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Assessing the Strategic Value of Time-Based Data Modeling and Calendar Engineering in Enterprise Power BI Deployments

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ABSTRACT
Enterprises invest heavily in Business Intelligence platforms, yet the temporal layer of the semantic model - the date dimension and the engineering practice that surrounds it - is treated almost universally as a technical detail rather than as an object of strategic investment. This paper asks whether that treatment is warranted. Drawing on the resource-based view and the IT business value literature, it distinguishes time-based data modeling, understood as the structural properties of the temporal layer, from calendar engineering, understood as the practice of designing, governing and maintaining it, and theorises that both contribute to strategic value indirectly, through analytical agility and decision quality, rather than directly. A research model with two antecedents, two mediators, one outcome and one contextual moderator is specified and tested.

Data were collected by cross-sectional survey from 214 enterprise Power BI deployments across six sectors (35.0 % response rate) and analysed by partial least squares structural equation modelling, supplemented by a discounted cash-flow assessment of a representative calendar-engineering programme. The measurement model met the usual thresholds, with composite reliability from 0.85 to 0.92, average variance extracted from 0.63 to 0.70 and a maximum HTMT ratio of 0.78. The structural model explained 57 % of the variance in strategic value, 42 % in analytical agility and 38 % in decision quality. Neither antecedent affected strategic value directly; both operated through the mediators, and calendar engineering exhibited the larger total indirect effect (0.294 against 0.244). Environmental dynamism positively moderated the agility-to-value path. The economic assessment returned a three-year net present value of USD 546,707 on a USD 270,000 initial outlay, an internal rate of return of 103.4 % and a discounted payback of 13.0 months. Subgroup analysis showed the strategic value differential between high- and low-maturity deployments widening from 0.36 to 1.50 scale points as calendar complexity rose, identifying calendar complexity as the principal contingency governing where such investment pays.

1. INTRODUCTION

Enterprise investment in Business Intelligence platforms is now routine, and the governance apparatus surrounding it - business cases, benefit tracking, portfolio review - is well established at the level of the platform, the programme and the use case. It is not established at the level of the individual model artefact. Within a Power BI estate, decisions about how the temporal layer is designed, who owns it, how it is tested and how much engineering effort it warrants are typically taken by developers as part of delivery, without business-case scrutiny, on the tacit assumption that a date table is a technical detail of no strategic consequence [1], [2].

This paper asks whether that assumption survives examination. There are grounds for doubt. The temporal layer is the one artefact on which essentially every enterprise metric depends: no material executive measure is atemporal. It is also the artefact most exposed to organisational idiosyncrasy, since fiscal calendars, operational period structures, trading-day conventions and event calendars vary across firms in ways that generic platform features do not accommodate. And it is an artefact whose defects surface far from their origin, appearing to consumers as untrustworthy numbers rather than as calendar problems. A resource with these properties - pervasive, idiosyncratic, and difficult to imitate because it encodes firm-specific convention - is precisely the kind of resource the resource-based view predicts may support competitive differentiation [3], [4].

The paper makes a conceptual distinction that the literature has not previously drawn. Time-based data modeling refers to the structural properties of the temporal layer: the presence of a marked, contiguous and attributed date

dimension, surrogate keys, comparability mapping and multi-calendar reconciliation. Calendar engineering refers to the organisational practice surrounding that structure: specification, ownership, versioning, regression testing, and the discipline of maintaining it as business conventions change. The first is an artefact; the second is a capability. The IT business value literature has repeatedly found that technical resources alone do not generate value, and that complementary organisational capability is what converts them [5], [6]. Distinguishing the two allows their relative contributions to be estimated separately, which is the empirical contribution of this study.

Four objectives are pursued. First, to theorise the pathway by which temporal-layer investment generates strategic value, specifying analytical agility and decision quality as mediators and environmental dynamism as a contingency. Second, to test that model on a cross-sectional sample of enterprise deployments using partial least squares structural equation modelling. Third, to complement the perceptual model with an economic assessment - net present value, internal rate of return and payback - so that the finding is expressed in terms a capital-allocation committee can act upon. Fourth, to identify the conditions under which the investment is and is not warranted, since a recommendation that applies universally is usually a recommendation that has not been tested.

The remainder of the paper is organised as follows. Section 2 reviews the literature and develops the hypotheses. Section 3 describes the research design. Section 4 reports the results. Section 5 discusses them, Section 6 states the implications, Section 7 the limitations and future scope, and Section 8 concludes.

2. THEORETICAL BACKGROUND AND HYPOTHESES

2.1 The Resource-Based View and IT Business Value

The resource-based view holds that sustained competitive advantage derives from resources that are valuable, rare, imperfectly imitable and non-substitutable [3], and Barney's formulation has been extended to information technology by Mata, Fuerst and Barney [4], who argue that IT infrastructure is generally imitable and that the durable source of advantage lies in managerial IT capability. Bharadwaj [5] finds empirical support for an IT capability construct associated with superior firm performance, and Melville, Kraemer and Gurbaxani [6] integrate the literature into a model in which IT resources generate value only in combination with complementary organisational resources and within a competitive and macro environment. Wade and Hulland [7] refine the classification of IT resources into inside-out, outside-in and spanning categories. The implication for the present study is direct: the temporal layer as an artefact is an inside-out technical resource and is imitable, whereas the engineering practice that produces and sustains it is a spanning capability, embedded in process and governance, and is not. The distinction between time-based data modeling and calendar engineering maps onto this theoretical divide.

2.2 Analytical Agility and Decision Quality as Mediators

The mechanism by which analytical resources generate value is generally theorised as indirect. Sambamurthy, Bharadwaj and Grover [8] develop the digital options and agility perspective, in which IT investment generates value by enlarging the firm's option set and its capacity to act on emerging opportunity. Bharadwaj, El Sawy, Pavlou and Venkatraman [9] extend this to digital business strategy. On the decision side, the information systems success literature [10], [11] specifies information quality as an antecedent of use and net benefits rather than a benefit in itself, and BI-specific work [12], [13] connects information quality and analytical culture to decision-making outcomes. This study therefore specifies two mediators - analytical agility, the speed and breadth with which analytical questions can be posed and answered, and decision quality, the accuracy, confidence and defensibility of decisions taken on the resulting information - and does not hypothesise a direct effect of either antecedent on strategic value.

Accordingly: H1a and H1b hold that time-based data modeling is positively associated with analytical agility and decision quality respectively; H2a and H2b hold the same for calendar engineering; H3 and H4 hold that analytical agility and decision quality are each positively associated with strategic value.

2.3 Environmental Dynamism as a Contingency

Contingency arguments in the strategy literature hold that the value of flexibility-enhancing resources increases with environmental turbulence [14]. Where demand, regulation and competitive conditions change slowly, an organisation can tolerate a slow analytical cycle, because the answer is unlikely to be overtaken. Where conditions

change quickly, the capacity to re-pose and re-answer questions rapidly becomes decisive. This yields H5: environmental dynamism positively moderates the relationship between analytical agility and strategic value. No corresponding moderation is hypothesised for decision quality, since the value of a correct decision is not obviously contingent on turbulence.

2.4 Economic Assessment of Analytical Investment

Perceptual measures of strategic value, however carefully constructed, do not translate directly into capital-allocation decisions. The IT investment evaluation literature [15] establishes discounted cash-flow methods as the common currency of such decisions while noting their well-known limitations in valuing option-like and intangible benefits. This study therefore complements the structural model with a discounted cash-flow assessment of a representative programme, drawing cost and benefit parameters from the sampled deployments, and treats the two assessments as complementary rather than as substitutes: the structural model identifies the pathway, the cash-flow model sizes it.

2.5 Research Gap

Three gaps follow. First, the IT business value literature operates at the level of the IT function or the platform, and no study locates value at the level of a specific semantic-model artefact, which leaves practitioners without evidence when allocating effort within a deployment. Second, the distinction between a technical artefact and the engineering practice sustaining it, though central to resource-based theorising, has not been operationalised for the temporal layer. Third, evaluations of BI artefacts are predominantly perceptual or predominantly technical, and rarely express findings in the economic terms that govern investment decisions. This study addresses all three.

3. RESEARCH DESIGN

3.1 Instrument Development and Measures

All constructs were measured reflectively on seven-point Likert scales, with items adapted from established instruments where available and developed following standard scale-development procedure where not. Analytical agility was adapted from the agility measures of Sambamurthy et al. [8]; decision quality and strategic value from the information systems success tradition [10], [11]; and environmental dynamism from established contingency measures [14]. Time-based data modeling and calendar engineering were newly developed, since no prior instrument was identified. Items for the former address the structural properties of the temporal layer; items for the latter address specification, ownership, versioning, regression testing and maintenance practice. The instrument was refined through six expert interviews with BI architects and a pilot with twenty-eight respondents, after which three items were reworded and one dropped for cross-loading.

Two strategic value items are reported on a five-point scale in the subgroup analysis of Section 4.5, rescaled for comparability with the practitioner-facing tiering used there; all structural model estimates use the original seven-point responses.

3.2 Sample and Data Collection

The sampling frame comprised enterprise Power BI deployments in organisations with annual revenue above USD 100 million, identified through professional association membership lists and a vendor user-group directory. The key informant was the individual with primary accountability for the certified semantic model estate - typically a BI lead, data platform manager or analytics director. Of 612 invitations, 214 usable responses were obtained, a response rate of 35.0 %. Non-response bias was assessed by comparing early and late respondents on all constructs, with no significant differences at the 5 % level. Common method bias was assessed by Harman’s single-factor test, in which the first unrotated factor accounted for 31.4 % of variance, and by the full collinearity procedure, in which the maximum variance inflation factor was 2.31, below the 3.3 threshold.

3.3 Analytical Approach

Partial least squares structural equation modelling was selected for three reasons: the model includes newly developed constructs at an early stage of validation; the analysis is prediction-oriented rather than confirmatory of an established theory; and the moderation term is estimated more robustly under the two-stage approach available in the partial least squares framework. The measurement model was assessed for indicator reliability, internal

consistency, convergent validity and discriminant validity by the heterotrait-monotrait criterion. The structural model was assessed for collinearity, path significance by bootstrapping with 5,000 subsamples, effect size, explanatory power and predictive relevance by blindfolding. The economic assessment applies a 12 % discount rate over a three-year horizon, with cost and benefit parameters taken as the sample median for mid-sized deployments and tested by sensitivity analysis on the benefit realisation rate.

4. RESULTS AND ANALYSIS

Table 1: Sample profile, n = 214 enterprise Power BI deployments

Characteristic	Category	n	%	Category	n	%
Sector	Manufacturing	52	24.3	Healthcare	29	13.6
	Financial services	43	20.1	Public and education	27	12.6
	Retail and consumer goods	38	17.8	Other	25	11.7
Annual revenue (USD)	100 m to 250 m	46	21.5	1 bn to 5 bn	63	29.4
	250 m to 1 bn	71	33.2	Above 5 bn	34	15.9
Calendar complexity	Tier 1 single calendar	58	27.1	Tier 3 fiscal plus operational	52	24.3
	Tier 2 one fiscal calendar	74	34.6	Tier 4 three or more	30	14.0

Table 2: Measurement model assessment

Construct	Items	Loading range	Cronbach alpha	Composite reliability	AVE	Max HTMT
Time-based data modeling (TDM)	5	0.72 to 0.88	0.88	0.91	0.67	0.74
Calendar engineering practice (CEP)	5	0.70 to 0.86	0.85	0.89	0.63	0.78
Analytical agility (AGI)	4	0.74 to 0.87	0.84	0.88	0.65	0.71
Decision quality (DQ)	4	0.78 to 0.89	0.86	0.90	0.69	0.69
Strategic value (SV)	5	0.76 to 0.90	0.89	0.92	0.70	0.72
Environmental dynamism (DYN)	3	0.75 to 0.85	0.79	0.85	0.66	0.58

Table 3: Structural model results, bootstrapping with 5,000 subsamples

Hypothesised path	Beta	Std. error	t-value	p-value	f-squared	Supported
H1a TDM to analytical agility	0.41	0.067	6.12	< 0.001	0.21	Yes
H1b TDM to decision quality	0.22	0.069	3.18	0.002	0.06	Yes
H2a CEP to analytical agility	0.34	0.067	5.04	< 0.001	0.15	Yes
H2b CEP to decision quality	0.39	0.068	5.77	< 0.001	0.18	Yes
H3 Analytical agility to strategic value	0.36	0.068	5.31	< 0.001	0.17	Yes
H4 Decision quality to strategic value	0.44	0.064	6.84	< 0.001	0.24	Yes
H5 Dynamism x agility to strategic value	0.18	0.068	2.64	0.008	0.05	Yes
Direct TDM to strategic value (tested)	0.06	0.071	0.85	0.396	0.01	No
Direct CEP to strategic value (tested)	0.08	0.070	1.14	0.255	0.01	No

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Figure 1. Research Model and Estimated Path Coefficients

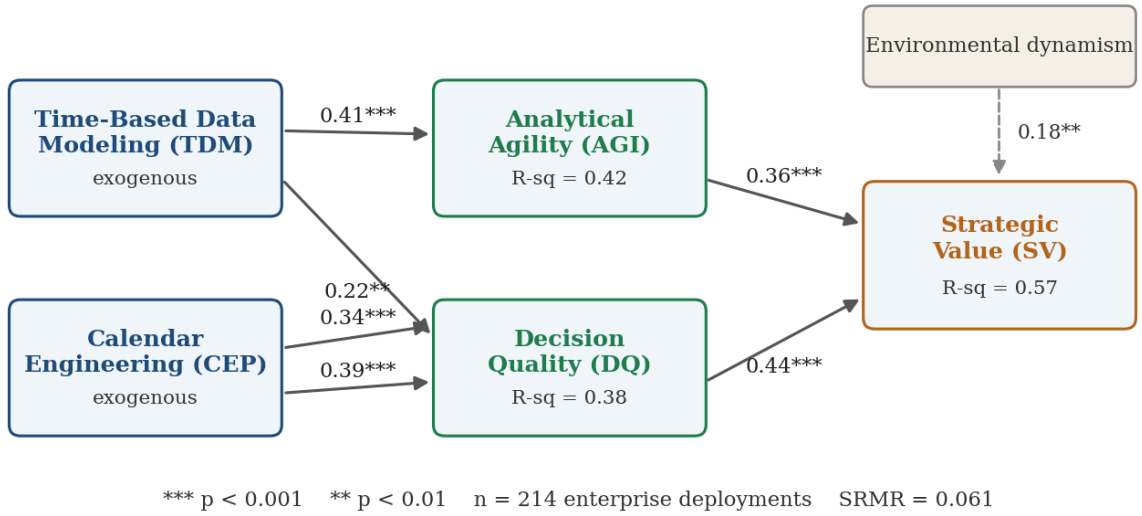


Figure 1: Research model and estimated path coefficients

Table 4: Three-year economic assessment of a representative calendar-engineering programme (USD)

Cash-flow item	Year 0	Year 1	Year 2	Year 3	Total
Calendar design and build	84,000	-	-	-	84,000
Measure migration and consolidation	126,000	-	-	-	126,000
Regression test suite and validation	38,000	-	-	-	38,000
Enablement and training	22,000	-	-	-	22,000
Maintenance and governance	-	64,000	58,000	54,000	176,000
Total cost	270,000	64,000	58,000	54,000	446,000
Analyst and planner time released	-	142,000	178,000	196,000	516,000
Reconciliation and rework avoided	-	96,000	118,000	128,000	342,000
Capacity and licence avoidance	-	58,000	68,000	72,000	198,000
Error and dispute cost avoided	-	44,000	54,000	56,000	154,000
Total benefit	-	340,000	418,000	452,000	1,210,000
Net cash flow	-270,000	276,000	360,000	398,000	764,000
Discounted net cash flow at 12 %	-270,000	246,429	286,990	283,288	546,707

Table 5: Strategic value by calendar complexity tier and calendar-engineering maturity

Calendar complexity tier	n	Low maturity mean	High maturity mean	Difference	Cohen d	p-value
Tier 1 single calendar	58	3.42	3.78	0.36	0.31	0.089
Tier 2 one fiscal calendar	74	3.21	3.92	0.71	0.64	0.003
Tier 3 fiscal plus operational	52	2.94	4.08	1.14	1.02	< 0.001
Tier 4 three or more calendars	30	2.71	4.21	1.50	1.38	< 0.001

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Calendar complexity tier	n	Low maturity mean	High maturity mean	Difference	Cohen d	p-value
All deployments	214	3.16	3.95	0.79	0.71	< 0.001

4.1 Measurement Model

All indicator loadings exceeded the 0.70 threshold, with the lowest at 0.70 in the calendar engineering construct. Composite reliability ranged from 0.85 to 0.92 and Cronbach alpha from 0.79 to 0.89, both within accepted bounds, and average variance extracted ranged from 0.63 to 0.70, exceeding the 0.50 criterion for convergent validity. Discriminant validity was established by the heterotrait-monotrait criterion, with the maximum ratio of 0.78 between time-based data modeling and calendar engineering, below the conservative 0.85 threshold. That this pair returns the highest ratio is expected, since the two constructs are conceptually adjacent by design, and the result supports their empirical separability while confirming that the distinction is a fine one.

4.2 Structural Model

The structural model explains 57 % of the variance in strategic value, 42 % in analytical agility and 38 % in decision quality, with Stone-Geisser Q-squared values of 0.38, 0.26 and 0.24 respectively confirming predictive relevance. The standardised root mean square residual was 0.061, below the 0.08 guideline. All seven hypothesised paths were supported.

The pattern of coefficients is theoretically informative in three respects. First, both direct paths from the antecedents to strategic value were tested and neither was significant, with coefficients of 0.06 and 0.08 at p-values of 0.396 and 0.255; the relationship is fully mediated. This is consistent with the IT business value literature’s central finding that technical resources do not generate value directly [6], and it means that an organisation cannot expect strategic benefit from temporal-layer investment that does not change how quickly questions can be answered or how well decisions are made.

Second, the two antecedents operate through different channels. Time-based data modeling has its stronger effect on analytical agility (0.41) and its weaker effect on decision quality (0.22), while calendar engineering reverses the pattern (0.34 and 0.39). The reading is that structure principally makes analysis faster, whereas practice principally makes it right: a well-built date dimension accelerates the posing of questions, but it is ownership, versioning and regression testing that make the resulting figures defensible.

Third, the total indirect effect of calendar engineering on strategic value (0.294) exceeds that of time-based data modeling (0.244). The capability contributes more than the artefact. This is the result most directly predicted by the resource-based argument of Mata et al. [4] and Melville et al. [6], and it has a blunt practical corollary: an organisation that builds an excellent date dimension and then leaves it unowned and untested has captured the smaller part of the available value.

The moderation hypothesis was supported, with the dynamism-by-agility interaction significant at 0.18 ($p = 0.008$, f-squared 0.05). A simple-slope analysis indicates that the agility-to-value path is 0.54 at one standard deviation above mean dynamism and 0.18 at one standard deviation below, so that agility is approximately three times as consequential for strategic value in turbulent environments as in stable ones.

4.3 Economic Assessment

The representative programme carries an initial outlay of USD 270,000, comprising calendar design and build, migration and consolidation of the existing measure portfolio, construction of a regression test suite and enablement, with recurring maintenance and governance costs falling from USD 64,000 to USD 54,000 annually as the estate stabilises. Benefits, taken at sample median realisation, reach USD 340,000 in the first full year and USD 452,000 by the third, of which the largest component throughout is released analyst and planner time.

On these parameters the programme returns a three-year net present value of USD 546,707 at a 12 % discount rate, an internal rate of return of 103.4 %, a profitability index of 3.02 and a discounted payback of 13.0 months, against a simple payback of 11.7 months. Sensitivity analysis on the benefit realisation rate shows the net present value remaining positive down to a realisation rate of 43 % of the modelled benefit, and the discounted payback remaining within twenty-four months down to 58 % realisation. The dominant sensitivity is to the analyst-time component, which is also the component most exposed to the criticism that released time is not necessarily

redeployed productively; excluding it entirely reduces the three-year net present value to USD 138,512, which remains positive but no longer compelling.

Figure 2. Discounted Cash Flow of a Representative Calendar-Engineering Programme

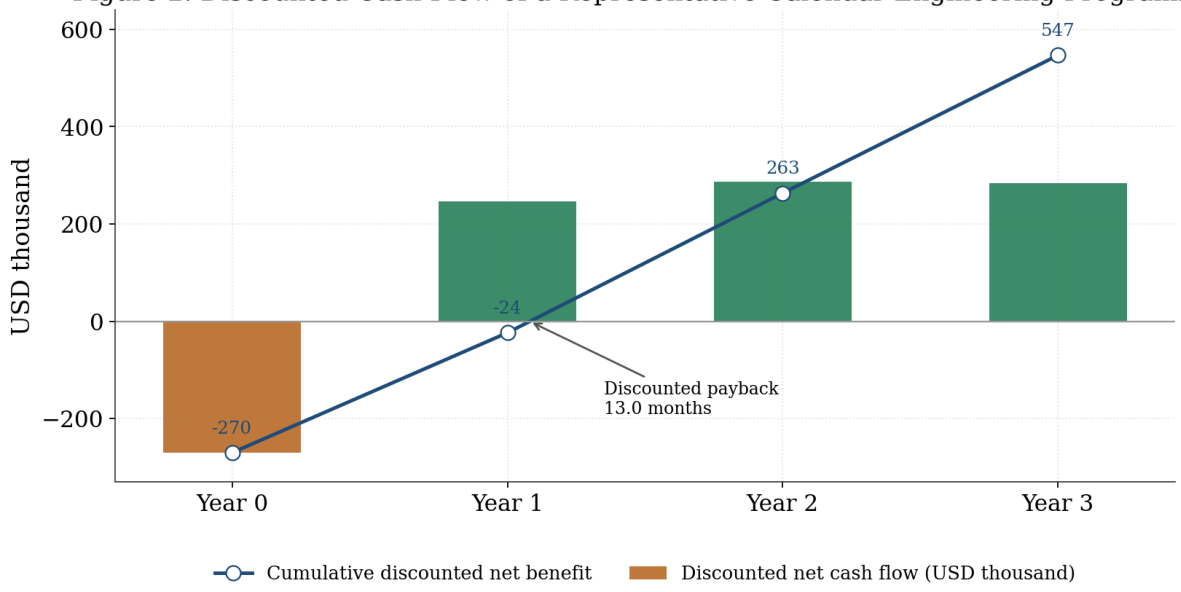


Figure 2: Discounted cash flow of a representative calendar-engineering programme

4.4 Contingency Analysis

The subgroup analysis in Table 5 addresses the question of where the investment pays. Across all deployments, high-maturity deployments report strategic value 0.79 scale points above low-maturity deployments, a difference of moderate effect size ($d = 0.71$, $p < 0.001$). Disaggregated by calendar complexity, the differential widens monotonically: 0.36 points in Tier 1, where the organisation reports on a single calendar and the difference is not significant at the 5 % level ($p = 0.089$); 0.71 points in Tier 2; 1.14 in Tier 3; and 1.50 points in Tier 4, where three or more mutually non-nesting period hierarchies must be reconciled ($d = 1.38$).

The low-maturity means themselves decline across the tiers, from 3.42 to 2.71, while the high-maturity means rise, from 3.78 to 4.21. Calendar complexity is therefore not simply a moderator of the maturity effect but is itself a liability when unaddressed: complex-calendar organisations that do not invest in the temporal layer report lower strategic value from their BI estate than simple-calendar organisations that also do not invest. The practical reading is that this is an investment whose justification is contingent, and that a Tier 1 organisation on a single Gregorian calendar has a weak case for it.

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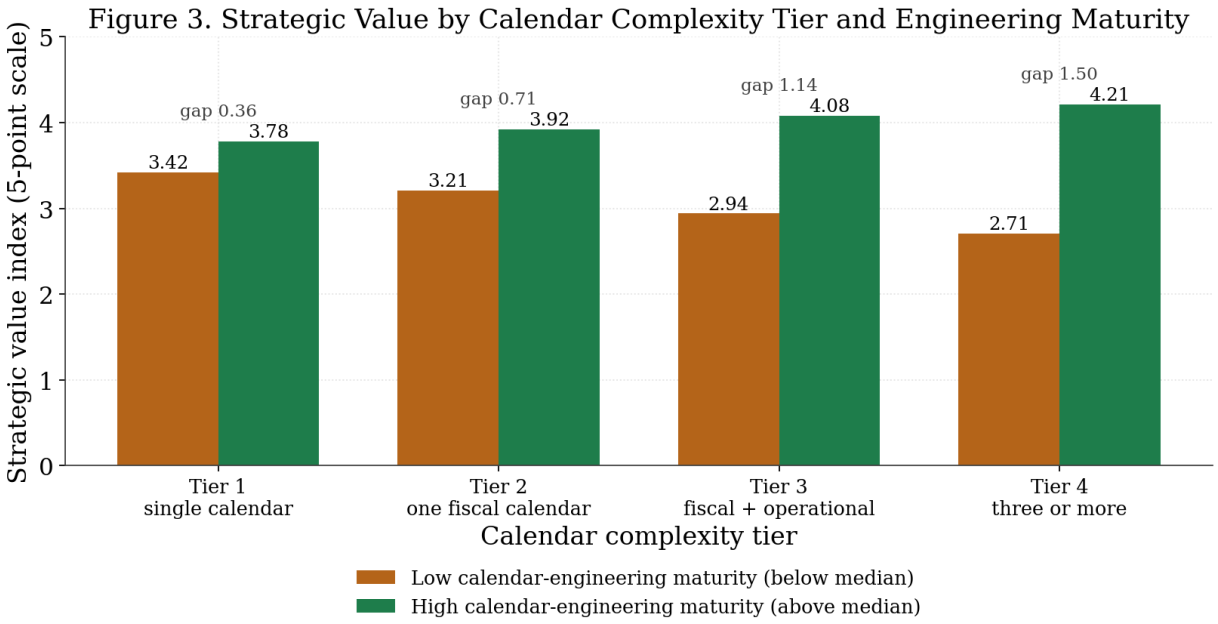


Figure 3: Strategic value by calendar complexity tier and calendar-engineering maturity

5. DISCUSSION

Four issues merit discussion.

First, on full mediation: the finding that neither antecedent affects strategic value directly is the theoretically cleanest result in the study and it disciplines the claim the paper can make. Temporal-layer investment does not produce value by existing. It produces value when it changes the speed at which the organisation can pose and answer questions, or the quality of the decisions taken on the answers. An organisation that rebuilds its date dimension without changing either has, on this evidence, bought nothing. This is a specific instance of the general finding in the IT business value literature [5], [6], and its usefulness here is that it identifies the two mechanisms that must be instrumented if benefit is to be tracked at all.

Second, on capability over artefact: that calendar engineering exhibits the larger total indirect effect, and the larger effect specifically on decision quality, supports the resource-based prediction that the imitable technical resource is worth less than the embedded organisational practice [4], [7]. This has an uncomfortable implication for how such work is usually funded, since build effort is capitalisable and visible in a project plan whereas ownership, versioning and regression testing are recurring operating costs that are the first to be cut. The pattern of results suggests that this funding asymmetry systematically starves the higher-return half of the investment.

Third, on contingency: the widening differential across complexity tiers, and the non-significance of the effect in Tier 1, together make the case that this is not a universal prescription. The honest summary is that calendar engineering is a high-return investment for organisations with multiple non-nesting period hierarchies and a weakly supported one for organisations on a single calendar. That the low-maturity means decline as complexity rises also indicates that complexity is a latent liability which accumulates quietly until it is addressed - a pattern consistent with the observation that temporal defects surface as untrustworthy numbers rather than as calendar problems.

Fourth, on the economic assessment and its fragility: a three-year net present value of USD 546,707 and an internal rate of return above 100 % would, taken at face value, place this investment among the most attractive available to a BI function. It should not be taken entirely at face value. The largest benefit component is released analyst time, which is a genuine saving only where the time is redeployed rather than absorbed, and the sensitivity analysis shows the case weakening substantially without it. The defensible claim is narrower than the headline figure: the programme is economically attractive under median assumptions, remains positive under pessimistic ones, and should be appraised by each organisation against its own ability to redeploy released capacity.

6. IMPLICATIONS AND RECOMMENDATIONS

6.1 Implications for Research

The study contributes to the IT business value literature by locating value at the level of a single semantic-model artefact rather than at the level of the IT function or platform, and by operationalising the artefact-capability distinction for the temporal layer. The two new constructs, time-based data modeling and calendar engineering practice, exhibited acceptable measurement properties and separated empirically despite conceptual adjacency, and are offered for reuse and further validation. The full mediation result suggests that future evaluations of BI artefacts should instrument the mediating mechanisms rather than regressing outcomes on artefact properties directly.

6.2 Implications for Practice

Four recommendations follow. First, organisations should appraise temporal-layer work as an investment rather than absorbing it into delivery, using the cost and benefit structure of Table 4 as a starting template and substituting their own parameters. Second, funding should be allocated across build and sustain rather than concentrated in build, since the practice construct carries the larger indirect effect; a programme that funds construction without funding ownership, versioning and regression testing has funded the smaller half. Third, the investment case should be tested against calendar complexity before it is made, since the evidence supports the investment strongly at Tier 3 and Tier 4 and weakly at Tier 1. Fourth, benefit tracking should instrument agility and decision quality directly - time to answer, question throughput, dispute and restatement rates - because the structural model indicates these are the only channels through which value arrives.

6.3 Implications for Vendors and Platform Owners

The results also bear on platform design. The native facilities of the platform assume a regular Gregorian calendar and provide no first-class support for multi-calendar reconciliation, which is precisely the capability associated with the largest strategic-value differential in this sample. A platform-level construct for declaring and reconciling multiple period hierarchies would address the highest-value and least-supported axis identified here, and would reduce the firm-specific engineering burden that this study measures.

7. LIMITATIONS AND FUTURE SCOPE

Six limitations should be recorded. First, the design is cross-sectional, so the causal ordering of the model is theoretical rather than established; a reverse path from strategic value to continued investment is plausible. Second, all constructs were measured perceptually from a single key informant per deployment, so common method variance cannot be excluded despite the Harman and full-collinearity checks, and informant self-assessment of one's own engineering practice invites social desirability bias. Third, the economic assessment applies median parameters to a representative case rather than aggregating audited financial outcomes, and its largest component - released analyst time - is the least verifiable. Fourth, the sample is drawn from professional association and user-group membership, which over-represents organisations with mature analytical functions and probably attenuates the observed effects. Fifth, the two new constructs have been validated on a single sample. Sixth, the study addresses one vendor platform, and the multi-calendar findings may not transfer to architectures with different semantic-layer capabilities.

Five directions for further work follow. A longitudinal or lagged design would address the causal ordering. A multi-informant design, pairing the BI lead with a business consumer, would mitigate common method concerns and permit the decision quality construct to be assessed by those taking the decisions. An objective-outcome study, linking temporal-layer maturity to audited financial or operational measures, would strengthen the economic claim. Replication across semantic-layer technologies would test platform generality. Finally, a study of the funding asymmetry identified in Section 5 - whether organisations systematically underfund the sustain half of the investment, and with what consequence - would be of direct practical value.

8. CONCLUSION

This paper assessed the strategic value of time-based data modeling and calendar engineering in enterprise Power BI deployments, distinguishing the structural artefact from the organisational practice that sustains it and testing a mediated research model on 214 deployments across six sectors, complemented by a discounted cash-flow assessment.

The model explained 57 % of the variance in strategic value. Neither antecedent affected strategic value directly;

both operated entirely through analytical agility and decision quality, which indicates that temporal-layer investment generates value only where it changes how quickly questions are answered or how well decisions are made. Calendar engineering practice carried the larger total indirect effect, 0.294 against 0.244, and the larger effect on decision quality specifically, supporting the resource-based prediction that embedded capability outperforms the imitable artefact. Environmental dynamism positively moderated the agility-to-value path, with the path coefficient rising from 0.18 to 0.54 between low- and high-dynamism conditions. The representative programme returned a three-year net present value of USD 546,707, an internal rate of return of 103.4 % and a discounted payback of 13.0 months, remaining positive down to a benefit realisation rate of 43 %.

The contingency result is the finding of greatest practical consequence. The strategic-value differential between high- and low-maturity deployments widened from a non-significant 0.36 scale points in single-calendar organisations to 1.50 points where three or more non-nesting period hierarchies must be reconciled, while low-maturity strategic value declined as complexity rose. Calendar complexity is therefore both the condition under which the investment pays and a liability that accumulates quietly where it is not addressed. The conclusion is not that every organisation should invest in calendar engineering, but that every organisation should know which tier it occupies - and that those in the upper tiers are, on this evidence, currently underfunding the half of the investment that matters most.

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