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Resilience Maturity Model vs. Sustainable Cities Maturity Model: criteria, limitations and applications in the Brazilian context

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Resilience Maturity Model vs. Sustainable Cities Maturity Model critérios, limites e aplicações no contexto brasileiro

RESUMO

Objetivo – Analisar comparativamente o Resilience Maturity Model (RMM) e o Sustainable Smart Cities Maturity Model (SSC-MM), considerando seus critérios, escopos e potencial de aplicação no contexto urbano brasileiro.

Metodologia – Pesquisa qualitativa de natureza exploratória, baseada em análise documental comparativa dos modelos, utilizando critérios estruturais e operacionais.

Originalidade/Relevância – O estudo supre a lacuna de análises comparativas entre modelos de maturidade urbana, especialmente em países em desenvolvimento, onde há necessidade de instrumentos adaptáveis à realidade local.

Resultados – Identificaram-se diferenças relevantes quanto ao foco (resiliência vs. sustentabilidade), à estrutura (matricial vs. por pilares) e à operacionalização (políticas e stakeholders vs. indicadores e KPIs), além de possibilidades de uso complementar.

Contribuições teóricas/metodológicas – Proposição de um quadro comparativo entre modelos de maturidade urbana e diretrizes para sua aplicação integrada.

Contribuições sociais e ambientais – Apoio à formulação de políticas públicas mais eficazes, alinhadas à resiliência urbana e aos Objetivos de Desenvolvimento Sustentável (ODS).

PALAVRAS-CHAVE: Modelos de maturidade. Cidades sustentáveis. Resiliência urbana.

Resilience Maturity Model vs. Sustainable Cities Maturity Model: criteria, limitations, and applications in the Brazilian context.

ABSTRACT

Objective – To comparatively analyze the Resilience Maturity Model (RMM) and the Sustainable Smart Cities Maturity Model (SSC-MM).

Methodology – Qualitative exploratory research based on comparative documental analysis.

Originality/Relevance – Addresses the lack of comparative studies on urban maturity models in developing countries.

Results – Identifies structural and operational differences and complementarities between models.

Theoretical/Methodological Contributions – Proposes a comparative framework and integration guidelines.

Social and Environmental Contributions – Supports public policy formulation aligned with sustainability and resilience.

KEYWORDS: Maturity models. Sustainable cities. Urban resilience.

Modelo de madurez de la resiliencia frente al modelo de madurez de ciudades sostenibles: criterios, limitaciones y aplicaciones en el contexto brasileño.

RESUMEN

Objetivo – Analizar comparativamente los modelos RMM y SSC-MM.

Metodología – Investigación cualitativa basada en análisis documental comparativo.

Originalidad/Relevancia – Aborda la falta de estudios comparativos en países en desarrollo.

Resultados – Identifica diferencias estructurales y operativas.

Contribuciones Teóricas/Metodológicas – Propone un marco comparativo.

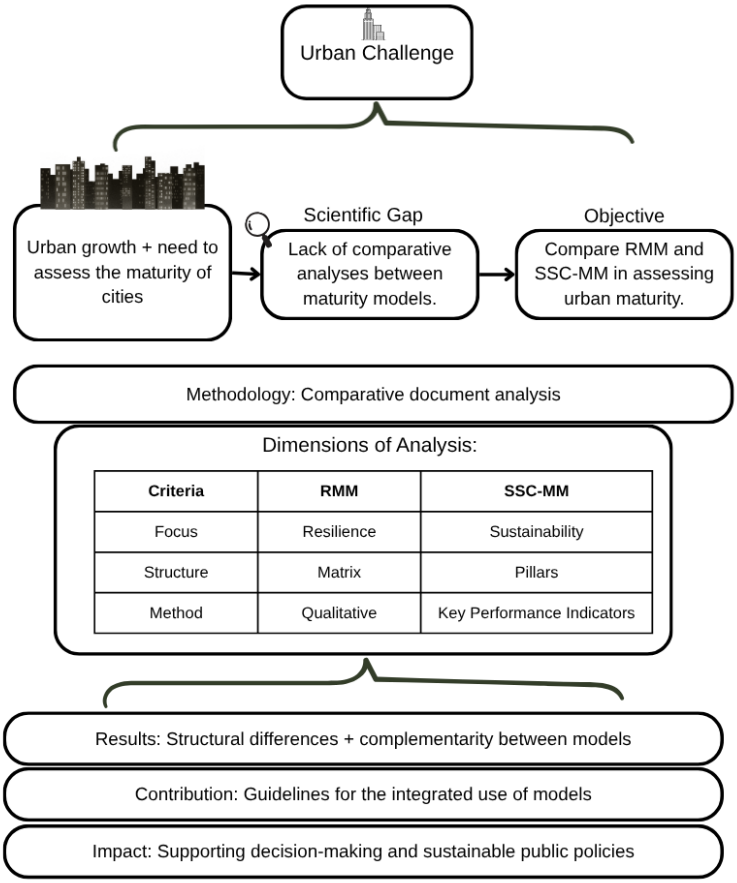
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Contribuciones Sociales y Ambientales – Apoya la formulación de políticas públicas sostenibles.

PALABRAS CLAVE: Modelos de madurez. Ciudades sostenibles. Resiliencia urbana.

GRAPHICAL ABSTRACT



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1 INTRODUCTION

Population growth and the urbanization advancement impose on municipal administrations the challenge of formulating strategies capable of promoting sustainable solutions in economic, social, and environmental spheres (Santos et al., 2022). In this context, urban management in Brazil demands models that integrate administrative efficiency with quality of life, going beyond purely technocratic views (Alexandre; De Alexandria; Braga, 2020). Moreover, acceleration urban growth and challenges related to sustainability have led managers and researchers to seek instruments that will guide the diagnosis, planning, and monitoring of cities (Lima; Lopes; Façanha, 2019).

Among these instruments, maturity models stand out for offering structured development trajectories, with progressive levels that make it possible to assess the current situation, project improvements and align public policies with long-term objectives (Röglinger; Pöppelbuss; Becker, 2012). The usage of indicator systems is essential so that urban planning ceases to be reactive and becomes strategic, allowing a precise reading of intra-urban disparities (Almeida; Gonçalves, 2018). In the field of urban management, such models have been applied to measure resilience, sustainability and innovation capacity of municipalities, supporting both policy formulation and decision-making by different governmental and social actors (Leal Filho et al., 2024). Application of global models in Brazil requires caution, since local specificities and the lack of basic infrastructure may limit the effectiveness of purely technological solutions (Antonello, 2023).

In this article, two models were deeply analyzed: Resilience Maturity Model (RMM) aimed at preparedness and response to risks and disasters, developed by Smart Mature Resilience (SMR, [online]); and Sustainable Smart Cities Maturity Model (SSC-MM), developed by the International Telecommunication Union (ITU, 2019), whose focus is to align the development of cities with the Sustainable Development Goals (SDGs). Although both address urban maturity, RRM emphasizes resilience in the face of critical events, while SSC-MM privileges an integrated and measurable view of sustainability across the economic, social, and environmental pillars. Despite relevance of these models, there is still a scarcity of comparative analyses discussing their convergences, limitations and possibilities for integration, especially in developing countries such as Brazil.

The choice of the RMM and the SSC-MM is justified by the fact that both represent consolidated and internationally recognized references for assessing urban maturity, each in distinct and complementary dimensions. There are other relevant maturity models in the literature, such as the Capability Maturity Model Integration (CMMI Institute, [online]), aimed at software development and organizational processes; the Enterprise Architecture Maturity Model (EAMM), applied to information technology management (Nascio, [online]); and the European Foundation for Quality Management (EFQM, [online]), widely used in quality management in companies. However, these models have a narrow focus on specific organizational areas and do not directly address urban planning challenges, community resilience, or socio-environmental sustainability.

In this sense, the selection of the RMM and the SSC-MM is because they are models directly conceived to apply in cities, considering both aspects of multilevel governance, risk management and

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economic, social and environmental pillars associated with international sustainability agendas. This combination of models makes it possible to carry out a comparative analysis with greater relevance to the urban context, exploring how resilience and sustainability can be integrated into a single maturity pathway for development of smart and sustainable cities.

In this context, this article aims to comparatively analyze the RMM and the SSC-MM, considering their criteria, scopes and potential for application in urban context. This study seeks to answer the following question: to what extent do the RMM and the SSC-MM differ from and complement each other as maturity references for cities? To this end, a comparative documentary analysis is carried out based on structural and operational criteria of each model. Results of which model are synthesized in a comparative framework. The article is organized as follows: in addition to this introduction, the next section presents theoretical framework on maturity models, followed by methodology, comparative results, discussion and finally conclusions with recommendations and future perspectives to this subject.

2 THEORETICAL FRAMEWORK

The following references provide theoretical foundation for this article. Subsequent sections introduce the maturity models and their core research concepts, followed by a discussion on RMM and SSC-MM and their practical applications in cities.

2.1 Maturity models

A maturity model, by definition, is a sequence of levels that follow a hierarchy and indicate a path to be followed ranging from initial to final stage of maturity (Röglinger; Pöppelbuss; Becker, 2012). In addition, maturity models are used to assess present situations, to drive improvement efforts, and to monitor future progress (Iversen; Nielsen; Norbjerg, 1999). Maturity models were developed to help organizations gain competitive advantage, minimize costs, improve quality of indicators and address other aspects that support their development in the market (De Bruin, 2005).

The fundamental purpose of maturity models is to develop specific capabilities within an organization over time (Hynds et al., 2014). Maturity models follow a growth hierarchy and are referred to as growth-stage models, stage models or stage theories (Prananto; Mckay; Marshall, 2003). According to Pöppelbuß and Röglinger (2011), there was a growth in maturity models after the introduction of the Capability Maturity Model (CMM) to the market, developed by the Software Engineering Institute (SEI). Since their creation in 1986, several other models have been established in the market and in the research domain, such as those by De Bruin et al. (2005) and Weber; Curtis; Gardiner (2008).

Some examples of maturity models are the Capability Maturity Model Integration (CMMI), developed by Carnegie Mellon, used for enterprise management and created in the 2000s; and the Enterprise Architecture Maturity Model, created by the National Association of State CIOs, used for information technology management and developed in the 2000s (De Bruin, 2005).

The European Foundation for Quality Management (EFQM) maturity model, developed through Excellence Model, is used for business management and was created in the 1990s. Process Maturity

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Model, developed by the Rummler-Brache Group is used for process management and was developed in the 1990s. Project Management Maturity Model, developed by the Office of Government Commerce (UK), is used for project management and was created in the 1990s (De Bruin, 2005).

Topic of maturity models geared toward cities has been explored for some time and has proven to be a tool oriented toward socio-environmental problems; however, there is still a limited understanding of the subject, given that the applicability of it standards differ for each region (De Santana et al., 2019). According to the author, a maturity model geared toward cities should consider the individual population culture, and the cities the classification should be composed of indicators based on its reality thus meeting its own demands.

In urban context, adoption of maturity models emerges as a response to the need to structure public policies, align actors, and integrate sustainability indicators, especially in light of the SDG agenda and the growing pressures for resilience in face of disasters. In this field, two internationally recognized reference models stand out, the RMM and the SSC-MM, selected in this article for comparative analysis.

2.2 Resilience Maturity Model (RMM)

The RMM was developed within the scope of the European project Smart Mature Resilience (SMR) (SMR, [online]) as a tool to support cities in strengthening their capacity to face risks and disasters. The model is structured into five maturity levels, described by the SMART matrix: Starting, Moderate, Advanced, Robust, and Vertebrate, presented in Figure 1, indicating policies and actions of each stage to be achieved (Hernantes et al., 2019).

Figure 1 – RMM Matrix Model



Source: SMR [online].

As shown in Figure 1, the policies are represented by the rows: L – leadership and governance, P – preparedness, I – infrastructure, and C – cooperation. Each stage describes a set of policies, practices and institutional relationships that the city must adopt to evolve along its resilience trajectory; thus, in initial stages absence of integration between departments and emergency services prevails, making it essential to identify stakeholders, define action plans, and place resilience on the local political agenda (Hernantes et al., 2019). As maturity advances, governance becomes more collaborative, integrating governmental actors, civil society, companies, and academic institutions; at highest levels, resilience

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comes to be internalized in the city's culture and expanded to national and international cooperation networks (Gimenez; Labaka; Hernantes, 2017).

Urban resilience, therefore, should be understood not only as a response to disasters but as the institutional capacity for continuous adaptation to environmental and social pressures (Silva; Tarouco; Edelweiss, 2018). Main contribution of the RMM is to offer a clear and staged roadmap for public managers, focusing on multilevel governance and coordination of multiple actors, fundamental aspects for facing recurrent threats such as floods, droughts, or landslides (Gimenez; Labaka; Hernantes, 2017). Finally, a maturity model for cities, in addition to indicating levels of structuring in relation to practices and processes, can also produce results expected by governments seeking smart and sustainable cities, identifying levels and main measures to be achieved (Hernantes et al., 2019).

2.3 Sustainable Smart Cities Maturity Model (SSC-MM)

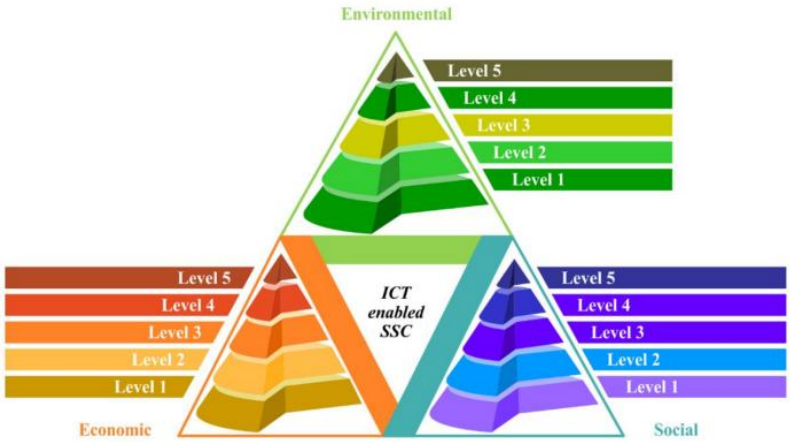
SSC-MM was proposed by the International Telecommunication Union (ITU) in 2019 as a reference to guide the development trajectory of cities toward sustainability and intelligence. The model is articulated around three pillars – economic, social, and environmental – which reflect the triple bottom line of sustainability and the SDGs (ITU, 2019).

Each pillar is divided into five maturity levels, ranging from the initial formulation of strategies to consolidation of integrated and innovative systems. In initial stages, this model emphasizes definition of vision, objectives and key performance indicators (KPIs). At intermediate levels, implementation of smart services stands out (such as digital health, efficient public transport and sustainable housing). At highest levels, the goal is data integration and advanced technologies, such as artificial intelligence, Internet of Things (IoT) and digital governance, to ensure continuous population improvement and quality of life (ITU, 2019). This is illustrated in Figure 2.

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Figure 2 – Sustainable Smart City Maturity Model (SSC-MM)



Source: International Telecommunication Union (ITU, 2019).

Integrated application of economic, social and environmental dimensions in a maturity model for smart and sustainable cities is essential to ensure balanced, resilient and inclusive urban development that meets the needs of present and future generations (ITU, 2019). Central characteristic of SSC-MM is its emphasis on measurability: through KPIs, it allows evolution of each city to be assessed across different dimensions, favoring comparisons and identification of best practices. Its approach is comprehensive and strategic, aligned with international agendas and oriented toward too long term, being especially useful for guiding investments and integrated public policies. However, implementation of smart-city technologies is only effective when accompanied by participatory governance that includes the population in decision-making process (Camargo; Cortese; Vils, 2020).

3 METHODOLOGY

This study is characterized as qualitative and descriptive research, conducted through comparative documentary analysis. The aim was to examine two maturity models applied to urban context, the RMM and the SSC-MM, in order to identify convergences, distinctions and possibilities for integration. Documentary analysis was based on technical reports, scientific publications and institutional materials that describe functioning and application of each model (Cellard, 2012). Choice of a documentary approach is because the models are internationally recognized but still lack in-depth comparative studies, especially in developing countries such as Brazil.

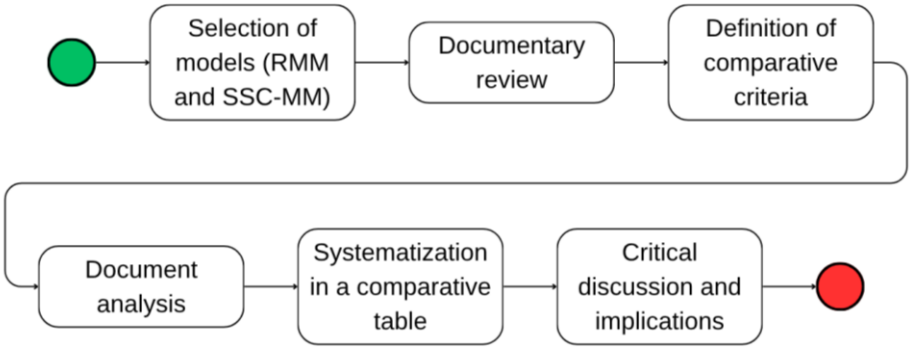
To structure comparison, analytical criteria were defined that make it possible to observe central dimensions of each model. It is organized as follows: central purpose (model's main objective), scope of application (thematic breadth and focus); structure and levels (how stages are defined and operationalized), unit of analysis (object assessed: cities), governance and stakeholders (actors involved and forms of articulation), indicators and measurability (ways of tracking progress), adherence to international agendas (especially the SDGs) and potential for application in Brazilian cities (feasibility,

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challenges, and opportunities). With the structuring of the stages, methodological flowchart was prepared, as shown in Figure 3.

Figure 3 – Methodological flowchart of the research



Source: The authors (2026).

The analysis consisted of examining each model considering these criteria, systematizing findings in a comparative framework and discussing their practical implications. This methodological strategy makes possible not only a description of models but also a critical reflection on their complementarities and limitations, helping to guide managers and researchers interested in the application of maturity models in urban context.

4 RESULTS

Documentary analysis revealed that, although RMM and SSC-MM share the same logic of evolution through maturity stages, they differ substantially in terms of focus, operationalization mechanisms and type of expected results. While RMM emphasizes resilience in face of risks and disasters, SSC-MM seeks to structure urban sustainability in a holistic and measurable way. Comparison shows that models should not be understood as competitors or mutually exclusive, but rather as complementary instruments whose integration can enrich urban management strategies.

RMM contributes to a practical approach oriented toward immediate risks, whereas SSC-MM stands out for its capacity for measurement and alignment with international sustainability agendas. Based on defined criteria (purpose, scope, structure, unit of analysis, governance, indicators, adherence to international agendas and applicability in Brazilian cities) Table 1 was prepared. It synthesizes main convergences and divergences between models and highlights their potential for use in distinct urban contexts.

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Table 1 – Comparative synthesis of RMM and SSC-MM models

Criteria	RMM (Resilience Maturity Model)	SSC-MM (Sustainable Smart Cities Maturity Model)
Central purpose	Strengthen urban resilience (risk management, preparedness, response, recovery)	Guide the trajectory of smart and sustainable cities, aligned with the SDGs
Scope of application	Focus on risks, disasters and multiscale governance	Broad focus on economics, social, and environmental pillars
Structure and levels	SMART matrix (S, M, A, R, T) with five stages	Five maturity levels per pillar (economic, social, environmental)
Unit of analysis	The city and its ecosystem of actors (government, civil society, companies)	The city as a socioeconomic and environmental system enabled by Information and Communication Technologies.
Governance and stakeholders	Strong collaborative governance; intersectoral and inter-city integration	Emphasis on digital governance, citizen participation and smart services.
Indicators and measurability	Qualitative indicators, based on policies and practices	Quantitative KPIs to measure progress of each pillar
Adherence to international agendas	Indirect (SDGs 11 and 13, via resilience and risk management)	Direct and structured by SDGs, with explicit alignment
Potential for application in Brazilian cities	Suitable for contexts of high socio-environmental vulnerability (floods, wildfires, landslides).	Suitable for cities seeking integrated planning aligned with global targets.

Source: The authors (2026).

Based on comparative analysis, it is observed that the models contribute in distinct ways to different dimensions of urban maturity. At institutional level, RMM has greater capacity to structure governance, intersectoral coordination and response protocols. SSC-MM operates in a more limited way in this dimension, assuming that such capacities are already partially consolidated. In contrast, in technological dimension SSC-MM stands out by requiring data integration, use of indicators and digital systems, elements little explored by RMM model.

It was also possible to observe that RMM stands out for its emphasis on resilience and multilevel governance, offering a practical path for cities that face immediate risks and need to strengthen coordination among local, regional and international actors. On the other hand, SSC-MM presented a more comprehensive and structured approach, articulating quantitative indicators aligned with the SDGs and favoring long-term monitoring of results.

This analysis showed that the two models have distinct but complementary vocations: while RMM is particularly suitable for contexts vulnerable to socio-environmental disasters SSC-MM is more appropriate for cities seeking to strategically plan their transition toward sustainability and urban intelligence. However, both converge in recognizing importance of evolution through maturity stages as a tool for diagnosis, planning and monitoring of urban management.

Beyond the structural and functional comparison between models, the results make it possible to advance toward an analysis oriented to suitability of the models for different municipality profiles, considering territorial, institutional and socioeconomic heterogeneities that characterize the Brazilian urban context. Literature points out that effectiveness of urban management models depends not only

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on their conceptual robustness but also on their adherence to local capacities, such as administrative structure, data availability, financial resources, and degree of socio-environmental vulnerability.

In this sense, uniform application of the same model to distinct municipal realities tends to generate distortions, whether by requiring nonexistent capacities or by failing to fully exploit the potential of more structured cities. Based on criteria analyzed in this study – scope, focus, institutional and technological requirements and type of capacity generated – it became possible to assess relative suitability of RMM and SSC-MM for different profiles of Brazilian municipalities. Table 2 synthesizes this analysis, showing how each model responds differently to the structural, organizational and technological conditions of cities of different sizes and maturity levels.

Table 2 – Suitability of RMM and SSC-MM by municipality profile

Municipality profile	RMM	SSC-MM	Rationale
Small size, low technical capacity	High	Low	Need for basic governance and response to risks
Medium size, vulnerable to disasters	High	Medium	RMM provides base structure; SSC-MM can be gradual
Medium size, initial technological base	Medium	High	SSC-MM feasible after institutional consolidation
Large size, metropolitan region	Medium	High	Data and systems allow full use of the SSC-MM
Capitals and global cities	Medium	High	SSC-MM dominant; RMM as a cross-cutting axis

Source: The authors (2026).

This comparative analysis also makes it possible to assess relative suitability of each model for different profiles of Brazilian municipalities. It is observed that RMM shows greater adherence to small- and medium-sized municipalities, especially those exposed to recurrent socio-environmental risks and with institutional limitations. In contrast, SSC-MM proves more suitable for cities with greater technological, administrative and financial capacity, where data collection and integration systems are already minimally structured.

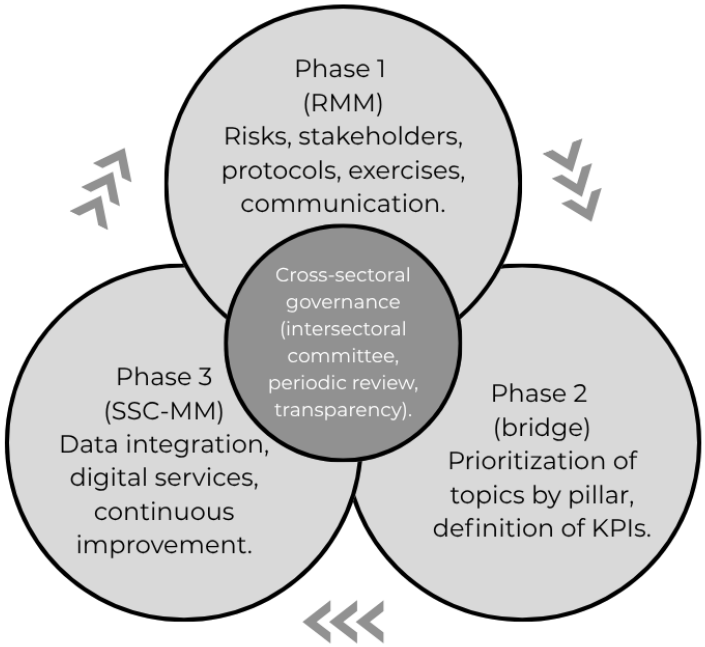
5 PRACTICAL GUIDELINES FOR APPLYING THE RESULTS

Practical guidelines presented in this section derive directly from comparative results obtained. Results shows that RMM contributes primarily to institutional strengthening and risk governance, while SSC-MM favors measurement and strategic planning, guided proposal of a hybrid roadmap structured in progressive phases, capable of accommodating different levels of urban maturity. The carried out analysis indicated that RMM and SSC-MM can be applied in an articulated manner. To support public managers in operationalizing this integration, Figure 4 was proposed, building a combination of the proposals and guidelines.

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Figure 4 – Integration of RMM and SSC-MM methodologies



Source: The authors (2026).

As shown in Figure 4, methodologies integration should follow three phases. In Phase 1, RMM starts from resilience and preparedness. This initial stage is aimed at strengthening institutional capacity in face of risks and disasters. It should involve preparation of a risk map, identification and engagement of main stakeholders, definition of response and recovery protocols, conduct of simulated exercises and implementation of clear and participatory communication channels with the population.

In Phase 2, the bridge between RMM and SSC-MM, after consolidating a minimum base of resilience, it is recommended to begin prioritizing strategic topics per pillar (economic, social, and environmental) and define key performance indicators (KPIs). This stage functions as a link between the qualitative logic of RMM and quantitative approach of SSC-MM, making it possible to align institutional capacities with results-based monitoring.

In Phase 3, SSC-MM acts on sustainability and intelligence; thus, once risk governance is consolidated and KPIs are defined, the city can advance toward integration of data and systems, implementation of smart digital services (such as sustainable urban mobility, digital health and integrated waste management), and creation of continuous-improvement mechanisms based on periodic performance assessment.

Finally, as a central link – cross-cutting governance – in all phases it is essential to establish an intersectoral governance committee, responsible for articulating different actors (local government, civil society, companies, academia), setting a regular schedule for reviewing policies and indicators and

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ensuring transparency and citizen participation in disseminating results and decisions made. These guidelines reinforce that adoption of models should occur gradually and adapted to the local reality, respecting institutional, technological and financial capacity of each municipality. Integration between RMM and SSC-MM allows cities to begin by addressing immediate vulnerabilities and to advance, in a structured way, toward smart, sustainable and inclusive development.

6 DISCUSSION

Comparative analysis shows that RMM and SSC-MM should not be interpreted as competing models, but as complementary tools that respond to distinct dimensions of urban maturity. While RMM privileges resilience in face of risks and disasters, SSC-MM guides long-term strategic planning grounded in the three pillars of sustainability. This complementarity reinforces the importance of considering both models in an articulated manner, especially in contexts of socio-environmental vulnerability and budgetary constraints.

This analysis between RMM and SSC-MM occurs not only conceptually but also sequentially. RMM can be interpreted as an initial or intermediate maturity model, suitable for cities that still face institutional weaknesses and high exposure to risks. On the other hand, SSC-MM proves more aligned with advanced maturity stages, in which the city has institutional, technological and financial capacity to implement monitoring and planning systems based on indicators.

In Brazilian context, marked by regional asymmetries, fiscal limitations and recurrence of extreme events, direct adoption of models based on high technological capacity tends to face significant barriers. In this scenario, RMM shows greater adherence as an initial instrument for diagnosis and institutional organization, whereas SSC-MM can be incorporated gradually as municipal capacity expands. This reading reinforces the need for flexible models adaptable to local realities, as opposed to universal and rigid frameworks.

However, operationalization of the proposed integration between RMM and SSC-MM does not come without without challenges. In small municipalities, often characterized by reduced technical teams, budgetary limitations and low institutional capacity, gradual implementation of strategies foreseen in both models may encounter significant obstacles. Studies on urban governance and organizational maturity indicate that effectiveness of management models depends directly on availability of qualified human resources, local administrative capacity and existence of permanent mechanisms for institutional coordination (Röglinger; Pöppelbuss; Becker, 2012).

In addition, literature on smart cities highlights that adoption of monitoring systems, indicators, and digital technologies tends to be more complex in contexts marked by financial constraints and technological infrastructure deficits (Leal Filho et al., 2024). Under these circumstances, absence of specialized professionals, dependence on external resources to finance projects and difficulties related to production, integration and management of data may compromise both strengthening of governance and resilience structures and consolidation of the measurement mechanisms foreseen by SSC-MM. Thus, integration between models should be understood as an incremental and adaptive process, respecting

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existing institutional capacities and prioritizing actions compatible with local reality, preventing methodological requirements of models from becoming barriers to their own implementation.

Although maturity models analyzed offer relevant contributions to urban management, results indicate that their application in isolation may generate analytical limitations and operational risks for formulation and implementation of public policies. Models based predominantly on institutional processes or, alternatively, on quantitative indicators tend to capture only part of urban complexity, especially in contexts characterized by territorial inequalities and heterogeneous institutional capacities, such as that of Brazil.

Thus, a systematic understanding of constraints and risks associated with exclusive use of each model becomes essential to avoid strategies misaligned with the local reality and to support more informed decisions by public managers. Table 3 demonstrates these limitations, highlighting potential risks of isolated adoption of RMM and SSC-MM in urban planning.

Table 3 – Limitations and risks of applying the models in isolation

Model	Limitation	Risk for urban policy
RMM	Absence of KPIs	Difficulty in monitoring progress
RMM	Focus on risks	Little long-term strategic guidance
SSC-MM	High technological requirements	Exclusion of small municipalities
SSC-MM	Normative approach	Detachment from the local reality

Source: The authors (2026).

According to Table 3, systematization of limitations shows that isolated application of each model may generate imbalances in urban policy. While exclusive use of RMM tends to limit measurement and tracking of results, isolated adoption of the SSC-MM may result in strategies that are unrealistic for municipalities with low institutional capacity. Integration of models therefore emerges not only as a methodological alternative but also as a risk-mitigation strategy.

In addition, application of both models requires adaptations to the local context. RMM still lacks more detailed indicators to assess socioeconomic dimensions. While SSC-MM demands a high capacity for generation, integration and analysis of data, which may represent an obstacle for small- and medium-sized municipalities. Integration between models therefore emerges as a viable path: using RMM to establish foundations of governance and resilience and gradually incorporating indicators and targets of SSC-MM as institutional and technological capacity strengthens.

This discussion indicates that combined application of the models can support municipal managers in building hybrid roadmaps for urban development that reconcile response to immediate vulnerabilities with the definition of long-term sustainability strategies. Moreover, it reveals a gap in empirical research testing this integration in Brazilian cities, which represents a promising agenda for future studies.

Unlike models based exclusively on indicators, such as those aligned with ISO 37122, integration between RMM and SSC-MM makes it possible to encompass both institutional processes and measurable

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results. This finding converges with De Santana et al. (2019), who point out the limitations of excessively normative models when applied to heterogeneous urban realities, such as those of Brazil.

7 CONCLUSION

This study comparatively analyzed two maturity models aimed at urban management, RMM and SSC-MM, with the objective of identifying their convergences, differences, and potential for integration. Analysis demonstrated that models have distinct but complementary purposes, in which RMM emphasizes resilience and multilevel governance in face of risks and disasters, while SSC-MM structures urban development around economic, social and environmental pillars, with a focus on measurability and alignment with SDGs.

Results indicate that, although each model presents its own limitations – such as absence of detailed indicators in RMM and high technological requirements of SSC-MM – their combined application can offer cities a more robust development trajectory. Thus, RMM and the SSC-MM should not be seen as mutually exclusive alternatives, but as complementary instruments that, when applied in an articulated manner, can support construction of cities that are more resilient, sustainable and aligned with contemporary challenges of urbanization. In contexts of socio-environmental vulnerability, it is recommended to begin with implementing resilience practices foreseen in RMM and, subsequently, to advance toward the adoption of long-term indicators and strategies of SSC-MM.

The main contribution of this article is to propose a systematized comparative framework that can serve as a guide for public managers and researchers interested in practical application of these models in Brazilian context. However, analysis was conducted on technical documents and secondary literature, which constitutes a limitation. For future research, it is recommended to apply the models empirically in case studies of Brazilian cities, to validate relevance of the used criteria and to assess results of proposed integration.

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DECLARATIONS

AUTHOR CONTRIBUTIONS

- **Study Conception and Design:** Beatryz de Almeida Alcantara; Márcia Marcondes Altimari Samed
- **Data Curation:** Isabela Antunes de Lima; Karoline Guedes; Ana Paula Bonini
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- **Funding Acquisition:** None
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CONFLICT OF INTEREST STATEMENT

We, **Beatryz de Almeida Alcantara; Isabela Antunes de Lima; Karoline Guedes; Bruna Maria Gerônimo; Ana Paula Bonini; Márcia Marcondes Altimari Samed**, declare that the manuscript entitled "**Resilience Maturity Model vs. Sustainable Cities Maturity Model: criteria, limitations, and applications in the Brazilian context**":

1. **Financial Ties:** Has no financial ties that could influence the results or interpretation of the work. No funding institution or entity was involved in the development of this study.
2. **Professional Relationships:** Has no professional relationships that could impact on the analysis, interpretation, or presentation of the results. No professional relationship relevant to the content of this manuscript was established.
3. **Personal Conflicts:** Has no personal conflicts of interest related to the content of the manuscript. No personal conflict related to the content was identified.