collect, categorize and group the existing rules and transform them into principles. This means defining statements that express the desired outcome, without adding specific quantitative requirements.

Whatever the drivers are to go for a principle-based approach, a decision has to be made regarding the rules that are not covered by principles but are in fact good and meaningful rules. These rules do not need to be abandoned. But it is wise to change them from architecture directives to guidelines that are maintained and controlled at another level in the organisation, i.e. policies, rulebooks or best practice standards that are valid for specific domains. For example, specific standards on how to apply a technology are best owned by the IT department that is responsible for the support and delivery of that technology. Compliancy to these rules can be ensured by having these rules included as stakeholder requirements in projects and change requests.

To migrate an architecture from PBA to RBA, the existing principles must be operationalized into rules by adding quantitative requirements and/or add best practices as required patterns of implementation. It may be necessary to define different sets for different domains. Care must be taken not to formulate more rules than required. Furthermore RBA requires a lifecycle-mechanism to assure the timely adaptation of rules to new insights, like innovations, in the organisation. Because they are more specific, rules run a greater risk of causing fossilization of knowledge than principles.

Conclusions

Literature on the comparison of principle-based and rule-based guiding is to be found in the field of regulation and legislation on enterprise governance, especially risk, finance and accounting, rather than in the field of enterprise architecture. The insights from the field of regulation and legislation can, however, be successfully translated to the field of enterprise architecture.

Directives can be regarded as normative statements that exist on a continuum, where the extremes are known as principles and rules. An architecture may consist of a mixture of principles and rules but can generally be characterised as primarily rule-based or principle-based, by using 7 dimensions.

A PBA is characterised as consisting of more fundamental directives that focus on the outcome, whereas a RBA contains directives that focus on how a required outcome should be achieved. The more details the architecture contains, the more predictable a design becomes. But also the larger the risk that the subsequent inflexibility in design does not meet the requirements of stakeholders because rules were not adapted in time and thus do not longer contribute to achieving the business objectives.

In order to achieve an effective architecture practice, the key is to find the organisations one or more sweet spots on the continuum: which manner of guiding directives is required to achieve the business goals, and fits the (parts of the) organisation best. Task complexity and level of empowerment are the most important dimensions that drive the choice of the sweet spot. Both approaches could work with agile development. In both cases, a suitable escalation mechanism must be put into place. Where RBA needs experts to trade off costs and benefits when a deviation from a rule is requested, PBA needs experts having enough knowledge of the context to understand the interpretation differences of principles.

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