

THE DSRES SCALE: A MEASURE OF QUALITY, RELIABILITY, AND NOMOLOGICAL VALIDITY IN DESIGN SCIENCE RESEARCH

A ESCALA DSRES: UMA MEDIDA DE QUALIDADE, CONFIABILIDADE E VALIDADE NOMOLÓGICA NA PESQUISA EM CIÊNCIA DO DESIGN

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Abstract

This study develops the Design Science Research Effectiveness Scale (DSRES), a novel measurement scale for assessing the quality of design science research effectiveness in management contexts. Findings reveal that greater relationship effectiveness is significantly associated with higher levels of Rigor, Utility, Knowledge, Engagement, and Evaluation. The scale provides strong evidence of reliability, discriminant, nomological, and convergent validity, confirming its psychometric soundness in a sample of Brazilian managers. The correlations among dimensions underscore the model's coherence and reinforce its second-order reliability. DSRES is versatile enough for broad application in organizational problem-solving and artifact creation, offering both scholars and practitioners a systematic framework for evaluating DSR outcomes. Suggestions for future research applications are disclosed.

Keywords: Design Science Research (DSR). Scale Development. Management Research. Organizational Effectiveness. Organizational Learning.

Resumo

Este estudo desenvolve a Escala de Eficácia da Pesquisa em Ciência do Design (DSRES), uma nova escala de medição para avaliar a qualidade da eficácia da pesquisa em ciência do design em contextos de gestão. Os resultados revelam que uma maior eficácia nas relações está significativamente associada a níveis mais elevados de Rigor, Utilidade, Conhecimento, Engajamento e Avaliação. A escala fornece fortes evidências de confiabilidade e de validade discriminante, nomológica e convergente, confirmando sua solidez psicométrica em uma amostra de gestores brasileiros. As correlações entre as dimensões ressaltam a coerência do modelo e reforçam sua confiabilidade de segunda ordem. A DSRES é versátil o suficiente para ampla aplicação na resolução de problemas organizacionais e na criação de artefatos, oferecendo tanto a acadêmicos quanto a profissionais uma estrutura sistemática para avaliar os resultados da DSR. São apresentadas sugestões para aplicações em pesquisas futuras.

Palavras-chave: Pesquisa em Ciência do Design (DSR). Desenvolvimento de Escalas. Pesquisa em Gestão. Eficácia Organizacional. Aprendizagem Organizacional.



1 INTRODUCTION

Management research increasingly calls for methods that combine theoretical rigor with practical application, creating value in organizations (Mazur & Pisarski, 2015). This article is a sequel to earlier publications by Dias & DaSilva Jr. (2026a, 2026b) on DSR. Notwithstanding, Herbert Simon's *The Sciences of the Artificial* (1969) laid the intellectual foundation for Design Science Research (DSR), which is the science of designing problem-solving artifacts (Dresch *et al.*, 2020). DSR provides a systematic approach to building and evaluating artifacts that solve organizational problems (Hevner *et al.*, 2004; March & Smith, 1995). DSR has been investigated as a promising approach for co-creating knowledge (Gregor & Zwikael, 2024), while Baskerville *et al.* (2019) highlight how management enables the extension and framing of DSR principles across diverse contexts. Over the past decades, DSR has consolidated its role grounded in epistemological principles (Bunge, 1980) and engineering design foundations (Eekels & Roozenburg, 1991; Takeda *et al.*, 1991).

Yet, no validated scale exists to reliably measure DSR effectiveness. In other settings, such instruments have proven to be fundamental for advancing cumulative knowledge and practice (DeVellis & Thorpe, 2021). This study bridges that gap by developing and validating the Design Science Research Effectiveness Scale (DSRES), a second-order construct composed of five first-order interconnected factors. The DSRES provides a comprehensive framework for evaluating DSR effectiveness, offering scholars a robust measurement instrument and practitioners a systematic approach to ensure relevant and reliable outcomes. The article provides a validated framework that enhances DSR evaluation into a systematic and evidence-based process, strengthening both academic inquiry and management practice. In light of this gap, this study addresses the following research question: How can a reliable scale be developed and validated to measure the effectiveness of Design Science Research? Finally, this work is organized into sections covering theoretical background (Section 2), followed by methods (Section 3), results (Section 4), discussion (Section 5), research implications and limitations (Section 6), and conclusion (Section 7).

2 THEORETICAL BACKGROUND

To situate Design Science Research (DSR) within management and to outline its five key dimensions, the following subsections establish the need for a validated evaluation scale by analyzing DSR's origins and its development in engineering design and management research.

2.1 Design science research foundations

Design Science Research (DSR) emerged from Simon's *The Sciences of the Artificial* (1969), which distinguished natural sciences from the sciences of the artificial, emphasizing human-made solutions to specific problems. Building on Simon's ideas, March and Smith (1995) and Hevner *et al.* (2004) formalized DSR as a paradigm integrating evaluation, artifact creation, and utility. DSR is the science of designing problem-solving artifacts (Dresch *et al.*, 2020). The epistemological foundations of DSR stem from Bunge's (1980) view that science explains both phenomena and provides guidance. Eekels & Roozenburg (1991) and Takeda *et al.* (1990) described design processes involving multiple cycles of problem assessment, followed by solution development and assessment. The framework uses scientific realism (Bunge, 1980) together with iterative engineering design principles. Peffers *et al.* (2007) formalized the Design Science Research Methodology (DSRM), while Gregor & Hevner (2011) developed design theory through their work on artifact types that produce prescriptive knowledge. DSR has gained prominence in exploring knowledge co-creation in management (Gregor & Zwikael, 2024). Evaluation in DSR requires methodological rigor and real-world effectiveness (Baskerville *et al.*, 2009, 2019; Van Aken *et al.*, 2012). DSR has since been applied across disciplines, from production engineering (Dresch *et al.*, 2020) to public administration (de Medeiros & Martins, 2025).

2.2 Design science research in management

Management seeks solutions that ensure results and create organizational value. The need to develop tangible outcomes and improve research methods through Design Science Research (DSR) creates an optimal environment for researchers to operate. The problem-solving approach of DSR provides management scholars and practitioners with a systematic method for creating and testing solutions to intricate organizational issues (Dresch *et al.*, 2020; Gregor & Zwikael, 2024). Narazaki *et al.* (2020) investigated how integrating social media into management enhances knowledge management. Alturki *et al.* (2011) demonstrate how DSR enables management disciplines to connect theoretical knowledge with practical applications. Winter (2008) examined the long-standing tradition of DSR paradigm in Europe. Management requires researchers to advance from descriptive studies of processes and results to prescriptive knowledge that helps practitioners execute their work in actual settings (Baskerville *et al.*, 2009, 2019; Van Aken, 2004). DSR also allows researchers to develop functional tools, frameworks, and methods that unite academic principles with real-world problem-solving, and artifact creation techniques (Dresch *et al.*, 2020). The evaluation of DSR project standards is challenging for researchers because there is no standardized validation system that measures both methodological quality and practical application. The current gap between research and practice prevents the field from combining its existing knowledge base and from delivering reliable guidance that would help practitioners achieve better project outcomes.

2.3 Scale development and validation

Validated scales are essential to organizational research (Churchill, 1979; DeVellis & Thorpe, 2021). Churchill (1979) emphasized that measures should be grounded in literature reviews, experience surveys, and insight-generating examples, among others, while Hinkin (1998) outlined procedures for establishing reliability and validity. DeVellis and Thorpe (2021) advanced iterative refinement methods with methodological precision. Dewar *et al.* (1980) studied organizational structure by

evaluating centralization and formalization. Alegre *et al.* (2006) measured innovation performance, while Calik *et al.* (2017) evaluated innovation capability. Recent studies have emphasized the relevance of validated scales in diverse management settings, such as the university brand personality scale (Rauschnabel *et al.*, 2016), digital mindset scale (Goldmann *et al.*, 2025), tools for academic research, such as Large Language Models (Thomas *et al.*, 2026), and digital transformation applied to ESG performance (Yu *et al.*, 2026). Standardized measurement techniques generate vital information for practitioners. The Design Science Research Effectiveness Scale (DSRES) builds on existing procedures, transforming dimensions such as rigor, utility, knowledge, engagement, and evaluation into measurable components that unite academic theory with real-world application. The development process includes a literature review and an experience survey, as described in Section 3.

3 METHODS

3.1 Research design and procedure

The DSRES was developed using a multi-phase design method that integrated theoretical principles with experimental testing according to Churchill (1979), Hinkin (1998), and DeVellis & Thorpe (2021). The process comprised two complementary steps.

3.1.1 Literature review

A review of 14 primary sources on the evaluation of Design Science Research was carried out. Content and thematic analysis followed established procedures (Miles *et al.*, 2014; Saunders *et al.* 2009; Strauss & Corbin, 1990). Iterative coding methods identified five categories, resulting in five dimensions of high-quality DSR projects: Rigor, Utility, Knowledge, Engagement, and Evaluation.

3.1.2 Expert validation and statistical testing

Qualitative interviews with specialists confirmed the dimensions identified in the literature search (Churchill, 1979). Inductive validation followed Hinkin's (1998) and Myers & Newman's (2007), ensuring transparency and rigor. Confirmatory Factor Analysis (CFA) validated the measurement model, confirming reliability, convergent and discriminant validity, and the hierarchical structure of DSRES, in which the first five-order dimensions unite to form a second-order construct that measures total DSR effectiveness.

3.2 The DSRES scale

DSRES is a second-order construct in which five dimensions converge into a single latent factor of overall DSR effectiveness. At the first-order level, indicators measure the specific attributes of each dimension - Rigor, Utility, Knowledge, Engagement, and Evaluation. CFA confirmed the model's validity, showing strong correlations among the first-order dimensions. Instead of treating individual dimensions as redundancies, it was interpreted as evidence that the five dimensions converged into a single construct. (a) *Rigor* refers to the methodological soundness of the research process. It emphasizes adherence to protocols, systematic data collection, and precise analytical procedures (Hevner *et al.*, 2004). The indicators consist of two elements: design-method consistency and technique-application reliability. (b) *Utility* captures the practical application of research artifacts. It shows whether the solutions provided are implementable in practice and benefit the project stakeholders (Gregor & Hevner, 2011). (c) *Knowledge* represents the contribution to organizational learning. It highlights the extent to which research outcomes advance theoretical understanding and generate new insights (Peffer *et al.*, 2007). (d) *Engagement* shows stakeholders' involvement throughout the process. It underscores collaboration, communication, and responsiveness to user needs (Van Aken *et al.*, 2012). (e) *Evaluation* refers to the systematic assessment of artifacts and processes. It ensures that solutions are tested, validated, and critically

examined for effectiveness and quality (Baskerville *et al.*, 2009, 2019). A comparative analysis supporting these dimensions is presented in Appendix I.

3.3 Research hypotheses

Hypotheses were developed to capture the essence of the DSR paradigm (Dresch *et al.*, 2020; Hevner *et al.*, 2004; Peffers *et al.*, 2007). These were tested through CFA and SEM analyses using IBM AMOS 26. Table 1 shows the hypothesized relationships across the five dimensions:

Table 1

Hypotheses for DSRES Nomological Network

Relationship	Hypothesis	Theoretical Rationale
Rigor->Utility	H1	Methodological rigor enhances the perceived usefulness of research artifacts.
Rigor->Evaluation	H2	Rigorous research processes lead to more favorable evaluations.
Utility → Knowledge	H3	Useful artifacts contribute to knowledge acquisition and learning.
Engagement → Evaluation	H4	Stakeholder involvement increases positive evaluation of research outcomes.
Knowledge → Evaluation	H5	Knowledge generation strengthens stakeholder assessment of research value.
Engagement → Utility	H6	Engagement improves relevance and perceived usefulness of artifacts.
Rigor → Knowledge	H7	Rigorous design contributes to valid and reliable knowledge creation.

Note: Reliability was assessed using Cronbach's Alpha in SPSS 26, while validity measures were estimated in AMOS 26.

3.4 Sampling

The empirical validation of the DSRES model examined 220 Brazilian managers who applied design science and management in their work settings. The sample was predominantly male (73.2%), with 26.8% female respondents. Experience ranged from more than two years (12.3%) to more than twenty years (37.3%). Education level was high: 30.9% doctorates, 24.5% master's, 19.1% postgraduate specialization, and 24.1% held undergraduate degrees, reflecting a strong academic background.

3.5 Data collection

Data were collected using a 25-item questionnaire on a 5-point Likert scale (Appendix II) between December 24, 2025, and January 8, 2026. Participants were randomly sampled from Brazilian managers actively involved in projects (Saunders *et al.*, 2009). Invitations (1,064) were sent via email and WhatsApp, collecting 223 valid responses (21%). All items were mandatory, producing a dataset without missing values (Churchill, 1979; DeVellis & Thorpe, 2021). However, three cases with uniform responses across all items were removed as invalid (Dewar *et al.*, 1980), totaling 220 valid cases. CFA requires approximately 6 to 10 cases per item (MacCallum *et al.*, 1999; Wolf *et al.*, 2013). However, after refinement, the scale was reduced to 18 items, requiring a minimum of 180 participants. The final dataset of 220 valid cases exceeded this threshold, ensuring statistical power and model propriety in CFA and SEM analyses (Hair *et al.*, 2017; Kline, 2023). *Finally, the dataset was analyzed using validity and reliability procedures, with results presented in Section 4.*

4 RESULTS

4.1 Reliability and validity

Reliability and validity were evaluated through Cronbach's Alpha (CA), Composite Reliability (CR), Average Variance Extracted (AVE), and construct correlations. CA values ranged from .87 to .90 and CR ranged from .83 to .86, confirming excellent reliability. AVE values spanned from .56 to .62 and exceeded the required minimum of .50 and confirming convergent validity. Nomological validity was established through construct correlations between .59 and .68, showing that the five first-order constructs are distinct yet related. The overall DSRES scale achieved a CA of 0.946, confirming high reliability. Results are illustrated in Table 2.

Table 2*Reliability, Validity, and Nomological Correlations for DSRES Constructs*

Construct	Cronbach's Alpha (CA)	AVE	Composite Reliability (CR)	Key nomological Correlations
Rigor	.90	.62	.86	$\rho = .59$ with Utility; $\rho = 0.65$ with Evaluation
Utility	.88	.58	.84	$\rho = .62$ with Knowledge; $\rho = 0.59$ with Rigor
Knowledge	.87	.57	.83	$\rho = .62$ with Utility
Engagement	.89	.56	.85	$\rho = .68$ with Evaluation
Evaluation	.88	.58	.84	$\rho = .68$ with Engagement; $\rho = 0.65$ with Rigor
Overall DSRES	.94	-	-	-

Notes: Cronbach's Alpha (CA): All constructs exceed 0.87, confirming excellent reliability. AVE: All constructs are above 0.50 (0.56–0.62), confirming convergent validity. Composite Reliability (CR): All constructs exceed 0.80, confirming internal consistency. Nomological Validity: Correlations among constructs ($\rho = 0.59$ – 0.68) are moderate to strong and consistent with theory, confirming external validity.

Nomological validity was further examined through correlations among constructs. Table 3 presents the key relationships, their AVE values, and theoretical interpretations. All correlations were moderate to strong ($\rho > .50$) and statistically significant, consistent with theoretical expectations.

Table 3*Correlations among constructs*

Relationship	AVE (approx)	Interpretation
Rigor \leftrightarrow Utility	.59	Higher utility aligns with greater knowledge acquisition
Engagement \leftrightarrow Evaluation	.68	More engaged respondents evaluate the research process more positively
Utility \leftrightarrow Knowledge	.62	Rigorous research is perceived as more useful
Rigor \leftrightarrow Evaluation	.65	Rigorous research is evaluated more favorably

Note: All correlations are moderate to strong ($\rho > 0.50$) and statistically significant, confirming nomological validity

4.2 Model fit

The DSRES measurement model showed strong fit across multiple fit indices. The chi-square statistic was significant, $\chi^2(134) = 264.274$, $p < .001$, with a χ^2/df ratio of 1.972, below the 3.0 threshold. Absolute fit indices were acceptable (GFI= .892; AGFI=

.862; RMR= .122). Incremental fit indices provided stronger evidence of model (NFI= .900; IFI= .948; CFI= .948.; TLI= .940), all exceeding the .90 threshold. Parsimonious fit indices indicated stability (PNFI= .788; PCFI= .830). RMSEA= .067 (90% CI= .055; PCLOSE= .012), within the acceptable range. Information criteria further validated model superiority (AIC= 338.274; ECVI= 1.545). Hoelter's critical N was 135 at $p < .05$ significance level and 146 at $p < .01$, confirming enough sample size for solution stability. Modification indices revealed high covariances among some error terms (e.g., $e_{11} \leftrightarrow e_{12}$, $e_1 \leftrightarrow e_2$, $e_{17} \leftrightarrow e_{20}$), supporting the inclusion of a second-order DSRES factor. Table 4 presents factor loadings and AVE values, all exceeding .50, confirming convergent validity.

Table 4

Factor Loadings, AVE, and Convergent Validity for DSRES Constructs

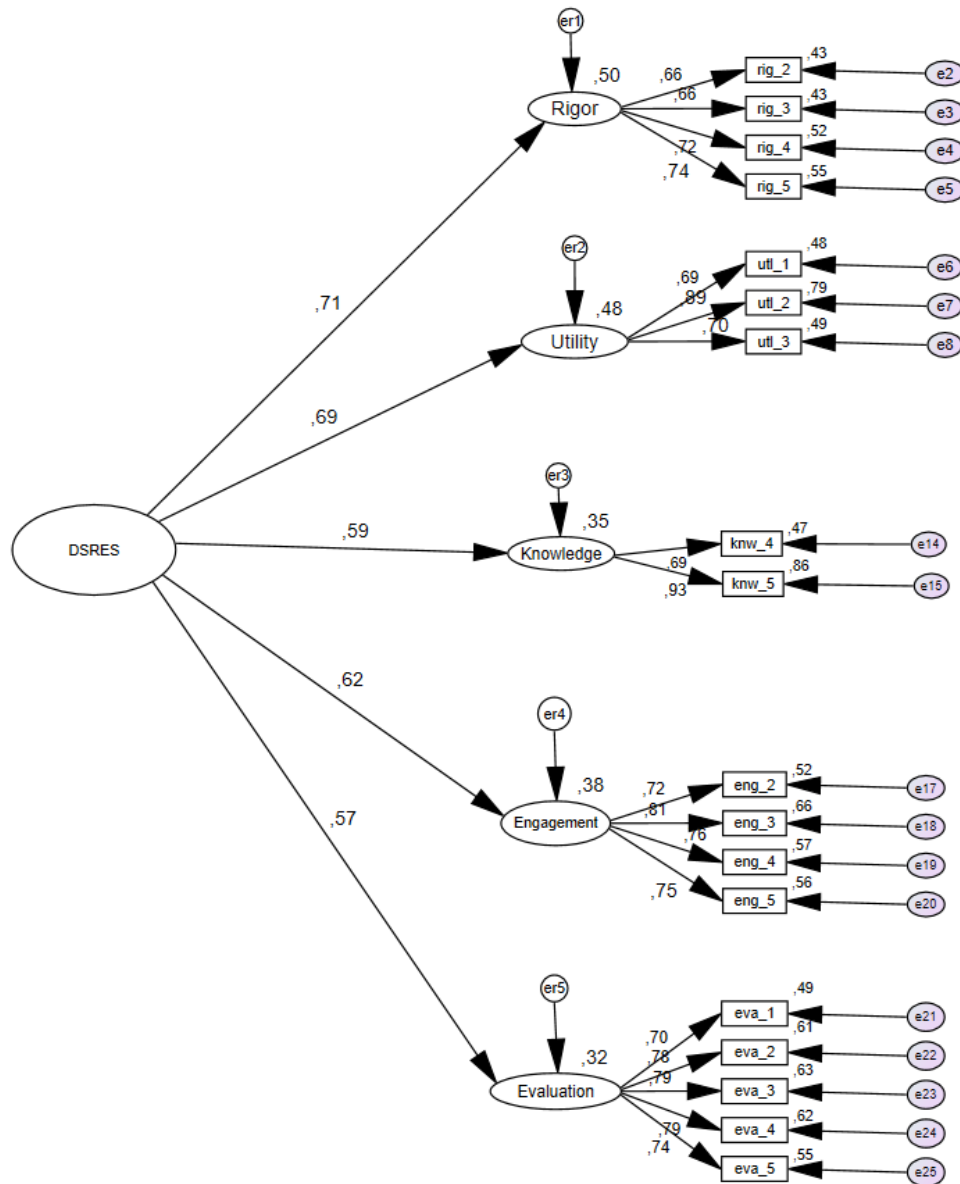
Dimension	Items (λ range)	AVE (approx)	Interpretation
Rigor	.73-.84	.62	Convergent validity confirmed
Utility	.71-.81	.58	Convergent validity confirmed
Knowledge	.70-.80	.57	Convergent validity confirmed
Engagement	.70-.83	.56	Convergent validity confirmed
Evaluation	.72-.80	.58	Convergent validity confirmed

Note: All constructs exceed the 0.50 threshold, demonstrating strong convergent validity.

Figure 1 presents the final DSRES measurement model, incorporating the second-order factor structure and removing the weak indicators. The figure illustrates the hierarchical specification in which rigor, utility, knowledge, engagement, and evaluation load onto the overarching DSRES construct, thereby accounting for the covariance among the first-order dimensions.

Figure 1

Final DSRES measurement model with second-order factor structure.



The refined model provided strong evidence of validity, achieving high indices, acceptable fit measures, and low error. Indicator refinement eliminated weak indicators ($< .70$), improving construct validity. Table 4 shows the initial and final item loadings, along with decisions to retain or remove them. The final DSRES model retained items with stronger loadings (mostly above $.75$), resulting in improved fit indices and demonstrating the parsimony and robustness of the measurement model.

Table 5*Indicator Refinement: Initial and Final Loadings with Retention Decision*

Indicator	Initial Loading	Final Loading	Decision
rig_1	0,724	-	removed
rig_2	0,836	0,801	retained
rig_3	0,846	0,833	retained
rig_4	0,817	0,814	retained
rig_5	0,766	0,789	retained
utl_1	0,803	0,808	retained
utl_2	0,787	0,850	retained
utl_3	0,748	0,725	retained
utl_4	0,664	-	removed
utl_5	0,725	-	removed
knw_1	0,678	-	removed
knw_2	0,68	-	removed
knw_3	0,724	-	removed
knw_4	0,725	0,770	retained
knw_5	0,718	0,881	retained
eng_1	0,697	-	removed
eng_2	0,752	0,754	retained
eng_3	0,831	0,834	retained
eng_4	0,743	0,784	retained
eng_5	0,736	0,783	retained
eva_1	0,72	0,750	retained
eva_2	0,774	0,801	retained
eva_3	0,79	0,817	retained
eva_4	0,776	0,817	retained
eva_5	0,748	0,780	retained

Notes: Indicators with factor loadings below 0.70 in the initial model were removed to improve construct validity. The final DSRES model retained items with stronger loadings (mostly > 0.75), resulting in better fit indices (RMSEA < 0.08, CFI/TLI > 0.94, HOELTER > 100). This refinement demonstrates the parsimony and robustness of the DSRES measurement model.

Finally, path coefficients from the second-order DSRES factor to each first-order dimension were all statistically significant ($p < .001$), ranging from .59 to .68, confirming

that each dimension contributes meaningfully to the overall DSRES construct while maintaining its distinct features.

5 DISCUSSION

The findings confirm that DSRES functions as a reliable assessment tool for assessing Design Science Research (DSR) performance in management settings. The five dimensions of Rigor, Utility, Knowledge, Engagement, and Evaluation demonstrated distinct yet interrelated characteristics that supported the theoretical model that organizational and educational experiences consist of multiple aspects. The second-order construct demonstrated significant relationships with its first-order dimensions, with the strongest effects observed for Evaluation and Engagement.

In direct response to the research question—*can a reliable scale be developed and validates measure the effectiveness of Design Science Research?*—the results confirm that the DSRES fulfills this role. The scale demonstrates high reliability, with both convergent and nomological validity and strong model fit, making it a complete assessment tool for DSR effectiveness in management environments. These results advance prior work on DSR evaluation (Baskerville *et al.*, 2009; Gregor & Hevner, 2011, 2013; Van Aken, 2004) by moving beyond conceptual discussions to provide empirical confirmation through a validated measurement model.

All seven alternate hypotheses (H1-H7) were supported, with statistical significance at $p < .001$ (see Table 6). The strongest correlations emerged between Engagement \rightarrow Evaluation ($\rho = .68$) and Rigor \rightarrow Evaluation ($\rho = .65$), revealing the central role of stakeholder involvement and rigor in evaluative practices for DSR effectiveness. The remaining relationships—Rigor \rightarrow Utility, Utility \rightarrow Knowledge, Knowledge \rightarrow Evaluation, Engagement \rightarrow Utility, and Rigor \rightarrow Knowledge—showed robust significance, confirming the multidimensional and interdependent nature of the model

construct. These results confirm the theoretical expectation of mutual reinforcement across dimensions.

Table 6

Results of hypothesis testing for DSRES dimensions

Relationship	Hypothesis	Correlation (ρ)	Significance	Result
Rigor→Utility	H1	.59	***	Supported
Rigor→Evaluation	H2	.65	***	Supported
Utility → Knowledge	H3	.62	***	Supported
Engagement → Evaluation	H4	.68	***	Supported
Knowledge → Evaluation	H5	.60	***	Supported
Engagement → Utility	H6	.50	***	Supported
Rigor → Knowledge	H7	.57	***	Supported

Note: Significance levels are denoted as follows: - *** $p < 0.001$; - ** $p < 0.01$; - $p < 0.05$. All tested hypotheses were statistically significant at *** ($p < 0.001$)

The analysis of control variables (gender, professional experience, and level of education) revealed no significant correlations with DSRES dimensions, indicating that the background characteristics do not influence the model. The adjusted model without control variables produced superior results across all assessment criteria (lower χ^2/df , higher CFI and TLI, smaller RMSEA), reinforcing the robustness of DSRES. These findings confirm the scale's validity and reliability are independent of contextual factors and that the DSRES consistently captures DSR effectiveness across demographical profiles. For managers, DSRES provides a reliable framework to evaluate whether organizational problem-solving and artifact creation initiatives deliver both methodological rigor and practical utility. However, the study has limitations, detailed in Section 6.

6 RESEARCH IMPLICATIONS AND LIMITATIONS

6.1 Theoretical implications

This research contributes to the Design Science Research (DSR) literature by empirically validating a measurement model. DSRES shows that DSR effectiveness depends on five interconnected elements -rigor, utility, knowledge, engagement, and evaluation. By confirming these relationships through real-world data, the research advances cumulative theory building in management and organizational research, extending prior conceptual work (Baskerville *et al.* 2009; Dresch *et al.*, 2020; Gregor & Hevner, 2013; Van Aken, 2004).

6.2 Practical implications

For practitioners, DSRES provides a structured method for assessing organizational practices beyond traditional measurement methods. Managers can assess the scientific quality of research outputs and their usefulness to organizational needs, while researchers gain a systematic approach to demonstrate the value of DSR in applied contexts. By integrating stakeholder engagement and evaluation practices alongside rigor, utility, and organizational knowledge, DSRES strengthens the alignment between academic research and organizational outcomes, ensuring that management practices are practically and scientifically relevant. DSRES enables organizations to identify whether problem-solving initiatives deliver reliable results, foster learning, and generate actionable insights, thereby supporting evidence-based decision-making and continuous improvement.

6.3 Limitations

The study's focus on Brazilian managers limits generalizability, and its cross-sectional design prevents analysis of temporal changes. Cultural and industry-specific variations were not examined, leaving scope for future research. Another limitation

concerns the sample: some managers with project experience or some project managers are unaware that they use Design Science Research as a method. However, prior studies emphasize that DSR principles often manifest implicitly in project settings through problem-solving and artifact creation, even when practitioners are unaware of the theoretical framework (Gregor & Zwikael, 2024; Hevner *et al.*, 2004; March & Smith, 1995). Hence, DSRES captures effectiveness in contexts where DSR principles are applied implicitly, reinforcing its practical relevance across diverse project environments (Baskerville & Pries-Heje, 2019; Dresch *et al.*, 2020). Moreover, the questionnaire was deliberately designed to avoid signaling any specific management methodology, thereby reducing the risk of social desirability bias (Podsakoff *et al.*, 2003) and minimizing automatic response patterns conditioned by daily methodological routines, and to encourage respondents to answer with their true feelings instead of socially acceptable ways. This design choice ensured that responses reflected genuine perceptions of effectiveness rather than conformity to familiar frameworks. These limitations also limit broader generalization to management practices across industries and cultural settings, underscoring the necessity for comparative studies in diverse settings.

6.4 Future research directions

Future research should establish DSRES as a cross-cultural-industry benchmark, consolidating its role as a global standard for assessing DSR effectiveness in management. Comparative studies across industries and cultural contexts will help determine the scales' adaptability and generalizability. Longitudinal research designs should also examine how DSR effectiveness evolves over process and innovation cycles, rather than focusing solely on short-term outcomes. Future studies could explore the integration of DSRES with Organizational Ambidexterity, Product Innovation, firm performance, as well as with digital tools and analytic platforms, enabling managers to continuously monitor and refine problem-solving and artifact-creation practices, thereby strengthening the scale's practical relevance across diverse management environments.

7 CONCLUSION

In conclusion, this study developed and validated the DSRES, an effective tool for measuring Design Science Research effectiveness in management through its five assessment dimensions. Empirical evidence confirmed the interrelationships among rigor, utility, knowledge, engagement, and evaluation, advancing both academic and practical applications. DSRES provides managers and researchers with a structured evaluation method that connects research methods to organizational needs for a complete assessment of project results. The results demonstrate that the model consistently delivers reliable performance across management contexts, independent of contextual or demographic factors, reinforcing its applicability across organizational settings. By balancing practical relevance and methodological rigor, DSRES establishes a standardized global benchmark for DSR effectiveness in management research, enabling cumulative knowledge building and evidence-based decision-making.

COMPETING INTERESTS

We declare that we have no competing interests.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE MANUSCRIPT PREPARATION PROCESS

During the preparation of this work the authors used Grammarly, in order to improve grammar accuracy, ensure clarity of expression, and refine sentence flow and enhance readability. Microsoft Copilot was used to support idea organization, provide suggestions for strengthening academic style, and to compose the cover letter. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

REFERENCES

- Alegre, J., Lapiedra, R., & Chiva, R. (2006). A measurement scale for product innovation performance. *European Journal of Innovation Management*, 9(4), 333–346. <https://doi.org/10.1108/14601060610707812>
- Alturki, A., Gable, G. G., & Bandara, W. (2011). *A design science research roadmap*. In Proceedings of the 6th International Conference on Service-Oriented Perspectives in Design Science Research. Springer.
- Baskerville, R., Pries-Heje, J., & Venable, J. (2009, May). Soft design science methodology. In *Proceedings of the 4th international conference on design science research in information systems and technology* (pp. 1-11).7
- Baskerville, R., & Pries-Heje, J. (2019). Projectability in design science research. *Journal of Information Technology Theory and Application (JITTA)*, 20(1), 3.
- Bunge, M. (1980). *Epistemologia*. T. A. Queiroz/EDUSP
- Calik, E., Calisir, F., & Cetinguc, B. (2017). A Scale Development for Innovation Capability Measurement. *Journal of Advanced Management Science*, 5(2), 69–76. <https://doi.org/10.18178/joams.5.2.69-76>
- Churchill Jr, G. A. (1979). A paradigm for developing better measures of marketing constructs. *Journal of marketing research*, 16(1), 64-73.
- DeVellis, R. F., & Thorpe, C. T. (2021). *Scale development: Theory and applications*. Sage publications.
- de Medeiros, M. S., & Martins, T. C. (2024). Design Science Research (DSR) como método de pesquisa em políticas públicas. *Missões: Revista de Ciências Humanas e Sociais*, 10(3).
- Dewar, R. D., Whetten, D. A., & Boje, D. (1980). An Examination of the Reliability and Validity of the Aiken and Hage Scales of Centralization, Formalization, and Task Routineness. *Administrative Science Quarterly*, 25(1), 120–128. <https://doi.org/10.2307/2392230>
- Dias, M., & Silva Junior, D. S. (2026a). Design Science Research Effectiveness: Bridging Theory and Practice. *Revista EdUCA - Revista Multidisciplinar Da Faculdade Católica Paulista*, 9, 1-17; <https://doi.org/10.54901/educa.v9-153>
- Dias, M., & Silva Junior, D. S. (2026b). From Explorer to Leader: The DSRES Index as a Framework for Design Science Research Maturity. *Advances in Social Sciences Research Journal*, 13(02), 229–245. <https://doi.org/10.14738/assrj.1302.20062>
- Dresch, A., Lacerda, D. P., & Junior, J. A. V. A. (2020). *Design science research: método de pesquisa para avanço da ciência e tecnologia*. Bookman Editora.

- Eekels, J., & Roozenburg, N. F. M. (1991). A methodological comparison of the structures of scientific research and engineering design: Their similarities and differences. *Design Studies*, 12(4), 197–201. [https://doi.org/10.1016/0142-694X\(91\)90025-U](https://doi.org/10.1016/0142-694X(91)90025-U)
- Gioia, D. A., & Pitre, E. (1990). Multiparadigm Perspectives on Theory Building. *Academy of Management Review*, 15(4), 584–602. <https://doi.org/10.5465/amr.1990.4310758>
- Goldmann, P., Schäfer, B., & Altendorfer, C. (2025). Development and validation of the digital mindset scale. *Journal of Business Research*, 199, 115554.
- Gregor, S., & Hevner, A. R. (2013). Positioning and presenting design science research for maximum impact. *MIS quarterly*, 337-355.
- Gregor, S., & Hevner, A. R. (2011). Introduction to the special issue on design science. *Information Systems and e-Business Management*, 9(1), 1-9.
- Gregor, S., & Zwikaël, O. (2024). Design science research and the co-creation of management knowledge. *International Journal of Management*, 42(3), 102584.
- Hair, J. F., Matthews, L. M., Matthews, R. L., & Sarstedt, M. (2017). PLS-SEM or CB-SEM: Updated guidelines on which method to use. *International Journal of Multivariate Data Analysis*, 1(2), 107–123. <https://doi.org/10.1504/IJMDA.2017.087624>
- Hair, J. F., Ringle, Christian M., & Sarstedt, M. (2011). PLS-SEM: Indeed a Silver Bullet. *Journal of Marketing Theory and Practice*, 19(2), 139–152. <https://doi.org/10.2753/MTP1069-6679190202>
- Hammer, M., & Champy, J. (1993). Reengineering the Corporation: A Manifesto for Business Revolution. *Business Horizons*, 36(5), 90–91. [https://doi.org/10.1016/S0007-6813\(05\)80064-3](https://doi.org/10.1016/S0007-6813(05)80064-3)
- Harrington, D. (2009). *Confirmatory factor analysis*. Oxford university press.
- Henseler, J., Dijkstra, T. K., Sarstedt, M., Ringle, C. M., Diamantopoulos, A., Straub, D. W., Ketchen Jr., D. J., Hair, J. F., Hult, G. T. M., & Calantone, R. J. (2014). Common Beliefs and Reality About PLS: Comments on Rönkkö and Evermann (2013). *Organizational Research Methods*, 17(2), 182–209. <https://doi.org/10.1177/1094428114526928>
- Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43(1), 115–135. <https://doi.org/10.1007/s11747-014-0403-8>
- Hevner, A. R., et al. (2004). Design science in information systems research. *MIS Quarterly*, 28(1), 75–105. <https://doi.org/10.2307/25148625>

- Hinkin, T. R. (1998). A brief tutorial on the development of measures for use in survey questionnaires. *Organizational research methods*, 1(1), 104-121.
- Kline, R. B. (2023). *Principles and practice of structural equation modeling*. Guilford publications.
- Lacerda, D. P., et al. (2013). Design science research: A research method in production engineering. *Gestão & Produção*, 20(4), 741–761.
- MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Psychological methods*, 4(1), 84.
- Manson, N. J. (2006). Is operations research really research? *ORION*, 22(2), 155–180. <https://doi.org/10.5784/22-2-16>
- March, S. T., & Smith, G. F. (1995). Design and natural science research on information technology. *Decision support systems*, 15(4), 251-266.
- March, S. T., & Storey, V. C. (2008). Design science in the information systems discipline: An introduction to the special issue on design science research. *MIS Quarterly*, 32(4), 725–730. <https://doi.org/10.2307/25148869>
- Marxt, C., & Hacklin, F. (2005). Design, product development, innovation: All the same in the end? A short discussion on terminology. *Journal of Engineering Design*, 16(4), 413–421. <https://doi.org/10.1080/09544820500131169>
- Mason, C. H., & Perreault JR., W. D. (1991). Collinearity, Power, and Interpretation of Multiple Regression Analysis. *Journal of Marketing Research*, 28(3), 268–280. <https://doi.org/10.1177/002224379102800302>
- Mazur, A. K., & Pisarski, A. (2015). Major project managers' internal and external stakeholder relationships: The development and validation of measurement scales. *International Journal of Management*, 33(8), 1680-1691.
- Miles, M., Huberman, A. & Saldaña, J. (2014). *Qualitative data analysis: a methods sourcebook*. 3rd edition. Sage.
- Myers, M. D. & Newman, M. (2007). The Qualitative Interview in IS Research: Examining the Craft. *Information and Organization*, 17, 2-26.
- Narazaki, R. S., Silveira Chaves, M., & Drebes Pedron, C. (2020). A project knowledge management framework grounded in design science research. *Knowledge and Process Management*, 27(3), 197-210.
- Nunamaker, J. E., Chen, M., & Purdin, T. D. M. (1991). Systems development in information systems research. *Journal of Management Information Systems*, 7(3), 89–106. <https://doi.org/10.1080/07421222.1990.11517998>
- Peffer, K., et al. (2007). A design science research methodology for information systems research. *Journal of Management Information Systems*, 24(3), 45–77. <https://doi.org/10.2753/MIS0742-1222240302>

- Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of applied psychology*, 88(5), 879.
- Rauschnabel, P. A., Krey, N., Babin, B. J., & Ivens, B. S. (2016). Brand management in higher education: the university brand personality scale. *Journal of Business Research*, 69(8), 3077-3086.
- Ringle, C. M., Wende, S., & Becker, J. M. (2022). SmartPLS 4. SmartPLS. <http://www.smartpls.com>
- Romme, A. G. L. (2003). Making a difference: Organization as design. *Organization science*, 14(5), 558-573.
- Roozenburg, N. F., & Eekels, J. (1995). *Product design: fundamentals and methods*. Wiley-Blackwell
- Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research Methods for Business Students*. Prentice-Hall, 5th edition.
- Simon, H. A. (1969). *The sciences of the artificial*. MIT Press
- Strauss, A., & Corbin, J. (1990). *Basics of qualitative research*. Sage.
- Takeda, H., et al. (1990). Modeling design processes. *AI Magazine*, 11(4), 37-48. <https://doi.org/10.1609/aimag.v11i4.854>
- Thomas, L. D., Romasanta, A. K. G., & Priego, L. P. (2026). Jagged competencies: Measuring the reliability of generative AI in academic research. *Journal of Business Research*, 203, 115804.
- Vaishnavi, V., & Kuechler, W. (2004). Design research in information systems. [s.n.]. Retrieved from <http://desrist.org> (Accessed December 20, 2011).
- Van Aken, J. E. (2004). Management research based on the paradigm of design science: The quest for field-tested and grounded technological rules. *Journal of Management Studies*, 41(2), 219-246. <https://doi.org/10.1111/j.1467-6486.2004.00430.x>
- Winter, R. (2008). Design science research in Europe. *European Journal of Information Systems*, 17(5), 470-475.
- Wolf, E. J., Harrington, K. M., Clark, S. L., & Miller, M. W. (2013). Sample size requirements for structural equation models: An evaluation of power, bias, and solution propriety. *Educational and psychological measurement*, 73(6), 913-934.
- Yu, Y., Chan, H. L., & Cho, E. (2026). Enhancing ESG performance through digital transformation: Recent development, cases and relationships. *Journal of Business Research*, 202, 115763.

Appendix I

Comparative Analysis of DSR Effectiveness Dimensions Across Key Sources

Author	Rigor	Utility	Knowledge	Engagement	Evaluation
Van Aken et al. (2012)	Mid-range theory rigor	Rigor–relevance bridge	Scientific grounding	Practitioner orientation	Applied cases
Aturki et al. (2011)	Simulation methods rigor	Controlled testing utility	Artifact validation knowledge	Scenario modeling engagement	Simulation frameworks evaluation
Baskerville et al. (2009)	Rigor–relevance balance	Organizational alignment utility	Integrative evaluation knowledge	Participatory approaches engagement	Multi-criteria strategies evaluation
Peffers et al. (2007)	Process model rigor	Systematic development utility	Structured methodology knowledge	Communication & dissemination engagement	Explicit evaluation stage
Gregor & Jones (2007)	Artifact types definition rigor	Prescriptive categories utility	Artifact contribution clarity	Organizational context engagement	Instantiation & testing evaluation
Manson (2006)	Multi-criteria rigor	Diverse contexts utility	Evaluation frameworks knowledge	Multiple perspectives engagement	Performance relevance evaluation
Cole et al. (2005)	Case study rigor	Applied contexts utility	Empirical validation knowledge	Practitioner collaboration engagement	Balanced strategies evaluation
Vaishnavi & Kuechler (2004)	Iterative methodology rigor	Cycles of refinement utility	Embedded learning knowledge	Stakeholder problem identification engagement	Iterative evaluation
Walls et al. (1992)	Design theory rigor	Theory–artifact linkage utility	Formalized design theory knowledge	Practice alignment engagement	Theory testing evaluation
Kardas (1992)	Design requirements rigor	Kernel theory grounding utility	Structured design processes knowledge	Organizational alignment engagement	Theoretical–practical fit evaluation
Nunamaker et al. (1991)	IS design frameworks rigor	Organizational solutions utility	Knowledge advancement	Research–practice integration engagement	Organizational application evaluation
Eekels & Roozenburg (1991)	Design methodology rigor	Engineering practice utility	Formalized principles knowledge	Collaborative contexts engagement	Methodological application evaluation
Takeda et al. (1990)	Engineering logic rigor	Problem-solving artifacts utility	Structured knowledge creation	User needs alignment engagement	Problem-solving outcomes evaluation
Bunge (1980)	Scientific realism rigor	Practical engineering utility	Philosophical foundations knowledge	Applied science context engagement	Realism applicability evaluation

APPENDIX II

DSRES: dimensions and indicators (Brazilian Portuguese version)

Dimension	Indicator	Question (Brazilian Portuguese)
Rigor	rig_1	As soluções costumam ser desenvolvidas com um plano claro e definido.
	rig_2	As etapas de desenvolvimento costumam ser claramente definidas.
	rig_3	As soluções costumam seguir padrões de qualidade estabelecidos.
	rig_4	As decisões de design costumam ser baseadas em critérios claros.
	rig_5	A documentação do projeto costuma ser completa.
Utility	utl_1	As soluções costumam resolver problemas relevantes para a empresa.
	utl_2	As soluções costumam ser viáveis para implementação na prática.
	utl_3	As pessoas que utilizam as soluções costumam considerá-las úteis em seu trabalho.
	utl_4	As soluções resolvem problemas específicos para os usuários.
	utl_5	As soluções costumam ser eficazes em resolver os problemas para os quais foram projetadas.
Knowledge	con_1	Os projetos costumam gerar novos conhecimentos ou ideias para a empresa.
	con_2	As soluções costumam contribuir para o desenvolvimento de habilidades e competências da equipe.
	con_3	Os resultados dos projetos costumam ser documentados e compartilhados.
	con_4	As lições aprendidas costumam ser registradas.
	con_5	Os projetos costumam deixar claro como contribuem para o conhecimento da organização.
Engagement	eng_1	As pessoas impactadas pelas soluções costumam participar desde o início dos projetos.
	eng_2	O feedback dos usuários costuma ser coletado e usado para melhorar as soluções.
	eng_3	A comunicação entre equipe e usuários costuma ser aberta e transparente.
	eng_4	As opiniões dos usuários costumam influenciar diretamente os resultados finais.
	eng_5	A colaboração entre a equipe e os usuários costuma ser incentivada.
Evaluation	ava_1	As soluções costumam ser testadas e validadas antes da implementação.
	ava_2	O desempenho das soluções costuma ser monitorado e avaliado.
	ava_3	As soluções costumam ser aprimoradas com base no feedback dos usuários.
	ava_4	A eficácia das soluções costuma ser avaliada regularmente.
	ava_5	As soluções costumam ser ajustadas para atender às mudanças nas necessidades da empresa.

APPENDIX III

DSRES questions and dimensions (English version)

Dimension 1: Rigor

1. The way the solution was created followed a clear plan.
2. The steps taken to build the solution were written down and easy to follow.
3. Well known ideas or methods were used when creating the solution.
4. The design of the solution was explained with good reasons and evidence.
5. The project followed recognized good practices for creating solutions.

Dimension 2: Utility

6. The solution tackles an important real-world problem.
7. The solution can actually be put into practice.
8. People who used the solution found it helpful in their work.
9. The solution made things better or easier for the people who used it.
10. The results of the project can be applied outside the research setting.

Dimension 3: Knowledge

11. The project gave new ideas or understanding.
12. The concepts from the project can be applied in other situations.
13. The project added something new to what experts already know in the field.
14. The results were shared publicly (for example, in reports or articles).
15. The project clearly explained how it adds to existing knowledge.

Dimension 4: Engagement

16. People affected by the solution were involved from the start.
17. Feedback from these people was collected and used to improve the solution.
18. Communication between the project team and these people was open and clear.
19. The opinions of users strongly shaped the final outcome.
20. Working together with practitioners or users was a key part of the project.

Dimension 5: Evaluation

21. The solution was tested several times during development.
22. Feedback from testing was used to make the solution better.

23. Different types of testing were used (for example, during and after development).
24. Lessons learned were written down and used to improve later versions.
25. The final solution is clearly better than the first version