



Systematic Analysis of Recovery Modelling Research and Identification of Future Modeling Needs from an Urban Planning Perspective



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Abstract: Post-disaster recovery modelling has recently emerged as a promising approach to inform decision-making in complex and uncertain situations, particularly where policy changes entail significant costs and risks. This paper conducts a literature review of the present state of recovery modelling research and analyzes the existing models in terms of their societal context, aim, focus, and values. By doing so, it identifies the unaddressed research questions and requirements for future model development to enhance their utility in recovery planning.

災害後の復興モデリングは、特に政策変更に必要なコストやリスクが伴う複雑かつ不確実な状況下において、復興計画及び制度設定を支援する有望な手法として近年注目を集めている。本研究では、復興モデリングに関する最新の文献をレビューし、既存のモデル（27）を社会的文脈、目的、焦点、そして重視される復興のフェーズ（復興活動の段階）の観点から分析する。それにより、これまで十分に扱われてこなかった研究課題を明らかにし、将来的なモデル開発に必要な要件を提示することで、復興計画への応用可能性の向上を目指す。

Key Words: disaster recovery, recovery modeling, ABM, SD, DES, CGE, EG, NEG, Markov chain

I. Recovery Model Typologies

Author(s) (year) Model type	Main focus	Temporal phase	Modeled Phenomena	Context	Aim	Phases		
				Stable (S); Growing (G); Declining (D)	Identification (I); Evaluation/Estimation (E); Target setting (T)	Emergency; Restoration; Recovery I; Recovery II		
[33] Sutley and Hamdeh (2018) Markov chain	Housing Recovery	Recovery Phase		S	E			
[22, 23] Ling and Wang (2017a, b) Markov chain				S	E			
[2] Burton et al. (2019) DTSB/EPUB				S	E			
[30] Nejat and Damjanovic (2015) ABM				S	I, E			
[3, 4] Bhattacharya (2015) Bhattacharya and Kato (2021) ABM				G; S; D	E			
[1] Alisjahbaha et al. (2022) ABM				S	I, E			
[13] Ghaffarian et al. (2021) ABM				G	E			
[8, 9, 10] Eid and El-adaway (2017a, b, c) ABM				S	E			
[5] Costa, et al. (2021) ABM				S	I, E			
[28] Moradi and Nejat (2020) ABM				S	E			
[18, 25] Huling and Miles (2015), Miles (2017), Longman and Miles (2020) DES				G; S	I, E			
[35] Wang et al. (2022) ABM				S	I, E, T			
[6] Costa et al. (2022) ABM				S	E			
[31] Peng et al. (2021) ABM				S	E			
[21, 7] Kumar et al. (2015) Diaz et al. (2015) SD				S	E			
[15] Grinberger and Samuels (2018) Economic model	Regional/urban Economic and Community Recovery	Recovery Phase		S	E			
[36] Xie et al. (2018) CGE				G	E			
[16, 17] Hosoya (2016) Hosoya (2019) EG				S	E			
[32] Sauser et al. (2017) ABM				S	E			
[29] Nasrazadani and Mashuli (2020) ABM				S	E, T			
[37] Xue et al. (2023) ABM				S	E			
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[19] Hwang (2015) SD	Urban System Recovery	Recovery Phase		S	E			
[24] Links et al. (2018) SD				S	E			
[27] Miles and Chang (2011) Markov chain				S	E			
[20, 34] Kanno et al. (2019) Lubashevskiy (2022) ABM				S	E			
[14, 15] Grinberger and Samuels (2018) Grinberger and Felestein (2019) ABM				S	E			
[11] Feofilovs and Romagnoli (2021) SD				S-D	E			
[12] Fujita et al. (2021) NEG				D	E			

II. Results and Discussion

- Societal Context:** Existing models mostly assume a Stable society where return to equilibrium (often both in terms of population and GDP) is expected. While this is useful for investigating fundamental research questions universal to all recoveries, additional models which address questions specific to Growing and Declining societies are limited (ref. [13, 36, 11, 12]) and necessary.
- Aim:** The primary objective of most recovery models is to estimate (E) factors such as recovery duration, spatial disparities, and to evaluate policy or planning scenarios. These functions are often effective in Stable or Growing societies, where identifying bottlenecks (I) can significantly improve recovery efficiency. However, in Declining contexts—marked by depopulation or economic downturns—flexible target-setting (T) mechanisms are essential. Unfortunately, only a limited number of models currently suggest such adaptive mechanisms to address the needs of these environments (ref. [35, 29]).
- Recovery Phases:** Most models focus heavily on the middle stages (Restoration and Recovery I – based on the framework of Kates & Pijawka, 1977) of recovery.

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- Recovery Phases:** Most models focus heavily on the middle stages (Restoration and Recovery I – based on the framework of Kates & Pijawka, 1977) of recovery. Yet, the Emergency phase is critical for understanding how initial actions (e.g. involuntary and voluntary out-migration) shape longer-term outcomes. Likewise, the final phase of recovery is deeply tied to societal goals, which can vary across contexts. Both phases deserve more attention in future model developments related to recovery. In addition, the recovery outcomes need to be evaluated based on a systems perspective (i.e. in relation to- and impacts on- its surrounding cities).

III. Reference and Further reading

- Kates, R. W., and Pijawka, D. (1977). "From rubble to monument: the pace of reconstruction." *Reconstruction following disaster*, 1, 1-23.
- Bhattacharya, Y., Shiozaki, Y., and Kato, T. (2025) "A Review of Disaster Recovery Models from a Planning Perspective," *19th International Conference on Computational Urban Planning and Urban Management (CUPUM)*.