Developing sustainable resilience through forecasting and backcasting in architectural education

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ABSTRACT: As contemporary architectural education faces many challenges, a whole range of design methodologies is needed to move towards a sustainable future. That is why rather than focusing on emerging problems, the engineering disciplines should engage in exercising visionary strategising. In this article, the authors outline their search for appropriate techniques of designing the future by analysing efficient frameworks in the disciplines of business, economy and management. Based on the critical investigation of two innovative approaches - forecasting and backcasting - the authors defined possible applications of these methods in architectural education. They also confirmed that these methods are adequate for development of sustainable and inclusive built environment in line with the New European Bauhaus initiative, as well as perfectly fulfilling the requirements of the Fit for 55 strategy. The research showed no quality distinction between forecasting and backcasting, but a differing range of scopes, thus making them complimentary. Both methods should be retained in education of engineering professionals, as they enable creating complex, innovative and interdisciplinary projects.

INTRODUCTION

Architectural education of the third decade of the 21st Century faces many new challenges. The change in design didactics was diagnosed by Gyurkovich, who emphasised the need of transformation both in terms of organising teaching and the substantive content being taught [1]. Although comprehensive and timely, the author's observations could still be supplemented with an overall value guiding both organisational and methodical aspects of teaching architecture - sustainable resilience.

A well-trained resilient mind-set of students and teachers would enable them to react to new, surprising challenges in an effective way. Exercising *academic* resilience not only helps to identify the factor of change, but also to shape and direct it towards a sustainable future. Since providing frameworks and strategies is one of the main functions of architecture, universities should not only teach directed solutions, but also flexible strategising. Therefore, resilience training should be the base of every designer's operational framework. As noticed by Elbæk, it is necessary not just merely to embrace the complexity, but to act and create within it [2].

While universities are facing and responding to the results of the Covid-19 pandemic now, it is crucial to acknowledge that the future may bring other unexpected and critical factors that could possibly reshape academic realities. Therefore, it is even more important to be ready for it through proficiency in applying resilient design schemes into educational frameworks. The desired flexibility in approaching a design challenge can be obtained with forecasting and backcasting. Those two prediction methods, which enable planning future scenarios, are derived from the world of economics. But instead of being used as quantitative schemes for predicting demand, in design education they can serve as qualitative means of learning how to envision different futures - the possible, the preferable and the avoidable one.

AN APPROACH

Creative, yet systemic ways of working on a resilient future include forecasting and backcasting - two gradual frameworks that vary in relation to time. Forecasting predicts the unknown future values based on known trends, while backcasting is a planning method that starts with defining a desirable future and then works backwards to identify policies and programmes that will connect that specified future to the present [3].

The difference between the two approaches, expressed graphically in Figure 1, is strategic. The former is not considered with the *desirability* of the research outcome (whether good or bad), while backcasting aims at creating the best future possible. Nevertheless, since the methods are complimentary in business-oriented workflows, they could also harmonise in a design process of architecture studios or engineering faculties.

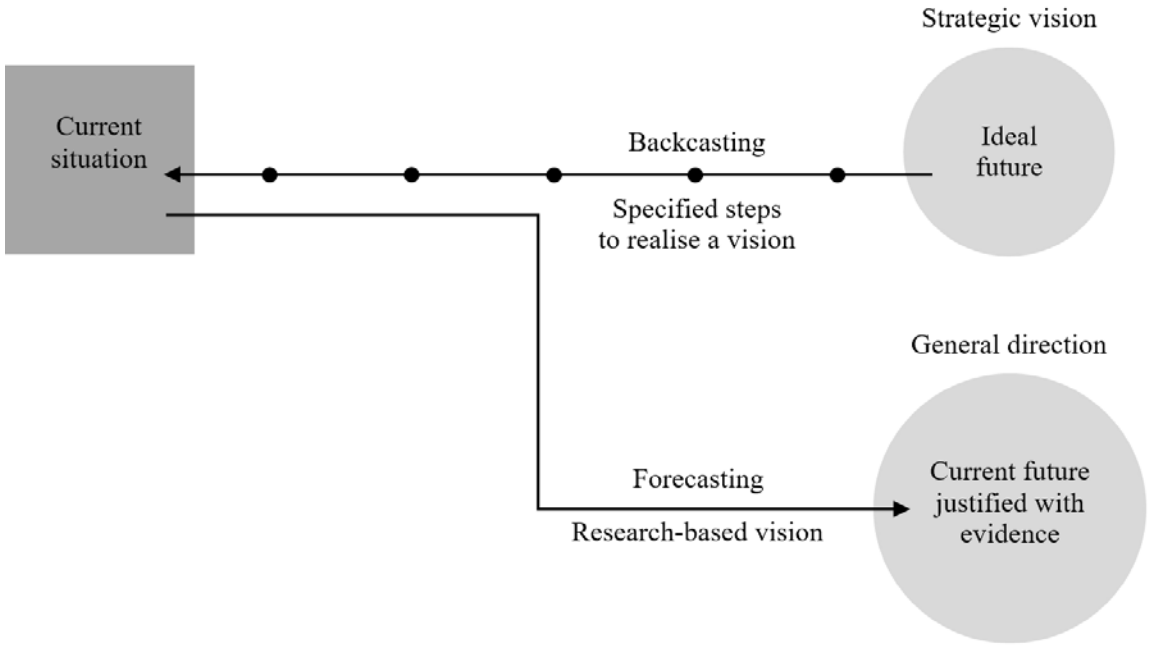

Figure 1: Forecasting and backcasting as methods of resilient design.

In the world of economy, both disruptive innovation and incremental growth guarantee the company's development, but it is the innovation that leads to major breakthroughs - and therefore it is more valued. The drive for economic innovation utilises both frameworks of forecasting and backcasting as the appropriate structures to support strategic thinking. As believed by economists, innovative development in leaps - as opposed to incremental steps - requires visionary direction, enabled by working within a forecasting framework. Once there is a vision for the future, backcasting can assist in planning the steps to get there. Then, the full process of producing an effective business strategy is completed. Creating a vision or strategy can be supported by defining dedicated forecasts, while specific designs to realise a long-range strategy can be envisioned within a backcasting framework. What is more, forecasting the results of an unexpected challenge can provide creative, diverse ways of overcoming a given problem. Proven efficient by e-commerce giants, such as Amazon, the strategy of combining both methods can also work in design and engineering education. The ability of correct usage of the two methods could support intuitive creativity of designers, and therefore foster the resilience of thinking in design faculties.

METHODS

As mentioned before, the first stage of dealing with a challenge or of creating a vision is forecasting, as illustrated in Figure 2.

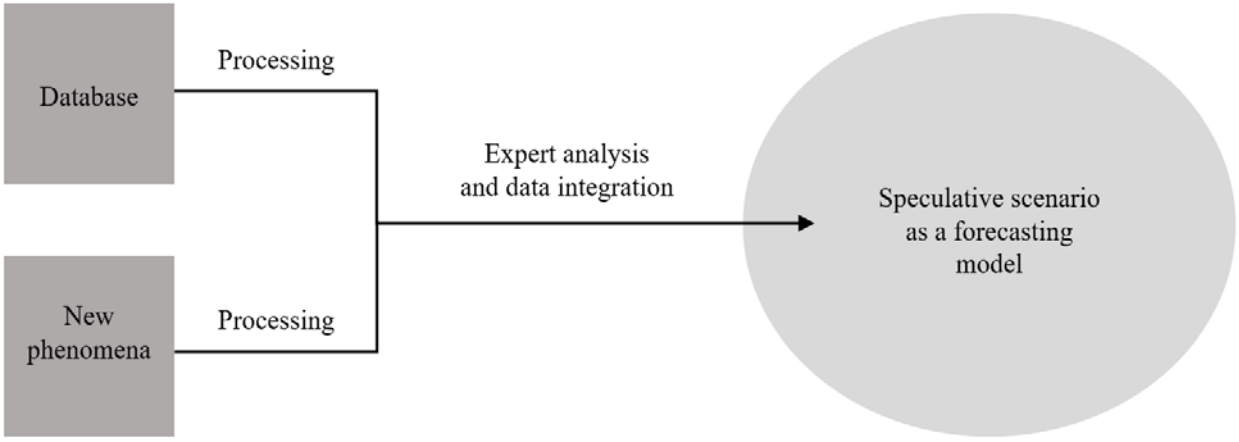

Figure 2: The forecasting analysis method.

Within this framework the challenge results or the vision's benchmarks can be successfully defined. The process of forecasting generates a future scenario based on combining known facts with multidisciplinary information, and key driving forces inspired by social, technical, economic, environmental and political trends. There are gradual stages that help generating reliable forecasts:

1) determining the forecast goal;

2) selecting the items the forecast is focused on;
3) defining the time horizon, choosing a short or long range;
4) selecting the forecast model;
5) gathering the data;
6) making the forecast.

While the forecast goal and scope can be connected to any aspect of architectural and urban planning, the forecast time horizon determines the applicability and possible implementation of the design based on the forecast. A short-range forecast indicates a high possibility of fast design implementation, while a long-range model suggests working on a much complex, multi-level strategy. While the timespan connects to the forecast scope, the method selection is to do with the team composition and the assigned roles of its members.

The first of the forecast methods is a judgmental forecasting model that utilises subjective and intuitive information to make predictions. This kind of forecast is the most appropriate in the initial work on a specific challenge, when the team members intuitively formulate their proposals. In this model, the proposal's accuracy is improved by adding new information in time. It is interesting that usually the predictions made within a judgmental model are overoptimistic - like the human judgment. Underestimating risks and overestimating the benefits is what Kahneman and Tversky call the inside view, where historical precedents are less valued than the desired projections [4].

Conversely, more realistic predictions can be made with an outside view or the Delphi method, which is formulated with knowledge of the past and general field expertise. Analogically to the judgmental model, the Delphi method utilises opinions provided by a group of individuals. But instead of guessing, the experts in diverse disciplines formulate their educated predictions of the research aim. Guided by the facilitator - teacher in the academy - they go through two or more rounds of directed predictions and formulate a common summary. The initial scopes and proposals, common or expert, are later validated with gathered data and dominating trends of various areas.

Steep - an assessment method whose acronym is derived from social, technical, economic, environmental and political factors crucial in evaluating external elements that can influence design decisions. Such a division of influencing components and their separate treatment can help better understand and analyse the context of a project. Of course, the interconnections between specific factors are established and taken under consideration, but only after all the aforementioned trends are researched separately. This way, one can consider a variety of external forces beyond personal preferences, preparing a truly objective forecast. Summing up, the forecasted outcome is themed and goal-oriented, but not always a preferred one.

It is the next step that utilises prepared forecasts to determine or develop the design vision. Usually, a few forecasts are being prepared within one process. If they depend on the diverse influencing factors, their final assessment can guarantee the broadest analysis. Similarly to the company economic workflow, the designer or design students can determine their vision of the future from different forecasted scenarios they had prepared. To transform such a vision into a pragmatic strategy, it is essential to follow forecasting with backcasting. This way, when progressing with the project, the design practitioner can define steps to achieve the selected and previously validated vision. Such a scenario-based design method of combining forecasting and backcasting, besides its successful commercial application, is regarded as a promising tool by many researchers e.g. Dreborg [5], Kok et al [6] and Mander et al [7].

Backcasting as a framework was pioneered and developed by John B. Robinson from the University of Waterloo, Ontario, Canada in the 1980s. Although the method has been developed systematically, backcasting - by asking what actions should be taken in order to attain a certain goal - backcasting also seems to be an intuitive and speculative revision. As graphically shown in Figure 3, backcasting is a process initiated by a preferred future, which can be elected fromthe forecasted scenarios.

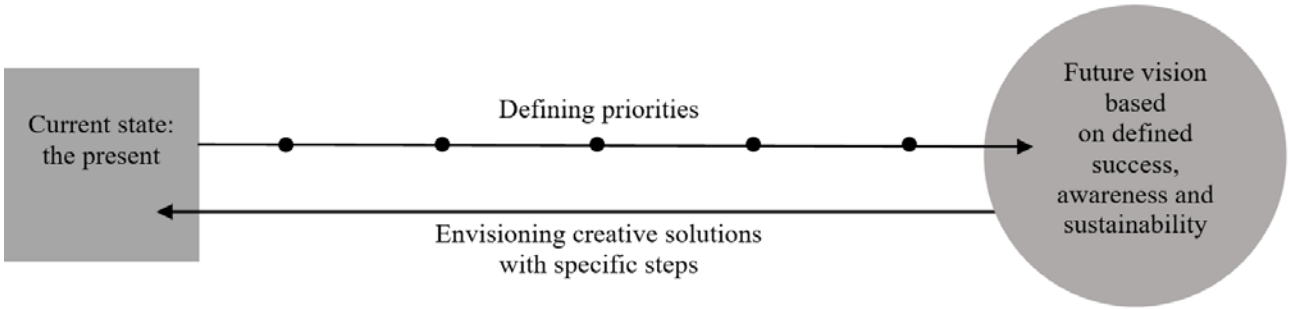

Figure 3: The backcasting analysis method.

The procedure allows identifying the obstacles and opportunities on the way to achieve the goal. Being goal-oriented, the method is a series of sub-processes, where the team members or the stakeholders: 1) craft the ideal vision of the future or a desired situation; and 2) define specific steps to obtain the desired outcome.

Although the method is a systemic narrative of consecutive stages, when exercised in a thoughtless way it can easily miss the target. Because typically it is not concerned with forecasts, backcasting is in danger of being based on the overoptimistic visions as drives for change. On the other hand, the more attractive the vision is, the more determined one can be to realise it, even when the goal seems improbable. Nevertheless, when preceded by the forecasting process, backcasting serves as a more reliable drive for achievable innovation. Moreover, it is believed that the backcasting method involves processes where more creative ideas can emerge and be expressed [8].

The most common analytical instrument used in backcasting is a scheme called the logic tree, as shown in Figure 4.

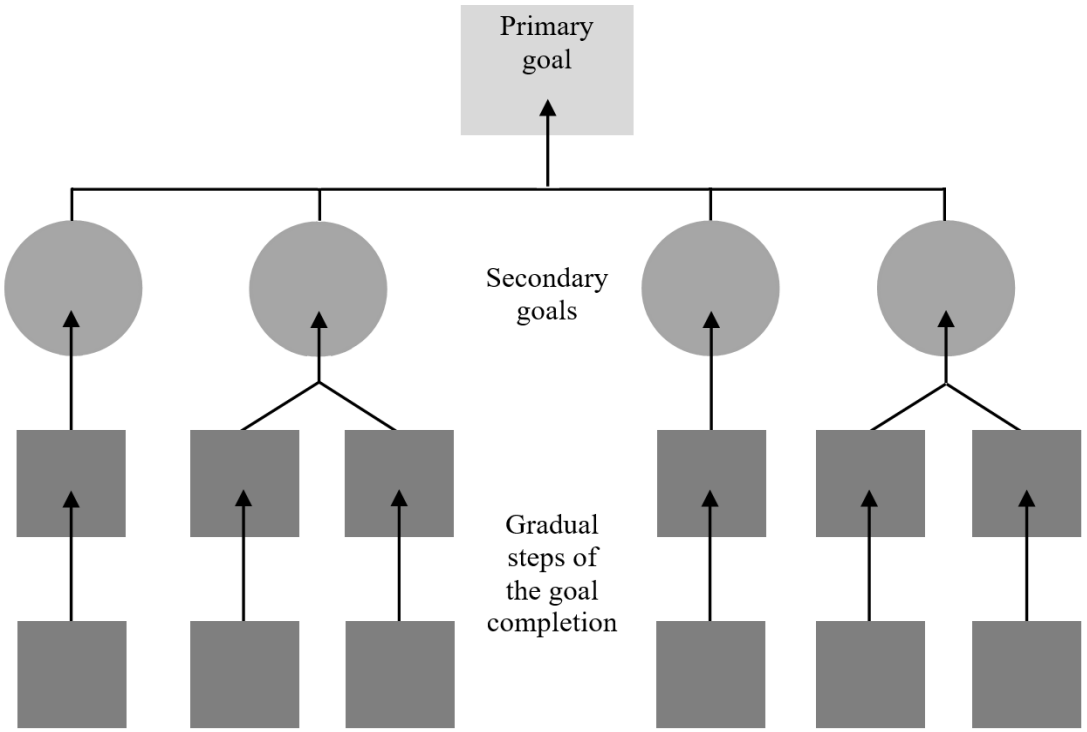

Figure 4: The logic tree diagram.

In this diagram, the top position (the light grey square) is occupied by the primary goal. It is followed by a set of secondary ambitions (grey circles). There can be many secondary goals: the more of those are defined, the more complex the whole procedure becomes. During the stage of defining secondary goals, a workshop group built from specialists of various disciplines and interests is an advantage, as they can propose multifaceted subsidiary targets.

The means or steps (dark grey squares) to achieve the secondary goals are located below each of the defined objectives, creating a gradual narrative of causal connections. The diagram, besides its hierarchical arrangement, follows a linear timeline with the furthest future at the top and the contemporaneity at the bottom. Using such a simple scheme can help exercising the backcasting method by visually capturing all the procedural steps. Because of its universal organisation, it can be exercised, within various disciplines and courses, from economics to urban planning and architecture.

A COMBINED APPROACH

Multifaceted targeting of the problem has proven a guarantee of success. As Dreborg had already concluded 25 years ago, sustainable development is a highly complex problem, which calls for major changes in the long run [5]. Emphasising the diagnosed complexity of the challenge and the methodological analogy to the economy sector, the two aforementioned design frameworks can work combined to provide sustainable, resilient solutions. Although the sequential application of these methods in the creative process is logically justified, forecasting and backcasting are usually researched separately in the disciplines of design and engineering [4-6].

To innovate within the methodological design framework both forecasting and backcasting should constitute a fluent process. Increasing methodological resilience and the effectiveness of design solutions are essential for design and engineering faculties, and they have to provide a successful toolkit for influencing the future with original and inventive projects. As those sustainable design visions demand embracing multiple ideas and values, the structuralised frameworks of forecasting and backcasting appear appropriate for upgrading the process. What is important in the context of architectural education is that the both methods exercise creative thinking: forecasting by speculating on the development of the current state with a research-based framework and backcasting by proposing gradual, imaginative design solutions to obtain a desirable goal. With Avsec and Jarman proclaiming that employed creativity and proactive behaviour improve contemporary teaching and learning [9], the described methods seem a worthy addition to architectural curricula.

RESULTS AND DISCUSSION

As demonstrated, there is a great potential in interdisciplinary translocation of thinking frameworks. Forecasting and backcasting applied in architectural design prove extremely efficient when treated jointly, similarly to economical procedures of commercial strategising [10-11].

Table 1 below is a brief summary of characteristic features of both methods presented through comparing parameters, the scheme of a narrative and possible applications of the end result.

Table 1: The comparison of forecasting and backcasting frameworks.

	Discipline	Economics	Design
Method	Characteristic features	Quantitative	Qualitative
Forecasting	Starting point	Current situation	
	Movement direction	Forward	
	Possible application	Defining a business benchmark or a company goal	Defining a design brief or a course goal
	Analyses gathered data	Yes	Yes
	Depends on intuition of an expert	No	No
	Depends on creativity	No	No
	Stimulates creativity	Yes	Yes
	Facilitates efficient teamwork	Division of roles and responsibilities within the team structure	
	Agenda	Defining through the process	
Backcasting	Starting point	Ideal future/design goal	
	Movement direction	Backwards	
	Possible application	Creating a business plan	Creating a design proposal
	Needs gathering the data	No	No
	Depends on intuition of an expert	Yes	Yes
	Depends on creativity	Yes	Yes
	Stimulates creativity	Yes	Yes
	Facilitates efficient teamwork	Multidisciplinary narrative of the brainstorming session	
	Agenda	Necessary at the start of the process	

The table collates forecasting and backcasting within economical and architectural processes, and indicates high effectiveness of the methods in both disciplines. It shows high efficiency in the use of both forecasting and backcasting, and guarantee the comprehensiveness of the design process. What is more, the table demonstrates that the methods - when used as complimentary work scenarios - can be applied in various stages of design education and design itself: from defining a brief or class agenda throughout teamwork to convincingly presenting the design flow. Furthermore, being proficient in both forecasting and backcasting helps navigating the effective teamwork and adjusting the work scheme to the group's dynamics. Both methods stimulate creativity while exchanging dependence on data-driven research or imagination.

For all those reasons the true resilience of the thinking process can be obtained by using forecasting and backcasting jointly within the design process.

CONCLUSIONS

The methodological transfer between disciplines has a great impact on the future of education, because it enables innovation by analogy. In this article, the authors analysed the methods of forecasting and backcasting, widely used in business management, translating them into the creative environment of design disciplines. The research traced the process of forming a resilient mind-set methodology by analysing two aforementioned planning routines: forecasting and backcasting. Arguing for their complementary use when designing, the authors propose adding the methods into the design syllabus.

The conducted comparative analysis of methodological praxis indicates significant gains from applying forecasting and backcasting into the design education portfolio. This approach does not validate one method above the other, but rather emphasises the difference in their focus areas and establishes the application order. It shows the possibility of using the design scope differentiation to successfully deal with challenges of the design process. Therefore, it is advisable to use both forecasting and backcasting to achieve best possible future-oriented design results.

Contemporary architectural educators and their students need to develop strategic thinking about a resilient and sustainable future. Climate crisis, socio-political changes and lack of ecological stability impact urban life and make existing solutions obsolete. This is why the engineers, both scholars and students, have a responsibility to make the environment prepared for the unexpected. To build an efficient base and influence the future generations, those transformations should also be evident in shifting perspectives of educational methods and focusing on training strategic

mind-sets rather than only zooming on burning issues. A successful strategy derived from other academic disciplines should be transferrable and prove coherent and productive. This behavioural shift could increase the resilience of professionals in engineering and design.

Forecasting and backcasting - the methods analysed in this article - should be introduced in a programmatic framework of those disciplines. The methods' narratives work in opposite directions: forecasting towards the unknown future of resultant qualities and backcasting from the desired outcome backwards with specific steps. Because of the efficient application in different scope scales, the aforementioned methods are complimentary. Using both of them can serve to prepare a multi-threaded overall strategy with defined means to obtain the strategic goals. Such a design process would result in creating truly comprehensive projects, resilient to changing factors, but still true to their core aims. Methodological, resilient thinking could improve designers' response to the United Nations Sustainable Development Goals [12], successfully finding spatial ways to build sustainable cities and communities (Goal 11), being the goal of innovation itself (Goal 9). The combination of forecasting and backcasting brings about a methodological innovation, adequate for development of sustainable and inclusive built environment in line with the New European Bauhaus initiative [13] and perfectly fulfilling the requirements of Fit for 55 strategy [14].

Summing up, interdisciplinary research and translocating the methods can be of great value. It can be successfully argued that applying both methodologies of forecasting and backcasting would bring design education closer to the professional ethos: envisioning, designing and guiding the spatial environment towards a sustainable future.

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