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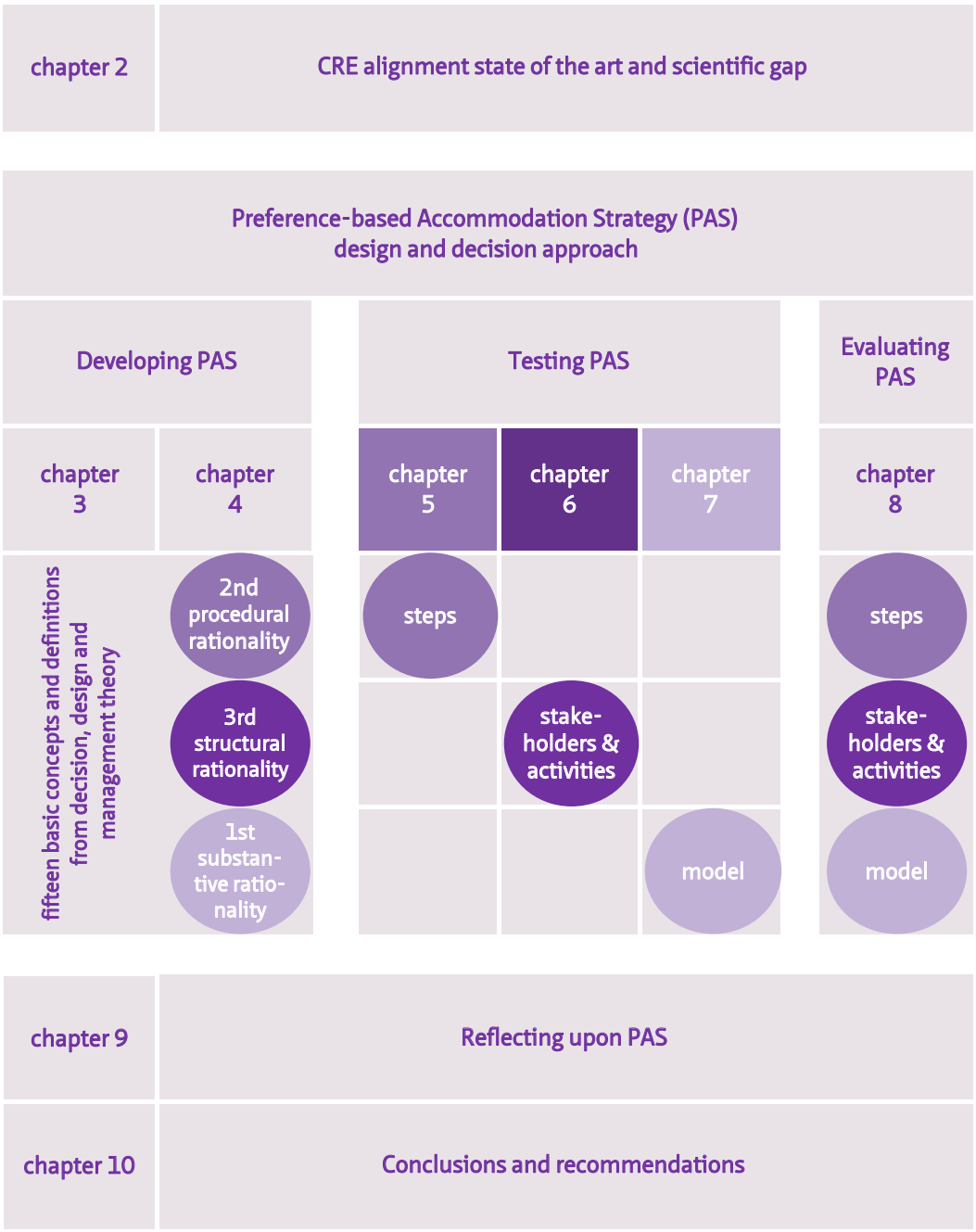
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10 Conclusions and recommendations

Even though extensive research into existing CRE alignment models has provided us with valuable insights into the building blocks, components and variables that are needed in the alignment process, these models still fall short in two ways. Most models pay little to no attention to (1) the design of new CRE portfolios and (2) the selection of a new CRE portfolio that adds the most value to the organization. With the development of a new approach, the Preference-based Accommodation Strategy design and decision approach (PAS), I address the deficiencies of the previous alignment models that either place too much emphasis on financial measures or lack clarity in decision making due to the difficulties of quantifying the intangible and subjective. In this chapter the main research question will be answered and recommendations for further research are formulated.

How can the Preference-based Accommodation Strategy design and decision approach (PAS) successfully be developed and tested on corporate real estate portfolio level in order to enhance CRE alignment?

10.1 Conclusions

This research developed a new design and decision approach in CRE alignment that makes it possible to design alternative CRE portfolios and then select the portfolio that adds most value to the organization. This new approach called PAS is tested successfully in three pilot studies and evaluated positively by the participants. To address the successfulness of the development and the usage of PAS to enhance CRE alignment on portfolio level, the conclusions are divided into conclusions about (1) developing PAS, (2) testing PAS, (3) evaluating PAS and (4) reflecting upon PAS.

Conclusions about developing PAS

The methodological aspects, characteristics and features of PAS are based upon fifteen basic concepts and definitions coming from management science, decision theory and design methodology. Of these fifteen concepts, Preference Measurement and Preference-Based Design are the two most important ones. PAS is also structured around three rationalities (Kickert, in De Leeuw, 2002) that allow stakeholders to choose an alternative and to involve more than one decision maker and that accounts for time. For PAS to be operational, all components need to be connected coherently. The coherence between the components is shown in the flowchart (see **Figure 10.1**).

Following the flowchart, it is explained which activity is performed by whom and which steps are done in that particular activity. Following the arrows in the flowchart it shows how the information of one step is input for the next step. The flowchart stops in the last interview when each stakeholder individually accepts the alternative with the highest overall preference score as the selected alternative. If one of the stakeholders does not accept this alternative, this means that (part of) their input does not reflect their preferences correctly and needs to be adapted accordingly. The adapted input goes back to model building (n) and continues in the flowchart represented until all stakeholders accept the best alternative.

PAS enables stakeholders to select an alternative indisputable and correct[78]

In CRE alignment, the goal is to achieve an optimal added value. Value, in this thesis, is technically equivalent to preference and is expressed in an overall preference score. PAS is *indisputable* by having one overall preference score and *correct* by using Barzilai's strong scales and the practical methodology preference functional modeling. The overall preference score of PFM is able to incorporate all types of values: both financial and non-financial, tangible and intangible, quantitative or qualitative. In mathematics, these value categorizations are not necessary to enable addition and multiplication. Barzilai (2010) distinguishes only physical or non-physical properties of an object. Following Barzilai, all physical properties are translated into non-physical properties (i.e. preference), including the preference for receiving and spending money, and aggregated into one overall preference score. By doing so, the restrictions as formulated by Barzilai (2015) and Mouter (2012) are avoided.

78 The eight requirements are referred to using the labels as explained in chapter 2 and shown in italic in this chapter.

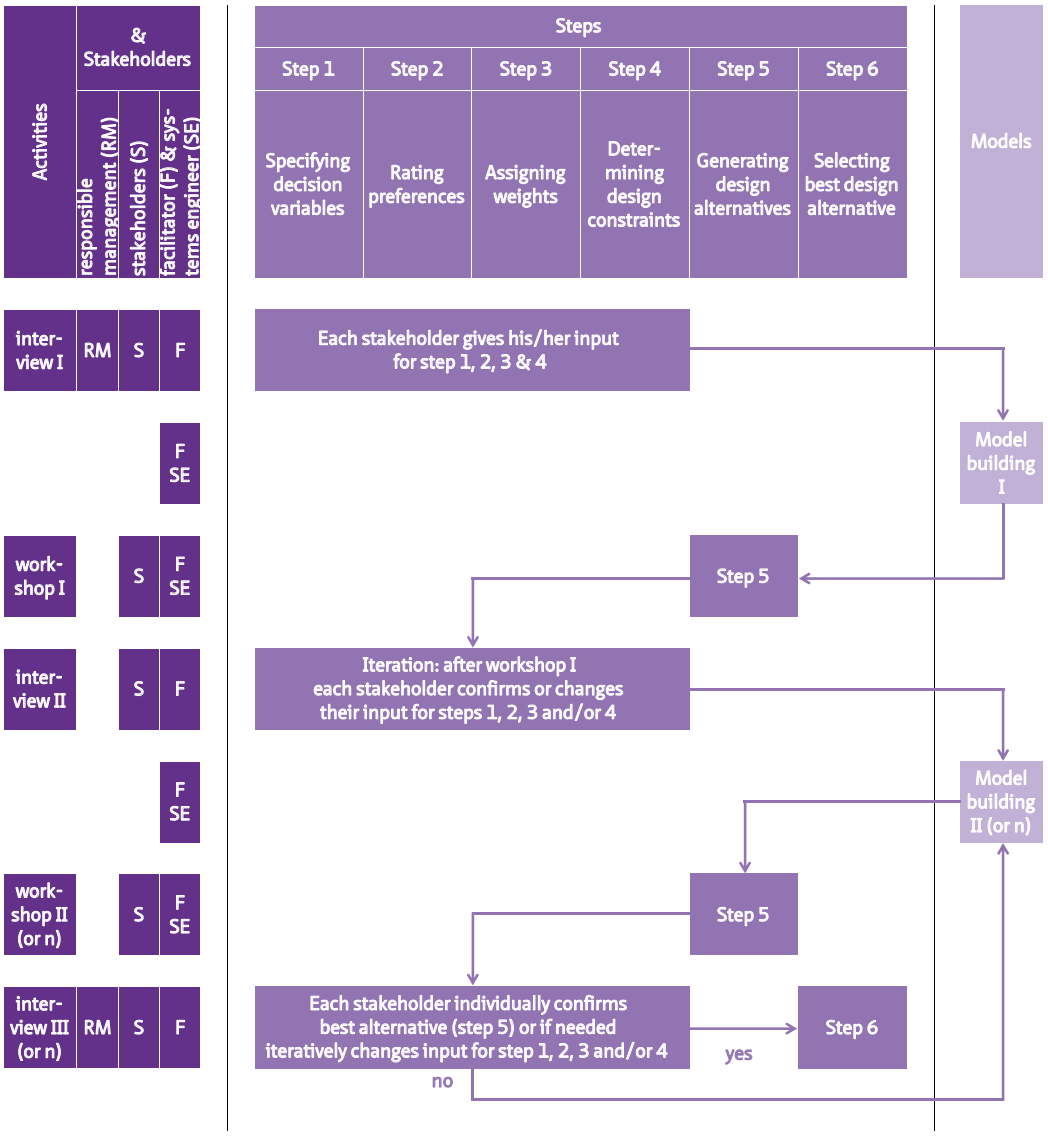

FIG. 10.1 PAS Flowchart Note adapted from Arkesteijn et al. 2017, p. 248. The stakeholders & two activities, interviews and workshops are displayed in the first four columns (darkest purple), the six steps are given in the intermediate columns (intermediate purple) while the model building is presented in the last column (lightest purple).

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In PAS, the bounded rationality (Simon, 1997) concept is used; human decision makers are not perfectly informed and also have a limited capacity for information processing. They are looking a satisficing alternative instead of an optimizing alternative. The satisficing alternative is made in step 5a, while at the same time the hard goal oriented systems approach is used in parallel to find a (local or global) optimal alternative in step 5b.

PAS enables stakeholders to design alternatives interactively, iteratively and optimally

By seeing a designed accommodation strategy (generated by PAS) as a solution for an organization 's strategic accommodation problem, PAS functions as a problem solving system. Design as problem solving leads to an instrumental view on the management because next to understanding reality, people also intervene in that reality. PAS is structured around the Preference-Based Design method to solve this accommodation design problem. In order to function on portfolio level, most of the steps of this method have been altered. The most important changes have been made to step 2, where the preference curves are made a posteriori using the Lagrange curve, and to step 5. In step 5a the stakeholders design alternative CRE portfolios themselves in the mathematical model and thereby produce a satisficing alternative. The approach is *iterative* by having an *interactive* interplay between demand (step 1 to 4 in the interviews) and supply (step 5 in the workshops). PAS is also able to determine the CRE portfolio with *optimal* added value because in step 5b the system engineer uses an optimization tool for another alternative with potentially a higher overall preference score. Depending on the complexity of the pilot the optimization tool is able to find a local or global optimum.

PAS enables stakeholders to formulate their demand personally, integrally and tangibly

PAS uses a soft systems approach to enable the stakeholders to determine which goal(s) need to be achieved. The stakeholders are seen both as individual and as group as designers and decision makers. PAS is *integral* because all relevant stakeholders can be involved and are able to specify all types of requirements (qualitative and quantitative). The approach is explicit because their CRE accommodation strategy is stated in objectives and/or related problems and expressed in well-defined *tangible* decision variables. The approach is also *personal* because each criterion is established by a specific stakeholder and is linked to this stakeholder during the whole process.

Conclusions about testing PAS

PAS is tested successfully in three pilot studies. All pilot studies show that the stakeholders were able to perform the steps and activities and that the systems engineers were able to build mathematical models.

Steps to achieve CRE alignment

In all pilot studies the stakeholders were able to perform each step of PAS. While stakeholders in general are familiar with most steps, step 2 (determining preferences) and step 5 (design alternatives) are new to them. The stakeholders were able determine their preferences and to design an alternative CRE portfolio with a higher overall preference than in the current situation (step 5a). The pilots respectively have an added value, expressed in an overall preference score of 54, 17 and 5 (see **Table 5.12**). In step 6, all stakeholders accepted that alternative as the final outcome.

TABLE 10.1 Achieved added value of the best design alternative (step 5a and 5b) in all pilots

Results (based on PFM algorithm)	1st pilot study food facilities TU Delft	2nd pilot study lecture halls TU Delft	3rd pilot study office locations Oracle
Overall preference score current portfolio	41	53	61
Overall preference score design alternative	95 (step 5a)	70 (step 5a)	66 (step 5b)
Added value	54	17	5

In two pilot studies, an alternative CRE portfolio has been generated with an optimization tool (step 5b). In the third pilot office locations, the optimization tool was successful and generated a global optimum. This design alternative (step 5b), has an overall preference score of 66 that is higher than the overall preference score of 64 decision makers designed (step 5a) or the 61 overall preference score of the current situation.

Mathematical models to achieve CRE alignment

Due to the nature of the third pilot, the brute force approach, as optimization tool, could be used and successfully generated a global optimum (see **Table 10.1**). In the first pilot for the TU Delft food facilities, the algorithm (step 5b) was not able to generate a local optimum with a higher overall preference than the best alternative the decision makers designed (step 5a). The reason for this was that a subset of the alternatives was infeasible. The feasible set of alternatives could not be characterized

mathematically and was not available to the algorithm. The feasible alternative made by the group decision makers is the best alternative. The brute force approach is preferable to the search algorithm as it finds a global optimum instead of a local optimum. However, if a pilot is more complex, the brute force approach cannot produce all possible alternatives.

Sometimes, a problem can be of such complexity that it is impossible to design alternatives solely based on PAS. This was the case in the second pilot, where linear programming (LP) was needed in addition to PAS to make a timetable based on the educational demands for a certain amount of lecture halls, and to incorporate time constraints per activity. The LP timetable model is subject to the same limitations as LP with negotiable constraints. However, in this pilot progress has been made as well, because the decision makers are now better equipped with LP and PAS to design an alternative with a higher overall preference score within the timetable design space.

Stakeholders & activities to achieve CRE alignment

The stakeholders in all three pilots have successfully performed the two activities: workshops and interviews iteratively and interactively. In these activities, all six steps have been performed.

Iteration is the key: at the outset of the project, our expectation was that design alternatives themselves would help the participants to better understand the relationship between the design alternatives and their decision variables. This was confirmed in the evaluation: the participants indicated that whilst the method of determining preferences is easy, accurately determining which preference is related to a certain decision variable value is not. Assigning preference scores to decision variable values can be arbitrary at first. By repeating the cycle of determining preferences and making designs a number of times, the stakeholders can see what the effect of the decisions made in the design is, and how their preferences affect those decisions. In all pilot studies, the decision makers used the opportunity to either add or remove decision variables, change curves, weights or constraints. This means they used the opportunity to alter, add or fine tune their input and design a favorable output. This demonstrates that the feedback helps the stakeholders to better understand their input and to improve it if necessary. By doing so, the representation of their preferences in the model better depicts the actual situation. The use of such a learning process in the context of work practice and problem-solving is described by Schön (1987) as reflection in action.

The amount of the available **design interfaces** per pilot differed, as well as the intensity in which the design interfaces were used. In all pilots, the most used interface was the main interface in which alternatives could be designed, followed by the interface displaying the interventions (if available). The interface with the information per stakeholder and per criterion was used less and mainly by the system engineer. The main design interfaces for the pilots differed. While they were more visual and similar in the first and second pilots, the model for the third pilot contained more information but was less visual. In general, the conclusion is that the design interfaces with a more condensed display of information were most used.

Conclusions about evaluating PAS

In all three pilots, the stakeholders as well as the observers evaluated PAS very positively. According to the stakeholders, determining preferences and refining and adjusting them in collective workshops is the attractive part of PAS. They repeatedly mentioned the direct feedback about the effects of the chosen interventions and the possibility for iteration during the process when asked about their experience. The group interaction or cooperation between the stakeholders was also highly appreciated in the first two pilots. In the third pilot, the group dynamic was different because in the pilot only two stakeholders were involved. The reason for this was that they had just finished their own process. The stakeholders indicated that they valued getting insight into their decision variables, and at the end of the studies valued expressing their preferences with curves. In the second pilot, the use of concrete decision variables was emphasized by many stakeholders. The majority of the stakeholders perceived PAS as attractive and effective. The result (goal) oriented approach contributed to the effectiveness. Almost all stakeholders expressed that they would like a continuation of working according to PAS.

Most stakeholders were open-minded towards PAS from the beginning. Some of them had a more cautious stand; all of them were (much) more positive at the end of the pilot. Only one of them still questioned whether the approach (sometimes) would not be too transparent. Many stakeholders compared PAS spontaneously to other approaches and, in all cases, they favored PAS, even though the first two studies were not set up to systematically compare PAS to other approaches. In the third pilot, a systematic comparison has been made where PAS favorably compared to their own process.

Conclusions about reflecting upon PAS

PAS has initially been intended to complement other CRE alignment models. However, using the PAS method as an add-on in these models creates managerial and methodical difficulties. The structure of these models is often not congruent with the structure of the PAS method. Therefore, PAS has been transformed into a management system that represents PAS from the organizations' point of view. This management system consists of four systems: PAS steering system; PAS programming system; PAS modeling system; and PAS design system.

The three pilot studies show that PAS can be applied in different organizations, and for different types of problems with a different level of complexity. In comparison, the first two pilots were more complex because more stakeholders were involved and more interventions were possible. Applying this approach to multiple context-dependent cases has yielded more valuable results than just applying it to one case. It can be argued, based on these results, that PAS can be used for a wide range of real estate portfolio types.

10.2 Recommendations

The recommendations regarding this research are divided in two main areas: (1) improving PAS and (2) professionalizing PAS for practice.

10.2.1 Improving PAS

In this paragraph six different ways are explored to improve PAS.

Use PAS in different type of real life pilots and with more stakeholders

PAS is generic by nature and can be used for a wide range of problems in real estate portfolios. The more important the preferences of users are for the use of the portfolio, the more relevant a method like PAS becomes. Testing PAS in a wider variety of pilots is recommended.

In the pilot study, relevant stakeholders were represented by one or two persons. Only some groups, like the student council and the faculty secretary involved their constituents. In the evaluation the stakeholders recommended to involve more people in the process with a more diverse background. Next to involving internal stakeholders, it is recommended to involve the constituents of all groups and external stakeholders in the future.

Use PAS as part of the actual decision making

The next step in the development of PAS is to use PAS as part an actual decision making. In this thesis, PAS has been used for real life problems in a pilot situation. This means that the results were accepted by the stakeholders and used as input to the decision making process, but were not seen as the actual decision. It is recommended to test if using PAS in actual decision making gives other results or insights.

Continue the development of the search algorithm to generate alternatives

The use of an optimization tool in PAS makes it possible to achieve a (local or global) optimum alternative that stakeholders might not be able to design. It is recommended to continue developing the search algorithm, since in the first pilot it was not successful. The focus of future research should be to develop a functioning algorithm in which the infeasibilities can be incorporated and then to study the difference in quality of the solution found by the algorithm and the stakeholders.

Use PAS in transparent decision making

The subject owners of the PAS process had a different stand towards the level of transparency in PAS. Where one was reserved about amount of transparency, the other fully supported this way of working. One of the stakeholders indicated that PAS has gradually taken him into the process to find an optimal solution. However, this participant, while satisfied with the result, does not rule out that he would have played strategic games when confronted with a less positive result.

PAS is transparent and thus a glass box and non-manipulative, as the facilitator and system engineer refrains from incorporating their own personal preferences. An organization that wants to use PAS consciously needs to choose such a transparent approach. However, it is recommended to further study the attitude of policy makers towards PAS's glass box transparent approach. Although transparency largely has a positive connotation, according to Scholtes (2012, p. 343-345) it is not an

unambiguous concept nor a simple concept. She indicates that associations with 'objective', 'just' and 'verifiable' are made transparent, but it is also a normative concept that will bring about effects.

Use PAS as a game

While decision systems focus predominantly on providing its users with a solution, i.e. making decisions, gaming focuses predominantly on the learning experience of its users. PAS combines both by creating a solution and focus on learning at the same time. In PAS, stakeholders learn, because just as in gaming, they are confronted with the consequences of their actions and those of others and have the possibility to act upon them. It could be worthwhile to test PAS solely as a game.

Focus solely on evaluating of the new PAS design and decision approach

From a research methods perspective it is recommended to perform a PAS process and fully focus on evaluating PAS. This evaluation should be approached from both a soft and a hard systems perspective from the start. Next to that, a comparative research set-up with other approaches, as has been done in the third pilot, could be useful.

10.2.2 Professionalizing PAS

Professionals in practice are able to perform the PAS using the descriptions in paragraphs 4.3, 4.4. and 4.5 as well as 9.2 and 9.3. The examples of the pilots in chapter 5, 6 and 7 can serve as an aid. This does not alter the fact that a user-friendly manual can be made in the follow-up to this PhD research to professionalize PAS for practice. The following recommendations have been formulated:

Creating a web-based tool for generic PAS steps

Now that it is clear that stakeholders can perform all PAS steps, it is worthwhile to professionalize PAS by creating a generic web-based tool or app to support the execution of steps 1 to 4. In conjunction with the decision tool, a PAS introduction should be made in which both the method, an example, as well as the PAS foundations need to be addressed. The evaluation has shown that PAS interfaces could be improved in three ways: firstly, by using less interfaces and less content per interface and by experimenting with visualizing the portfolio. Secondly, by better explaining the backend of the model, making it possible for the users to understand

the relationships between the variables and the interventions even more quickly. Thirdly, by experimenting with a (partially) stakeholder operated model. Next to that, some stakeholders would benefit from more time for the PAS process with both individual and group workshops.

Develop PAS and an expert reference model

Some PAS interfaces had a direct relation to another CRE alignment model, namely the Designing an Accommodation Strategy (DAS) frame. PAS was used as add-on to the DAS model. The relationship between both models is not a perfect fit. Given the recommendation to use less interfaces and less content per interface, it is recommended to study whether stakeholders benefit from an explicit connection with DAS or not. Given the reflection in chapter 9, it seems to be preferred to work with PAS on the one hand and combine it with a purely substantive reference model on the other hand.

This purely substantive reference model can be built based upon the existing CRE alignment models. Since many stakeholders are involved in CRE alignment problems only incidentally, sharing state of the art knowledge is important. During the study, it has been noticed that many of these CRE alignment models are not known in practice. Therefore, it is recommended to enhance the accessibility of these existing reference CRE alignment models or create an expert system.

The additional design tools in all pilots have not been used much. It is recommended to research whether a reference model, as used in the first pilot, can be of more use if it is offered earlier in the process to the stakeholders, when defining their design variables.

Use PAS with an internal or external PAS facilitator and system engineer

Some organizations might prefer to use an external facilitator and system engineer to operate PAS, while other organizations may have the capabilities to do this themselves. It has substantial advantages for stakeholders to determine their preferences curves and to collaboratively design alternative CRE portfolios. Firstly, it allows for their demand to be better understood and secondly they themselves will better understand their own demand and that of others. It will raise awareness of the complex CRE alignment problem. However, since this approach is so different from approaches familiar to them, a facilitator helps them to embark in this new approach. At first this might not be easy, but the experience in the three pilots showed that two different facilitators were able to do so.

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