

Review Article

The dual role of CEO-CTO: Balancing Business Strategy with Hands-On Product Development

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Abstract: Digital product companies, start-ups funded by venture capital, and platform firms are increasingly putting both strategic and technical decision-making power in the hands of one executive, usually one of the founders whose credentials are based on market insight as well as expertise in engineering. This structure can accelerate product learning, speed decision-making, and improve architectural coherence; however, it can also increase role overload, concentrate technical judgment, and decelerate the process of organizational maturation. The present review synthesizes peer-reviewed literature relevant to the CEO-CTO dual role by integrating findings from upper echelons theory, organizational ambidexterity, the attention-based view of the firm, founder governance, innovation management, and dynamic capabilities. The major themes include the innovation benefits of technically grounded leadership, the governance risks of concentrated power, the conditional value of direct product involvement across venture stages and the role of delegation systems in sustaining strategic breadth and technical excellence. The evidence remains fragmented because little of the literature examines the combined CEO-CTO role directly; most of the evidence is based on related constructs like founder-CEO effect, executive technical experience, top management team structure, or ambidextrous leadership. Despite this limitation, the literature suggests a consistent pattern: technical involvement at the top appears most valuable, coupled with selective delegation, role definition, and organizational designs that avoid bottlenecks in attention.

Keywords: Ambidexterity, Chief Executive Officer, Chief Technology Officer, Product Development, Strategic Leadership

I. INTRODUCTION

The growing centrality of software, data infrastructure, and platform logic has changed the role design of executives in technology-intensive companies. In many young ventures, particularly venture-backed software, AI, developer tools, cybersecurity, and digital health startups, both strategic and technical authority are vested in the same individual. This individual may formally hold the title of chief executive officer while functioning in practice as a de facto chief technology officer by making product architecture decisions, conducting technical hiring, overseeing code reviews and participating in release trade-offs. The upper echelons theory is a good place to begin in the analysis of this arrangement since it correlates strategic outcomes with executive experiences, cognitive frames and value structures [1]. A technically trained executive is more likely to place greater weight on platform strength, architectural optionality, and engineering talent density than a commercially trained executive. These interpretive differences are significant because they do not just affect the allocation of resources, but also the definition of competitive advantage, in product-led firms.

The CEO-CTO combination is especially relevant when product-market fit is still unstable, which is rather unstable and demands the swift exchange of data between engineers and users and vice versa. With that said, strategic choice and product development are separated by a very thin line. market positioning, feature emphasis, infrastructure investment, logic of pricing, and the design of the ecosystem are normally agreed in the same discussion. The difference between exploration and exploitation as put forward by March explains the main conflict [2]. Strategic leadership requires portfolio thinking, environmental scanning, financial discipline, and organizational adaptation, and hands-on technical leadership needs depth, concentration, and engagement in engineering problems that are unsolved. This integrated position may enable faster alignment between exploration and exploitation since the same executive is capable of directly taking market signals into product decisions. The same level of concentration can result in distorted focus, especially when more long-range strategic thought is dominated by technical issues, or when technically elegant investments with delayed commercial payoffs are pursued despite capital-market pressures.

The literature on organizational ambidexterity overlaps this issue as well. Firms that innovate successfully over time tend to develop mechanisms for balancing short-term execution with long-term adaptation, usually by means of structural differentiation, time cycling or integrative leadership [3]. In the companies functioning under a combined CEO-CTO structure, such a balancing act is very personalized. The architectural decisions may be biased toward future value of the



options, but the same architectural choices must be commercialized in the short term by sales alignment, external coalition, compliance and organizational scaling management. The dual-role executive can function as a powerful integrator, who can translate the product vision and competitive strategy without a translation loss. Meanwhile, ambidexterity literature implies that sustainable balance is hardly ever reliant on heroic multitasking by itself. The increasing demands of the organization across customers, regulators, employees, investors and complementors increase as the organization expands. What worked in the early stages may become increasingly fragile as the product lines grow, technical debt grows and managerial spans increase.

Another useful explanatory lens is the attention-based view which views executive attention as a limited resource of an organization as opposed to an unlimited resource of cognitive capacity [4]. CEO-CTO set-up seems to be appealing due to the fact that it minimizes the number of coordination interfaces, but it also loads up various high-variance streams of attention on a single desk. Urgent issues can include board management, fundraising, staffing, customer support issues, platform outages, security issues, and roadmap conflict. A more differentiated executive structure distributes this complexity across specialized roles. The act of task switching in itself becomes a strategic role in a combined role. Technical crises may create distortion of quality of long-range decisions, but strategic shocks may annihilate continuity which is an indispensable element of in-depth product development. The issue is not simply workload intensity; it is repeated switching across qualitatively different forms of attention: abstract and concrete, external and internal, exploratory and exploitative, deliberative and time-critical.

Research on cognition and technological transitions also suggests that the executive mental models have the ability and constraints to change [5]. An executive with detailed technical expertise can more rapidly be in a position to detect architectural discontinuities or threats of platform migration or change of behavior on the part of developers. This kind of expertise can guard the firm against superficial responses to the market which ignore technical feasibility. However, technical expertise may also become rigidly attached to current architectures, preferred frame of problems, or preferred engineering solutions that are no longer in time in the market. Despite the importance of this tension, the topic of CEO-CTO dual role has rarely been studied in literature. Most of the studies revolve around the influence of the founder-CEO, executive technical experience, the degree of innovation, the composition of the top management team or ambidextrous leadership. The current review fills that knowledge gap by discussing how the current body of literature can be used to explain the overall advantages, risks, boundary conditions, and organizational implications of the strategy and hands-on product authority in a single executive. The remainder of the review is organized as follows: the literature review surveys the major analytical streams; the next section outlines the principal conceptual and methodological approaches; the results and discussion compare reported findings and contingencies; and the final sections identify future research priorities and present the conclusion.

II. LITERATURE REVIEW

Although no studies directly examine the CEO-CTO dual role, the adjacent literature on closely related issues is substantial. One major stream examines executive traits and innovation behavior. Barker and Mueller found that CEO characteristics help shape R&D spending which implies that the orientation and background of the chief executive determine the attitude of the company to innovation and not the industry structure, in isolation [6]. This observation was generalized by Wu, Levitas and Priem, who demonstrated that the tenure of CEOs had an interaction with technological dynamism in influencing the results of invention [7]. These papers are not contextualized in terms of shared CEO-CTO power, but both suggest that technically informed decision-making at the top can be important where commitment of innovation investment is at the highest level in the face of uncertainty. A second stream deals with the establishment of teams and the founder-CEO control. Literature is especially relevant because most dual-role structures emerge at the founding stage when such role differentiation is not a necessity.

Table 1 summarizes the core studies used in this review and shows that the evidence base, while fragmented, remains informative. Some of the articles concentrate on the background of executives and innovation effort, whereas some of them are dedicated to the imprinting of founders, governance, team, and management of paradox. The literature indicates that the issue is not merely one of job title, when read together. To be more precise, it is an iterative organizational approach to information asymmetry, technical uncertainty and coordination cost in the industries where product architecture is the core of competitive advantage.

A considerable portion of the literature believes that centralized power can be beneficial in setting up a new business. Beckman showed founding-team affiliations may have enduring effects on subsequent firm behavior which can be explained by the concept of the technical founders who leave not only the product architecture, but also the decision-making rules and assumptions of growth [8]. A more cautionary note is provided in the founder-CEO succession work of Wasserman: the same founder power that creates energy in the initial growth may be a barrier to the organizational transition that is needed

later [9]. This review is situated precisely within that tension. The presence of a chief executive as chief technologist helps reduce internal translation costs, prioritization of features and identification of engineering talent faster using technical credibility. But the same focus also can delay the development of a middle-management layer, restrain opposition to architectural decisions, and establish a brittle reliance on the whims of a single person. The results of Daily and Dalton on the governance structure of an entrepreneurial firm support the role of formal role design, especially as outside parties start to demand greater accountability and tighter control mechanisms [10].

Table 1: Summary of key findings

Ref	Focus	Key Findings
[6]	CEO characteristics and R&D intensity	Executive attributes influence R&D spending levels, indicating that innovation investment is partly a function of top-level cognition and risk posture rather than sector averages alone.
[7]	CEO tenure under technological dynamism	Longer CEO tenure can support invention in stable settings, yet high technological dynamism alters the value of experience and increases the importance of adaptive attention.
[8]	Founding-team affiliations and firm behaviour	Prior organizational affiliations of founder's shape strategic behaviour, indicating durable imprinting effects on coordination patterns and strategic orientation.
[9]	Founder-CEO succession	Founder retention can support continuity and vision, yet delayed succession may generate governance strain and constrain later-stage organizational development.
[10]	Governance structure in entrepreneurial firms	Role concentration and governance design affect performance in entrepreneurial settings, highlighting the organizational consequences of limited formal separation.
[11]	Top management team competence and growth	Experience-based competence at the executive level supports sustained growth when firms confront complex coordination and scaling challenges.
[12]	Early team demography, financing, and going public	Early team composition affects external legitimacy, venture financing, and strategic development, indicating that technical and managerial balance matters to resource acquisition.
[13]	Exploration-exploitation tensions in innovation	Productive innovation requires active management of paradox rather than simple prioritization of one pole over the other.
[14]	Dimensions of organizational ambidexterity	Balanced exploratory and exploitative activity can produce synergistic performance effects under appropriate organizational conditions.
[15]	Strategic paradox in complex business models	Leaders managing simultaneous tensions gain from integrative framing, but paradox intensifies as business models become more complex and interdependent.

A different stream is connected with executive competence and composition of the teams instead of the single founder. Kor discovered that competence in the top management team based on experience is a factor that enables the company to grow sustainably and indicated that dual-role effectiveness is partially dependent on the executive team in which the focal leader works but not the leader [11]. Beckman, Burton, and O'Reilly reported similar findings, showing that first team demography affects the venture financing and transition to the public market which makes the result that the providers of capital take into account the completeness of management and technological novelty [12]. With a CEO-CTO individual, this means that the benefits of technical centrality can be offset by the availability or lack of complementary commercial, operating or product-management skills in the top team. A technically dominant chief executive paired with strong commercial and organizational complements may achieve alignment without crippling overload. The same type of executive, when embedded in a thin or homogeneous team, may create a bottleneck in the product, staff and strategic choices.

The study of ambidexterity and paradox expands the discourse of the topic of founder governance. Andriopoulos and Lewis demonstrated that innovation-oriented firms manage tensions through ongoing paradox work rather than by seeking a static equilibrium between exploration and exploitation by engaging in continuous paradox work instead of tensions in equilibrium [13]. Cao, Gedajlovic and Zhang also showed that ambidexterity has various dimensions which interact to influence performance [14]. Smith, Binns and Tushman related the ideas with multifaceted business models and said that leaders who have to deal with several tensions simultaneously are better suited with integrative cognitive framing [15]. It can be directly applied to the CEO-CTO dual role. The merged role is frequently there since a company aims to be more closely coupled between technological discovery and commercial uses. But the literature indicates that the long-term performance is attained due to the formation of mechanisms that sustain the two poles, and not by collapsing them indiscriminately. The distinction is significant in that real-world interaction can hold up product coherence without

invariably undermining the organizational ambidexterity unless the executive’s technical emphasis begins to crowd out portfolio balancing, ecosystem negotiation, or market diversification.

In these themes, several common limitations emerge. First, the majority of studies infer the existence of technical influence indirectly on the basis of the expenditure on research and development, experience of the executive or the position of the founder and not the explicitly combined CEO-CTO role. Second, outcome measures are very varied (e.g. the number of inventions, expansion of a firm, or sources of financing, or the overall performance) and it is difficult to directly compare them. Third, institutional context is important: institutional context also matters: venture-backed digital firms differ from public industrial firms in investor pressure, product modularity, and decision velocity. Those caveats notwithstanding, there is a strong pattern which the literature reaches. The peak of technical authority appears to be most applicable to situations in which there is high uncertainty, architectural decisions are consequential and feedback is short. Role concentration is no longer beneficial when the organization becomes more complex, there are more external coordination burdens, and the strategy is extended beyond the product core. This pattern points to the need for a more explicit conceptual framework and a deeper analysis of the methods to study the neighboring types of executive duality.

III. ANALYTICAL FRAMEWORK

The literature offers several conceptual lenses that are highly relevant to the CEO-CTO question, although the combined role is rarely measured directly. One important conceptual lens treats the issue as a problem of ambidexterity. Jansen, Van den Bosch, and Volberda differentiated between exploratory and exploitative innovation and demonstrated that the antecedents in the organization and environmental factors determine the performance consequences of either of them [16]. Raisch and Birkinshaw conducted a review of past studies on ambidexterity and found antecedents, outcomes and moderators at structural, contextual and leadership levels [17]. In the case of the dual CEO-CTO role, this viewpoint would imply that direct technical interaction at the top of the organization can be more conducive either to exploration or to disciplined exploitation in the exercise of the role. An architecturally knowledgeable chief executive will be able to tie architecture decisions to strategic interests, but this depends on whether the organization around her maintains a sufficient amount of differentiation to prevent crowding out nontechnical objectives.

The second conceptual approach focuses on external interdependence and dynamic coordination. Adner and Kapoor have shown that innovation outcomes are not determined solely by focal-firm capability, but the organization of technological interdependence within the ecosystem around [18]. Eisenhardt, Furr and Bingham described performance in changing contexts with micro foundations which strike a balance between efficiency and flexibility [19]. These arguments shift attention from the executive role itself to the broader system within which that role operates. A CEO-CTO structure can result in swift and consistent decisions in a loosely coupled environment with little complementor reliance. With highly interdependent ecosystems, however, the chief executive will have to place a lot of focus on partner sequencing, standards wars, and cross-boundary coordination. In such circumstances, excessive internal focusing of product development can turn out to be expensive since value creation requires orchestration outside the engineering organization.

Figure 1 integrates these recurring mechanisms into a conceptual framework that has been developed through reviews. The figure shows the dual role as a structural option which triggers both positive and negative pathways. The positive paths include reduced translation loss, speedier product-market iteration, stronger technical talent signaling, and architectural coherence. Examples of negative pathways are attention fragmentation, decision bottlenecks and slow executive specialization. Other contingencies that the framework identifies are the stage of the venture, the complexity of the product, its dependence on the ecosystem, and the complementarity of the top team. This structure is consistent with existing literature since the value of concentrated technical authority is consistently shown to be conditional rather than universal.

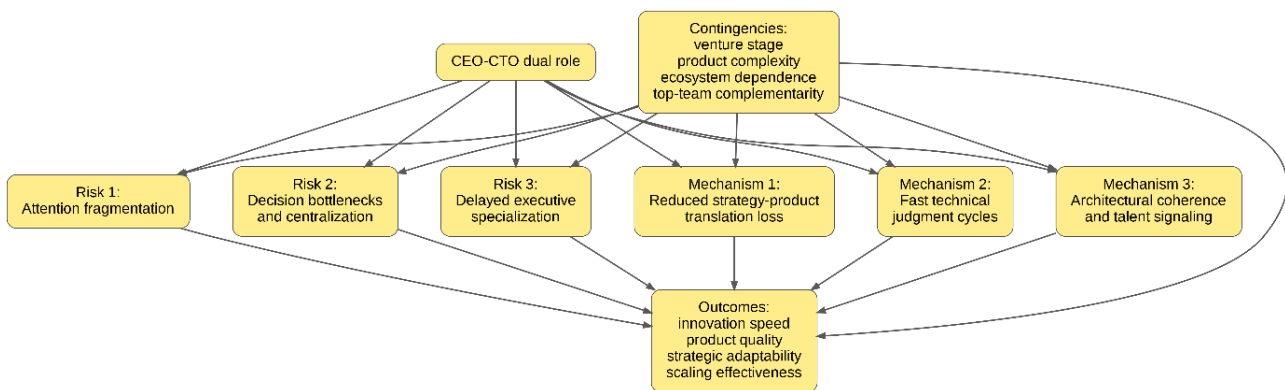


Figure 1: Review-Derived Conceptual Framework of the CEO-CTO Dual Role

The dual role as illustrated in Figure 1 is better understood as a contingent governance design than as a universally superior model of entrepreneurial leadership. It facilitates discussion by clarifying the two-sided logic that recurs throughout the literature: the very structured decision that can enhance product-strategy fit can create fragility in coordination. The figure also justifies the differences in the findings of the empirical studies in various settings. Different studies mention various items on the same causal map.

A third line of approach is concerned both with executive competence and cognition and with adaptation. Kaplan, Klebanov, and Sorensen were also interested in the applicability and importance of the traits and abilities of the CEO, emphasizing that executive effectiveness is multi-dimensional rather than reducible to a single characteristic and can be characterized by one characteristic [20]. Helfat and Peteraf introduced the idea of managerial cognitive capabilities, and related managerial action to the micro foundations of dynamic capabilities [21]. Comparisons of CEO and organizational effects on adaptation to technical change which cognition influences but which are also determined by organizational structure were also made by Eggers and Kaplan [22]. These strategies are quite applicable since the CEO-CTO position requires both technical and strategic thinking, although existing empirical designs rarely measure the switching cost among the two arenas. A leader can excel in both spheres and have structural constraints on bandwidth, delegation or role performance. This has methodological implications: even these relatively accessible indicators, such as technical education, founder status, or R&D intensity, fail to capture the lived complexity of the dual role.

The fourth strategy is founded on role design and top-team contingency. The analysis of the chief operating officer by Marcel revealed that the value of structuring a powerful second-in-command role depends on broader top-management-team characteristics [23]. Even though it focuses on the COO, instead of the CTO, the rationale is applicable. The success of a combined CEO-CTO position will probably hinge on whether neighboring executive functions usurp commercial, operating, and organizational pressures with enough power. The four dominant methods found in the literature reviewed are archival panel studies of secondary data; survey-based studies of innovation behavior; longitudinal case studies of adaptation and paradox; conceptual reviews that combine theories across adjacent streams. Each of these approaches contributes useful insight, but each also has limitations, yet they have shortcomings. Archival studies are scaled but using crude proxies. Mechanism is shown in case studies but tends to be context-dependent. The designs of surveys take in the perceptions but fail to play the role over an extended duration. The most serious gap is the absence of a validated, direct operationalization of the CEO-CTO dual role across venture stages, industries, and governance settings.

IV. RESULTS AND DISCUSSION

The reviewed literature suggests that dual strategic and technical control may generate performance benefits, but only under specific conditions. Studies of executive traits suggest that top-level orientation influences both innovation investment and innovation output [6], [7]. Evidence from founder succession and entrepreneurial governance suggests that the concentrated power may become even more and more problematic during the process of organizational scaling [9], [10]. The top-team competence evidence and early-team design evidence show that the effectiveness of the focal executive depends in part on complementary capabilities elsewhere in the organization in the other areas of the organization [11], [12]. Taken together, these findings support a stage-contingent interpretation towards the CEO-CTO role. During formation and first product iteration, the cost of communication can be lowered with a concentrated authority and preserve technically informed intent. The same setup can become a bottleneck in case of scaling unless it is counterbalanced by delegation, role clarification, and enhanced managerial complements.

One of the critical findings of the adjacent studies is the value of direct knowledge transfer between the market judgment and technical judgment. Architecture and strategy are considered to be inseparable in young firms. Product performance, reliability, extensibility and developer experience have as much influence on the market adoption as price or branding. An executive can assess the architectural consequences of execution choices and customer demand which in turn can reduce translation loss that would otherwise take place between the commercial and engineering functions. This helps explain why technically grounded leadership is often associated with greater levels of R&D commitment or greater levels of invention activity [6], [7]. It does not simply reflect enthusiasm for technology. Instead, such technically costly decisions as platform refactoring, tooling investment, or API design, with potentially high but delayed strategic payoffs, are more typically authorized by the leader. At the same time, the literature indicates that the benefit declines as the growth increases to require more coordination outside the engineering core, especially as the number of products to be dealt with increases or as the number of external dependencies increases [18].

Managerial competence surrounding the focal executive is also important. According to the article by Kor, competence of the top management based on experience is useful in attaining long-term growth [11]. Similar results were demonstrated by Beckman, Burton, and O'Reilly, who indicated that initial team structure has an impact on the venture legitimacy and financing patterns [12]. The implication of the dual CEO-CTO role is that the technical centrality is not

necessarily an issue, but complementary executive authority remains underdeveloped. Even when a chief executive is involved in the product, the arrangement can still be effective when commercial, financial, and organizational functions are led by trusted and capable deputies. When compared to this, a technical founder that takes control of fundraising, sales growth, architecture, staffing, and culture-making can develop an organization optimized for short-term speed in the short term but one that is susceptible to stalling and concentrating decision-making in the future. This distinction also adds to the analysis of conflicting outcomes of the literature on founder-governance. Founder continuity can be an advantage in some companies whereas it might be necessary in other companies to have succession or greater executive differentiation [9], [10].

These findings emerge from diverse research designs, and diversity affects interpretation. Table 2 gives a comparison of methodological approaches of the reviewed literature. The main advantage of archival research is its broader generalizability across firms and industries over the firm and the industry, but the role enactment is usually deduced based on the crude indicators of the tenure, background or the governance structure. More fine-grained mechanisms are revealed by case-based and paradox-oriented research especially to understand how leaders may be able to negotiate conflicting demands but is less generalizable. Cognition-based research sheds light on the adaptation but rarely captures the day-to-day switching between strategic leadership and product-development leadership. This means that the available evidence base is not conclusive but rather indicative of the exact CEO-CTO mix.

Table 2: Method comparison

Ref	Method	Strengths	Limitations
[6]	Archival quantitative study of CEO traits and R&D spending	Broad organizational coverage; direct innovation investment indicator; useful for linking executive profile to resource allocation	R&D intensity is an indirect proxy for hands-on technical leadership; limited visibility into role enactment
[7]	Archival longitudinal analysis of CEO tenure and invention	Captures temporal dynamics and technological dynamism; uses invention-related outcomes	Tenure does not reveal whether the CEO is technically active in product work
[8]	Archival study of founding-team affiliations	Strong imprinting logic; reveals durable effects of early executive backgrounds	Founding affiliations are distant proxies for later executive dual-role behaviour
[9]	Event-history and organizational analysis of founder-CEO succession	Illuminates lifecycle transitions and governance consequences	Focuses on succession events rather than technical engagement intensity
[11]	Archival analysis of top-management-team competence	Connects executive capability to sustained growth; highlights complementarity	Team competence measures do not isolate the combined CEO-CTO configuration
[13]	Qualitative multiple-case study of innovation paradox	Rich mechanism for understanding exploration-exploitation balancing	Context-specific evidence; limited statistical generalization
[16]	Survey and quantitative analysis of exploratory and exploitative innovation	Differentiates innovation modes and organizational antecedents	Organizational-level measures may mask executive-level role effects
[18]	Industry-level longitudinal analysis of ecosystems and interdependence	Strong external-validity contribution; captures ecosystem complexity	Not designed to measure executive role structure directly
[20]	Multi-method evaluation of CEO abilities	Broadens CEO assessment beyond demographics; emphasizes ability configuration	General CEO effectiveness framework lacks direct product-development indicators
[22]	Comparative analysis of cognition and adaptation to technical change	Strong theoretical fit for strategic-technical role integration	Adaptation outcomes reflect multiple organizational factors beyond the focal executive
[23]	Contingency analysis of COO role design	Useful analogy for executive role differentiation and complementarity	Focuses on COO structure rather than CTO integration

This becomes clearer when the findings are compared across systems, metrics, and outcomes. These contrasts are summarized in Table 3. The table indicates that gains related to innovation in relation to technical leadership are likely to manifest themselves in the form of R&D intensity, invention, strategic adaptation, or speed-related processes, and governance-related costs manifest themselves in the form of succession difficulty, scaling friction, or structural imbalance. This distinction is important because it guards against overly simplistic conclusions. The dual role is not inherently better or worse. Its value is determined by the issue that the company is attempting to address, the maturity of the organization and the presence of complementary executive capacity.

Table 3: Results Comparison

Ref	System	Metric	Outcome
[6]	Public firms with observable CEO characteristics	R&D spending intensity	Executive profile is associated with innovation investment differences
[7]	Firms facing varying technological dynamism	Invention output	CEO tenure effect is contingent on technological environment
[9]	Founder-led ventures during leadership transition	Founder succession timing	Continued founder control can become maladaptive during later growth stages
[11]	Growing firms with varied executive competence	Sustained growth	Top-team competence supports durable expansion under complexity
[12]	Early-stage venture teams	VC financing and public-market transition	Balanced early-team composition improves external legitimacy outcomes
[14]	Organizations pursuing exploratory and exploitative activity	Ambidexterity dimensions and performance	Balanced dual innovation modes can create synergistic effects
[16]	Firms with different innovation antecedents	Exploratory innovation, exploitative innovation, performance	Environmental conditions moderate the value of each innovation mode
[18]	Innovation ecosystems with technological interdependence	Firm performance across technology generations	External interdependence conditions innovation returns
[19]	Organizations in dynamic environments	Efficiency-flexibility balance and performance	High performance depends on balancing disciplined execution with adaptability
[20]	CEO labour-market and performance contexts	CEO abilities and firm outcomes	Executive effectiveness is multi-attribute, not trait-specific
[23]	Top-management-team role design contexts	Strategic fit of second-in-command structure	Executive-role complementarity alters the value of concentrated authority

Another common finding in the literature is that the chief executive should most often be technically immersed in situations where product architecture continues to be the main strategic bottleneck. It happens in the case of founding, platform redesign, or times of technological discontinuity. Tripsas and Gavetti showed that the question of cognition is a very important issue in the technological transition [5]. Later Eggers and Kaplan demonstrated that renewal due to technical change is a manifestation of the cognition of leaders and the conditions within the organization [22]. These results help to substantiate one of the main hypotheses of the current topic: operational technical engagement at the top is particularly beneficial when firms must interpret weak signals in contexts where routines are not yet established. The absence of alignment between technology and strategy may also hinder adaptation at times such as this as strategic decisions cannot be checked out of context of the underlying system architecture. The risk, however, is that continued immersion beyond routine maturity may lock the firm into an executive-centered model that will not make an investment in scalable process and product management infrastructure and engineering leadership depth.

Ambidexterity literature is another helpful corrective to the romantic founder-led technical leadership literature. Andriopoulos and Lewis noted that paradox management is actively practiced as opposed to compromise [13]. Cao, Gedajlovic, and Zhang revealed that performance is implied in different ways by some dimensions of ambidexterity [14]. According to Smith, Binns, and Tushman, leaders who have to deal with multifaceted business models have to hold

contradictory commitments at the same time [15]. The findings can be applied to the CEO-CTO role and that means that the best leaders are not necessarily involved in all the technical decisions. Rather, it seems that successful dual-role enactment is about selective immersion, i.e., going into product work when architecture, platform integrity, or discontinuity demand top-level intervention, and then withdraw once the issue can be managed by competent technical subleaders. That is, the literature supports disciplined oscillation as compared to unvarying technical centralization.

The time distribution of the review corpus is shown in Figure 2. The figure shows that academic interest, which is applicable to the issue of the CEO-CTO, began to pick up steam in 2000 and has been especially active in 2005-2009. This tendency supports the point that the topic of the subject is intellectually developed enough to be the object of integrative review, although direct empirical examination of the combined CEO-CTO role remains limited.

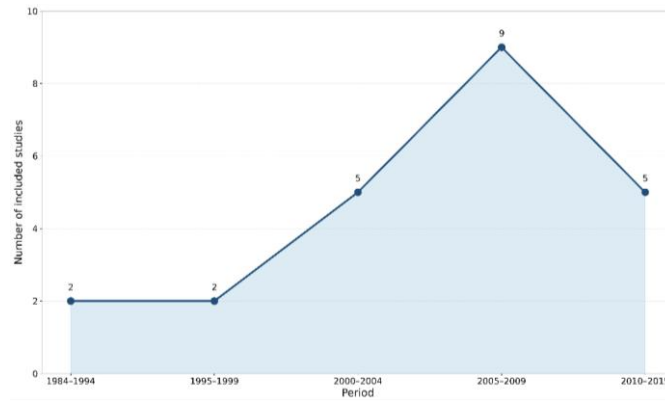


Figure 2: Publication Trend in the Review Corpus

Figure 2 does not purport to show growth in direct CEO-CTO studies as such, but instead, the figure reflects the growth of surrounding peer-reviewed studies on executive cognition, founder control, and ambidexterity and innovation governance that shape the subject. The advantage of the curve is that it shows a robust foundation of theory and research in addition to shedding light on the lack of an empirical stream dedicated to the specific dual-role set-up.

The key relationships reported in the literature are mapped in Figure 3. The positive pathways between role integration and speed, coherence and technical credibility, and the negative pathways between the same integration and overload, bottlenecks and delayed specialization exist. The figure aids the discussion to demonstrate why it is possible to have conflicting empirical observations and yet not be inconsistent. Different studies capture different mechanisms under different conditions.

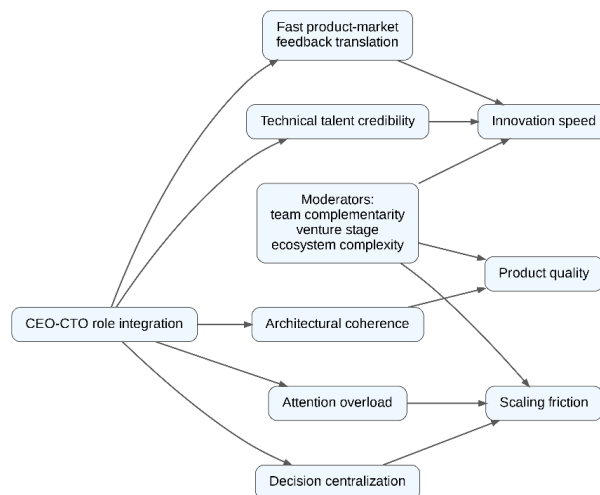


Figure 3: Relationship Diagram for Reported Mechanisms

One last integrative measure is to determine under what circumstances a dual CEO-CTO structure is likely to be positive. Figure 4 shows a stage-sensitive model that integrates the fundamental results of the review. According to the model, the combined role is most beneficial to firms in high-uncertainty periods where architecture-weight decisions are necessary, and in scaling periods where firms maintain value by making more delegation decisions, enhancing complementary executives and codifying technical governance. This model serves to strengthen the overall finding that the role needs to change as the organization matures and does not stand still.

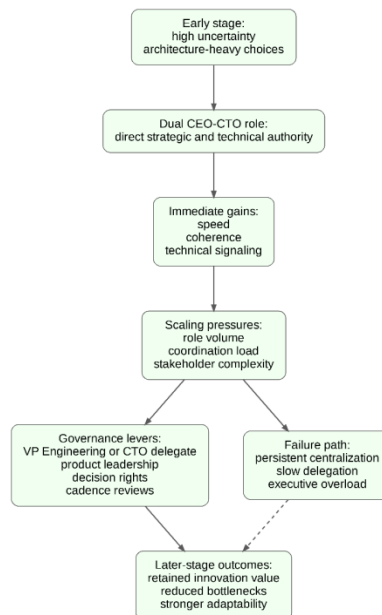


Figure 4: Integrated Model of Stage-Contingent CEO-CTO Effectiveness

Overall, the reviewed studies can be synthesized to illuminate the CEO-CTO dual role. This arrangement appears most effective when it addresses a real coordination problem between strategy and product development rather than merely reflecting founder preference or title concentration. It creates value by tightening the link between strategic judgment and technical decision-making, accelerating learning, and strengthening technical credibility. At the same time, it can generate executive overload, delayed specialization, governance opacity, and organizational bottlenecks. The most defensible reading of the literature is therefore contingent: role integration appears especially valuable in early-stage or discontinuous contexts but becomes more difficult to sustain as organizational complexity increases.

V. FUTURE DIRECTIONS

Future research should not rely solely on proxy measures of the dual CEO-CTO position but should directly identify and measure it. The existing evidence is mostly based on the founder status, technical education, CEO tenure, R&D intensity or team composition. The variables help shed light on neighboring questions, but do not show how frequently chief executives intervene directly in technical decisions, which decisions are centralized and how role boundaries change over time. The information on the executive biography, history of titles, engineering organization scheme, governance disclosures and digital traces of involvement in product decisions would make an empirical agenda stronger. These designs would be able to differentiate between symbolic technical legitimacy and actual hands-on authority and would help to test the hypothesis whether the intensity of dual-role involvement declines gradually, abruptly, or cyclically across venture stages.

The second priority is the development of time- and process-sensitive research designs. The research that is available indicates that role concentration can perform especially well during founding and technological discontinuity, but it becomes increasingly risky as the company expands [9], [22]. This proposition should be tested using longitudinal designs. Multi-wave designs would be able to see the leadership structure in the periods before and after major events like platform rewrites, expansion of a product category, regulatory shocks, security incident or financing transitions. The process data would also help explain how successful leaders manage the tension by delegating formally, using architectural governance routines, implementing more product management or appointing a later-stage technical counterpart. The question of the dual role itself is not the most important, but the development of the dual role and the processes that can allow firms to reconfigure or exit the dual role without sacrificing innovation speed.

Interdisciplinary integration is a third direction in strategy, entrepreneurship, software engineering management, organizational behavior and innovation studies. The current literature has a wealth of adjacent theory but is measurement fragmented. Software engineering research can be used to get information on the complexity of the architecture, deployment rate, defect rates or even technical debt. Constructs that can be added to the research on strategy include ecosystem, dynamic capabilities and competitive timing. Entrepreneurship research can contribute venture-stage sensitivity and identity-related insights. Organizational behavior research can shed light on role conflict, cognitive load, and delegation quality. By uniting these streams, it would be possible to have multi-level models where executive role structure is not only related to broad firm outcomes, but also to technical-process outcomes that mediate the broad firm outcomes.

A final research priority concerns heterogeneity. The value of the CEO-CTO arrangement is unlikely to be uniform across the product structures, industry clock speeds, financing structures, or regulatory structures. Highly interdependent platform companies may require early role differentiation in comparison to highly-focused infrastructure start-ups. The long-term executive technical control of the mission-critical products may remain beneficial for longer than the consumer products with modular experiments. Board structure, investor time horizon as well as availability of engineering talent capable of assuming leadership positions can also determine the best role-integration time. Such contingencies could be modelled with comparative designs in the future instead of trying to find an average effect of treatment. The most likely outcome of this kind of work is a more narrowly focused, stage-contingent theory of when, how and how long the dual strategic and technical leadership boosts the performance of the organization.

VI. CONCLUSION

The literature review suggests that the CEO-CTO dual role can be understood as a contingent response to the strategic centrality of product architecture. Strategic and technical authority can be combined in situations where the technical design and competitive positioning are closely related to each other, which can accelerate organizational learning, maintain the architectural intent, and enhance the quality of judgment about innovation. This value is particularly pronounced at the time of founding when the product is in an early stage of development and during periods of technological discontinuity.

At the same time, the evidence also points to clear limits. Role concentration can bring about fragmentation of attention, decision-making bottlenecks, governance opacity, and delayed executive specialization. External coordination burdens and internal complexity tend to increase substantially beyond the capacity of a single executive to handle both strategy-level and hands-on product development. This role therefore becomes more challenging to uphold without strong complementary executives and meaningful delegation.

What makes the review academically significant is that the related evidence is organized in one place to explain why the dual role can produce strong outcomes in some contexts but weaker outcomes in others. The studies of executive traits, founder governance, ambidexterity, cognition, and ecosystems converge on a common insight: the quality of outcomes is shaped more by organizational stage, complexity, and structure than by title alone.

Persistent gaps remain. Combined CEO-CTO power is rarely directly measured; longitudinal data remain limited and technical-process measures are rarely related to executive role design. Nonetheless, the field is now sufficiently developed to support a more focused future research agenda. The most promising direction is a developmental theory in which strategic-technical integration generates early advantages and is later reconfigured as the firm matures.

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VII. REFERENCES

- [1] D. C. Hambrick and P. A. Mason, Upper echelons: The organization as a reflection of its top managers, *Academy of Management Review*. 9(2) (1984) 193-206.
- [2] J. G. March, Exploration and exploitation in organizational learning, *Organization Science*. 2(1) (1991) 71-87.
- [3] M. L. Tushman and C. A. O'Reilly III, Ambidextrous organizations: Managing evolutionary and revolutionary change, *California Management Review*. 38(4) (1996) 8-30.
- [4] W. Ocasio, Towards an attention-based view of the firm, *Strategic Management Journal*. 18(S1) (1997) 187-206.
- [5] M. Tripsas and G. Gavetti, Capabilities, cognition, and inertia: Evidence from digital imaging, *Strategic Management Journal*. 21(10-11) (2000) 1147-1161.
- [6] V. L. Barker III and G. C. Mueller, CEO characteristics and firm R&D spending, *Management Science*. 48(6) (2002) 782-801.
- [7] S. Wu, E. Levitas and R. L. Priem, CEO tenure and company invention under differing levels of technological dynamism, *Academy of Management Journal*. 48(5) (2005) 859-873.
- [8] C. M. Beckman, The influence of founding team company affiliations on firm behaviour, *Academy of Management Journal*. 49(4) (2006) 741-758.
- [9] N. Wasserman, Founder-CEO succession and the paradox of entrepreneurial success, *Organization Science*. 14(2) (2003) 149-172.
- [10] C. M. Daily and D. R. Dalton, The relationship between governance structure and corporate performance in entrepreneurial firms, *Journal of Business Venturing*. 7(5) (1992) 375-386.
- [11] Y. Y. Kor, Experience-based top management team competence and sustained growth, *Organization Science*. 14(6) (2003) 707-719.
- [12] C. M. Beckman, M. D. Burton and C. O'Reilly, Early teams: The impact of team demography on VC financing and going public, *Journal of Business Venturing*. 22(2) (2007) 147-173.
- [13] C. Andriopoulos and M. W. Lewis, Exploitation-exploration tensions and organizational ambidexterity: Managing paradoxes of innovation, *Organization Science*. 20(4) (2009) 696-717.
- [14] Q. Cao, E. Gedajlovic and H. Zhang, Unpacking organizational ambidexterity: Dimensions, contingencies, and synergistic effects, *Organization Science*. 20(4) (2009) 781-796.
- [15] W. K. Smith, A. Binns and M. L. Tushman, Complex business models: Managing strategic paradoxes simultaneously, *Long Range*

Planning. 43(2-3) (2010) 448-461.

- [16] J. J. P. Jansen, F. A. J. Van den Bosch and H. W. Volberda, Exploratory innovation, exploitative innovation, and performance: Effects of organizational antecedents and environmental moderators, *Management Science*. 52(11) (2006) 1661-1674.
- [17] S. Raisch and J. Birkinshaw, Organizational ambidexterity: Antecedents, outcomes, and moderators, *Journal of Management*. 34(3) (2008) 375-409.
- [18] R. Adner and R. Kapoor, Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations, *Strategic Management Journal*. 31(3) (2010) 306-333.
- [19] K. M. Eisenhardt, N. R. Furr and C. B. Bingham, Microfoundations of performance: Balancing efficiency and flexibility in dynamic environments, *Organization Science*. 21(6) (2010) 1263-1273.
- [20] S. N. Kaplan, M. M. Klebanov and M. Sorensen, Which CEO characteristics and abilities matter?, *Journal of Finance*. 67(3) (2012) 973-1007.
- [21] C. E. Helfat and M. A. Peteraf, Managerial cognitive capabilities and the microfoundations of dynamic capabilities, *Strategic Management Journal*. 36(6) (2015) 831-850.
- [22] J. P. Eggers and S. Kaplan, Cognition and renewal: Comparing CEO and organizational effects on incumbent adaptation to technical change, *Organization Science*. 20(2) (2009) 461-477.
- [23] J. J. Marcel, Why top management team characteristics matter when employing a chief operating officer: A strategic contingency perspective, *Strategic Management Journal*. 30(6) (2009) 647-658.