

Optimal Usage of Marketing and Sales to Push Residential Refurbishment

An empirically grounded Agent-Based Simulation on How to Push Refurbishment Decisions

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Abstract—Agent-based models can be used to assess the impact of different mixes of marketing and sales measures on homeowner’s energetic refurbishment decision-making. During the last two decades, governments have been using especially marketing-like measures (e.g., mass media campaigns) to push residential refurbishment – for a large part, unsuccessfully. Only recently, more sales-like activities (e.g., visits of energy consultants) have been offered for that purpose. The question now rises, whether this will be a more successful approach. This idea contribution addresses the research question asking what mix of marketing and sales measures is optimal to support homeowners during their refurbishment decision-making.

Keywords— *Agent-Based Modeling (ABM); refurbishment Decision-Making (DM); marketing and sales; empirically grounded.*

I. INTRODUCTION

Much research has been published about the importance of residential refurbishment for sustainability. Germany’s building stock has been erected for the largest part before the existence of any energetic building standards. Furthermore, German homeowners tend to energetically refurbish their property slowly and doubtfully. Consequently, heating residential buildings consumes too much energy and is accompanied by a huge ecological footprint [1].

More recently, the dependence of many European countries on Russian gas for heating buildings and the war Russia has been fighting against Ukraine has recharged the debate that energy efficiency in housing should be improved and refurbishment should be speeded up to lessen the dependency on Russian gas.

This idea contribution deals with the question asking how governments can optimally push homeowners in the direction of a positive refurbishing decision with the help of marketing and sales measures. In the past, governments used mass media campaigns to do this. More recently, local governments have been offering visits of energy consultants at a reduced (or even at no) charge to convince homeowners to refurbish. The question is whether there are optimal (e.g., cost efficient) mixes of marketing and sales measures that help homeowners make this decision positively. An empirically grounded Agent-Based Model (ABM) for refurbishment could be developed and the impact of different mixes

of marketing and sales on refurbishment Decision-Making (DM) could be simulated.

Science has applied ABM in the context of the current energy transition numerous times before. Du et al. [2] conclude in their review that ABM have been developed to model socio-demographic factors, housing factors, social influences, and environmental attitudes as drivers of DM in a context of energy transition. Most ABM, however, have focused on solar energy diffusion and less research was done to study refurbishment. Furthermore, Du et al. [2] conclude “Future studies can also evaluate the effectiveness of market-based policies [...]” (p. 8).

Jager already stated in 2007 that the effectiveness of marketing could benefit from social simulations like ABM [3]. He proposes different formalizations of the 4 P’s commonly used in marketing to be implemented in ABM (Product, Price, Place and Promotion). Delre et al. [4] focus especially on promotional activities, which is the category where mass and personal communication can be classified. Until today, however, ABM applied in consumer behavior DM studies do not differentiate between marketing and sales.

For both the literature concerning DM in an energy transition context, and ABM literature in the field of marketing, modeling an optimal usage of marketing and sales to push residential refurbishment is an interesting contribution.

This short description of the idea contribution is structured as follows. In Section II, this work briefly explains the key concepts used for this idea. Here, the Hierarchy Of Effects (HOE) model is explained, as this concept uses it to assess the impact of communication on DM. Furthermore, this section discusses the ABM modeling approach that is very suitable to answer the research question. The last concept explained is the Sinus lifestyle segmentation approach. The Sinus lifestyle typology differentiates the German society in ten groups. This typology can be used to simulate the refurbishment DM of 17 mi. homeowners in Germany, empirically grounded, in a differentiated way. Section III documents some thoughts concerning the development of such an ABM for refurbishment. It describes how the DM process concerning refurbishment for different agents and touchpoints can be modeled. Finally, Section IV summarizes this idea contribution and briefly gives an outlook concerning future work and the implementation of the ABM for refurbishment.

II. KEY CONCEPTS USED IN THIS IDEA

The objective of commercial communication (or “touchpoints”) is to have an impact on consumers and to support consumers in buying DM. A large body of research exists to assess this impact. HOE models represent a family of models that examine this impact of touchpoints on different steps in the buying behavior. In this logic, HOE models assume forthcoming steps in the DM process can only be reached when previous ones have been effectively completed. Consequently, the number of people who reach a next step in the process is usually reduced, compared to the previous step. This transfer from a previous step onto the next is called conversion. HOE models enable the calculation of transfer rates under the influence of communication – and as well under the influence of different kinds of communication: mass and personal communication.

As mentioned in Section I, ABM have not distinguished between marketing and sales until today. HOE models can do exactly this: The first stages in the model are primarily impacted by marketing (mass communication touchpoints), and the last stages primarily by sales (personal communication touchpoints). This is the main rationale behind applying the HOE logic within the ABM for refurbishment.

In previous research, the author developed a HOE model for energetic refurbishment of residential buildings [5]. The resulting model is based on Lewis [6], Lavidge and Steiner [7] and is shown in Figure 1. This model assesses the impact of touchpoints on DM for energetic refurbishment.

This idea contribution proposes to develop an ABM. This modeling approach simulates decisions and/or behavior of different individual agents. These agents can interact with their environment, as well as with each other. Within an ABM, usually different agents behave according to their individual preferences, their characteristics, their interactions, as well as their environment. Software for ABM allows for the setup and description of different agents, their preferences, interactions, as well as their environment. In this way, the aggregated system with its dynamics (that emerges from many different individual behaviors) can be simulated.

Agent-based models are especially interesting when problems of emergence are studied [8]. The idea is to use this approach to study refurbishment intention (after interactions with marketing and sales) at a lifestyle and system level.

The last concept described is the Sinus Lifestyle typology. The typology is used in marketing & sales, both in practice and in academics. The Sinus Institute has been monitoring sociocultural developments and trends in the German society since the 1980ies and small adaptations to the lifestyle typology are carried out regularly. The lifestyles are positioned in a two-dimensional space. The x-axis describes their orientation: Traditional towards progressive lifestyles. The y-axis describes social status: Lower class towards upper class.



Figure 1. HOE model for energetic refurbishment [5]

Ten lifestyles are located within this two-dimensional space. Previous research by the author [5] showed that depending on the Sinus lifestyle, German homeowners have very diverse attitudes and behaviors concerning energetic refurbishment of residential housing. This idea contribution uses the Sinus lifestyle approach as it forms an efficient segmentation approach to create differentiated, empirically grounded, agents within the ABM.

After this description of the key concepts of the idea, Section III will document some thoughts about the ABM that could be developed to simulate the impact of marketing and sales on homeowners’ refurbishment DM.

III. ABM FOR REFURBISHMENT

The ABM for refurbishment can be based on empirical data, taken from [5], as displayed in Table I. The representative sample (n = 4471) describes the status quo of the decision concerning energetic refurbishment of 17 mi. homeowners in Germany. The ABM will focus on the interaction of agents with various (mass and personal communication) touchpoints. This idea contribution does not take other drivers of DM (e.g., social influences) into account.

It comprises Sinus lifestyle data and their status quo concerning the DM process in the format of the developed HOE model, as described in Section II.

With the help of this data, conversion rates can be calculated, e.g., 65% of the social ecological lifestyle is converted from knowledge (80.0%) to attitude (52.3%). Within the ABM for refurbishment, 17 mi. agents (homeowners) can be set up according to the distribution of the status quo in their refurbishment DM (as displayed in Table I).

The ABM can simulate the impact of touchpoints on each individual agent with the support of a threshold variable. As a result of the interaction with a touchpoint during a period, the value of the threshold variable is increased. It is assumed that an agent needs to reach a threshold variable with a value of 4 prior to being transferred to the next step in the HOE model. Hence, as soon as an agent’s threshold variable reaches the value of 4, the agent is transferred towards the next step. Once an agent has been transferred, the threshold variable is set to 0. During the initialization of the model, the threshold variable can be set randomly between 0 and 3 to incorporate variability into the model.

TABLE I. EMPIRICAL DATA FROM [5]

German’s Sinus lifestyle	Status quo in DM				
	Awareness [%]	Knowledge [%]	Attitude [%]	Conviction [%]	Intention [%]
1. Established conservat.	99.0	80.1	51.0	33.7	14.9
2. Liberal-intellectual	99.7	82.9	57.9	40.6	13.3
3. High achiever	98.9	79.5	48.4	32.9	18.4
4. Movers and shakers	98.4	76.9	52.3	34.6	16.6
5. Adaptive pragmatics	99.5	69.0	53.9	42.4	22.4
6. Social-ecological	99.7	80,0	52,3	36,2	17,0
7. New middle class	98.5	76.9	44.1	32.6	11.8
8. Traditional	99.0	78.8	44.5	30.8	10.6
9. Precarious	99.6	64.4	36.1	20.6	9.3
10. Escapists	92.8	59.3	33.7	21.9	12.2

However, touchpoints come in different forms and should not be generalized. Not every touchpoint generates the same impact. It is generally acknowledged in marketing and sales, that mass communication touchpoints (e.g., advertising campaigns and information brochures) are best suitable to transfer consumers through the first stages of DM, especially awareness, but knowledge as well and, to a lesser extent, interest. Furthermore, personal communication touchpoints (e.g., sales talks) are best suitable to transfer consumers through the last stages of DM, especially intention, but conviction as well and, to a lesser extent, interest [9]. Hence, we detect an increased impact in the beginning and a decreased impact towards the end of DM, due to mass communication. Furthermore, we detect a decreased impact in the beginning and an increased impact towards the end of DM, due to personal communication. This phenomena of different impacts of touchpoints can be reflected in the ABM by incorporating a correction factor in the additions to the threshold variable. The correction factor is decreasing for mass communication and increasing for personal communication with every following step in the DM process.

Within the model, different amounts of mass and personal communication that an agent is exposed to in a period, can be set. The model can calculate the costs of these different mixes (of mass and personal communication), as these two types of communication vary greatly in price.

By varying the mixes of mass and personal communication, the model can explore:

1. How many homeowners reach a refurbishment intention under the impact of a set mix of mass and personal communication, and,
2. the costs for that specific mass and personal communication mix.

As described in Section I, time and especially acceleration of refurbishment behavior is important. For this reason, a budget can be set. The simulation can explore the impact of different mass and personal communication mixes in time, as long as the total costs are below the budget. In this way, the factor time (acceleration) can be considered as well.

IV. CONCLUSION AND FUTURE WORK

Heating Germany's residential buildings consumes too much energy and is accompanied by a huge ecological footprint. Governments have been using especially marketing-like measures (e.g., mass media campaigns) to push residential refurbishment among homeowners. Only recently, more sales-like activities (e.g., visits of energy consultants) have been offered for that purpose. This idea contribution deals with the question asking, how governments can optimally push homeowners in the direction of a positive refurbishing decision with the help of marketing and sales measures.

Future work consists of implementing (developing and coding) an ABM for refurbishment within an ABM modeling environment, according to the logic described in Section III. During the initialization (or set up) of the model, different agent groups should be created according to the size and distribution of Sinus lifestyles in Germany to take representativeness into account. This counts as well, for the status quo of the agents' refurbishment DM, as displayed in Ta-

ble I. Furthermore, attention will be paid to the following tasks:

A. *Costs of mass and personal communication touchpoints*

As discussed in Section III, many different touchpoints exist. Modeling results will be driven directly and strongly by the average costs assumed for mass and personal communication, which is why they should be researched carefully.

B. *Mixes of mass and personal communication*

Different mixes of mass and personal communication can be seen as scenarios for system refurbishment behavior. So, it is important to develop mixes of mass and personal communication that help the evaluation of policy effectiveness.

C. *Budgeting approach*

Speed is an important aspect of refurbishment, which can be simulated by a budgeting approach (see Section III). A budget must be developed to simulate time factors.

After successful implementation of these tasks, the ABM will enable the assessment of the impact of different mixes of mass and personal communication to push refurbishment. In this way, it can lead to recommendations on cost and time efficient approaches to push energetic refurbishment among German homeowners.

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