Automated System for Validating Beneficiaries and Safeguarding Government Resources

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ABSTRACT Government welfare programs and resource distribution initiatives often face challenges related to fraudulent claims, inefficiencies, and misallocation of funds due to manual beneficiary validation processes. To address these issues, an automated system for validating beneficiaries and safeguarding government resources is essential. This system leverages advanced technologies such as artificial intelligence (AI), machine learning (ML), and biometric authentication to enhance accuracy, security, and efficiency. By integrating real-time data verification, cross-referencing with government databases, and AI- driven fraud detection mechanisms, the system significantly reduces the risk of unauthorized claims and ensures that resources reach the intended recipients. Additionally, automation minimizes human errors, accelerates processing times, and enhances transparency in public service delivery. This research explores the architecture, implementation, and impact of such an automated system, highlighting its role in improving governance, optimizing resource allocation, and preventing financial losses due to fraudulent activities. The study further discusses challenges in system adoption, including data privacy concerns and technological integration, and suggests future advancements for better scalability and effectiveness.

INDEX TERMS Digital government, digital transformation, government resource validation, biometric authentication.

I. INTRODUCTION

With the Governments worldwide implement welfare programs to support vulnerable populations, but the effectiveness of these initiatives is often compromised by fraudulent claims, identity duplication, and inefficient manual verification processes. Traditional beneficiary validation methods rely on paperwork and human oversight, making them susceptible to errors, corruption, and delays. As a result, unauthorized individuals may receive benefits, while deserving recipients face obstacles in accessing essential resources. To address these challenges, an automated system for validating beneficiaries and safeguarding government resources is crucial. By integrating artificial intelligence (AI), machine learning (ML), and biometric authentication, this system enhances accuracy, efficiency, and security in the validation process. AI-driven fraud detection mechanisms can analyze vast datasets, identify suspicious patterns, and flag discrepancies in real time. Biometric verification, such as facial recognition and fingerprint scanning, ensures that only eligible beneficiaries receive aid, eliminating duplicate or false identities. Additionally, automation significantly reduces administrative costs, minimizes human intervention, and accelerates the processing time for benefit disbursement. This study explores the design and implementation of an automated beneficiary validation system, emphasizing its role in improving governance, optimizing resource allocation, and reducing financial losses. Furthermore, it discusses the challenges associated with adopting such technology, including data privacy concerns, system integration with existing databases, and the need for policy frameworks to regulate its use. By addressing these issues, governments can enhance transparency, accountability, and efficiency in social welfare programs, ensuring that resources reach those who need them most.

Ensuring that government resources are allocated to the right beneficiaries is crucial for the effectiveness and integrity of social welfare programs. An automated system for validating beneficiaries helps streamline the verification process, reducing fraud, errors, and misallocation of funds. By utilizing technologies such as biometric authentication, artificial intelligence, and database cross-checking, these systems enhance accuracy and efficiency in identifying eligible individuals. Automation not only minimizes manual intervention but also strengthens accountability, transparency, and data security in resource distribution. Implementing such a system enables governments to safeguard public funds, improve service delivery, and ensure that assistance reaches those who genuinely need it.

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II. EXISTING SYSTEM

Several governments worldwide have implemented automated systems to validate beneficiaries and safeguard public resources by preventing fraud, errors, and duplication in social welfare programs. For instance, India's Aadhaar- based Direct Benefit Transfer (DBT) system uses biometric authentication to verify beneficiaries before disbursing funds, reducing leakages and ensuring that subsidies reach the intended recipients. Similarly, the United States employs automated data-matching systems in programs like Medicaid and SNAP to cross-check beneficiary information with tax records, employment databases, and social security data. In Nigeria, the National Social Safety Net Program (NASSP) utilizes digital identity verification and data analytics to authenticate beneficiaries and prevent ghost enrollments. These systems leverage artificial intelligence, blockchain, and big data to enhance transparency, efficiency, and accountability in government resource distribution. Several countries have successfully implemented automated systems to validate beneficiaries and safeguard government resources, reducing fraud, errors, and inefficiencies in social welfare programs. India's Aadhaar-enabled Direct Benefit Transfer (DBT) system is one of the largest biometric-based authentication programs, linking government subsidies and welfare payments to a unique identification number, ensuring funds reach the rightful recipients while preventing duplication and identity fraud. The United States employs multiple automated systems, such as the Social Security Administration (SSA), Medicaid, and Supplemental Nutrition Assistance Program (SNAP), which use data-matching technologies to cross-verify beneficiary details with tax, employment, and financial records, reducing fraudulent claims and improper payments. The United Kingdom's National Fraud Initiative (NFI) utilizes data analytics and artificial intelligence to detect fraudulent benefit claims by matching records from multiple public sector agencies, enhancing efficiency and reducing losses. Similarly, Brazil's Bolsa Família program uses an integrated database to verify household income and eligibility, ensuring that financial assistance is provided only to low-income families, preventing resource misallocation. Nigeria's National Social Safety Net Program (NASSP) and the Bank Verification Number (BVN) system use digital identity verification and biometric data to eliminate ghost beneficiaries and ensure direct cash transfers to vulnerable citizens. South Africa's SASSA (South African Social Security Agency) employs biometric authentication for social grant distributions, minimizing fraud and ensuring benefits reach the intended recipients. In Kenya, the Huduma Namba system centralizes citizen data to streamline public service access, preventing duplicate registrations and reducing misuse of government funds. Additionally, China's Social Credit System integrates digital identity verification and big data analytics to track and verify social benefits distribution, ensuring compliance and reducing fraudulent activities. Estonia's e-Governance system uses blockchain technology for secure digital identity verification, allowing seamless and transparent access to government services while preventing identity fraud. Singapore's Sing Pass system provides citizens with a secure digital identity, ensuring efficient verification of eligibility for various government programs. These systems demonstrate how automation, artificial intelligence, biometrics, and secure databases can strengthen public welfare initiatives, improve resource allocation, and enhance transparency. As more countries embrace these technologies, the efficiency of social programs will continue to improve, ensuring that government resources are effectively safeguarded while benefiting the right individuals. One of the most comprehensive systems is India's Aadhaar-enabled Direct Benefit Transfer (DBT), which links social welfare programs to a biometric-based national identity system. This ensures that subsidies and financial aid reach only verified individuals, reducing fraud and ghost beneficiaries. Similarly, the United States' Social Security Administration (SSA), Medicaid, and Supplemental Nutrition Assistance Program (SNAP) employ automated cross-

verification with tax, employment, and banking records to prevent fraudulent claims and unauthorized payments. These automated systems showcase how governments worldwide are leveraging technology to strengthen accountability, reduce fraud, and optimize public resource allocation. As digital transformation continues, more countries are adopting innovative solutions to improve beneficiary validation and enhance the efficiency of social welfare programs. Pakistan's Ehsaas Program utilizes artificial intelligence and geotagging to verify and distribute cash transfers efficiently, ensuring that aid reaches underprivileged families while preventing duplication. In Rwanda, the Ubudehe categorization system classifies households based on socioeconomic status using data analytics, ensuring that government assistance is distributed fairly.

III. PROPOSEDSYSTEM

An Automated System for Validating Beneficiaries and Safeguarding Government Resources is designed to ensure that public funds and welfare programs reach only eligible individuals while preventing fraud and resource misallocation. This system integrates biometric verification, identity validation, and document authentication to confirm the legitimacy of beneficiaries. By linking with national databases such as tax records, social security, and voter registration, it ensures real-time updates and eliminates duplicate entries. Advanced AI and machine learning algorithms detect anomalies, fraudulent applications, and suspicious transactions, enhancing fraud prevention. The system streamlines decision-making through rule-based automated approvals, while complex cases are flagged for manual review. Additionally, it employs secure digital payment methods, such as direct bank transfers and mobile wallets, ensuring that funds reach the intended recipients without intermediaries. Blockchain technology can further enhance transparency by creating tamper-proof transaction records. Robust audit and compliance management features generate automated reports and ensure adherence to legal frameworks. By reducing fraud, improving efficiency, and increasing transparency, this system safeguards government resources while enhancing service delivery to genuine beneficiaries.

One of the key features of this system is its fraud detection and prevention mechanisms, which use artificial intelligence (AI) and machine learning (ML) algorithms to analyze data, identify inconsistencies, and flag suspicious activities. For instance, the system can detect multiple registrations under different names but using the same biometric data, ensuring that fraudulent attempts are blocked. Additionally, geo- tagging and real-time location tracking help confirm that beneficiaries reside in eligible areas, preventing unauthorized access to benefits. The system also employs automated decision-making through predefined eligibility criteria, allowing for quick approvals and rejections. In cases where anomalies are detected, the system escalates them for further human review, ensuring both efficiency and accuracy in decision-making. To further safeguard government resources, the system integrates secure and transparent disbursement mechanisms such as direct bank transfers and digital wallets, eliminating the need for intermediaries and reducing the risk of fund diversion. Blockchain technology can be incorporated to create immutable transaction records, ensuring transparency and preventing tampering. Automated notifications keep beneficiaries informed about their application status, approvals, or required actions, reducing manual intervention and delays. This system employs multiple layers of verification, including biometric authentication (fingerprint, facial recognition, or iris scans), identity validation through national databases, and automated document verification to confirm eligibility. By integrating with various government systems, such as tax records, social security databases, and other welfare programs, it creates a centralized and real-time updated database that prevents duplicate registrations and unauthorized claims.

These reports assist government agencies in monitoring program effectiveness and ensuring adherence to legal and policy guidelines. Access to the system is also strictly controlled, with role-based permissions granted to authorized personnel only, further enhancing data security. By implementing such an automated system, governments can significantly reduce fraud, improve efficiency, and enhance transparency in social welfare programs

IV. LITERATURE REVIEW

An automated system for validating beneficiaries and safeguarding government resources has been widely explored in literature as a critical tool for ensuring transparency, efficiency, and accountability in public service delivery. Studies highlight the significance of digital identity verification, biometrics, artificial intelligence (AI), and block chain technology in mitigating fraud, identity theft, and unauthorized access to government welfare programs. Researchers emphasize that automated beneficiary validation systems reduce human errors, enhance data accuracy, and streamline resource allocation by verifying eligibility in real- time. Additionally, literature points to the integration of machine learning algorithms and big data analytics in detecting anomalies, flagging suspicious activities, and ensuring compliance with policy guidelines. Several case studies demonstrate the effectiveness of such systems in reducing leakages in social protection programs, improving service delivery speed, and fostering trust between governments and citizens. However, researchers also raise concerns about data privacy, cybersecurity threats, and potential exclusion of marginalized groups due to technical limitations or lack of digital literacy. Overall, literature underscores the need for a balanced approach that leverages automation while ensuring inclusivity, ethical considerations, and regulatory compliance. The implementation of an automated system for validating beneficiaries and safeguarding government resources has been extensively studied as a means to enhance public sector efficiency and prevent fraudulent activities. Literature emphasizes the role of emerging technologies such as Machine learning, block chain, and biometric authentication in ensuring accurate identification and verification of beneficiaries. Studies reveal that traditional manual verification methods are prone to errors, manipulation, and delays, leading to inefficiencies and financial losses. Automated systems, on the other hand, leverage machine learning algorithms and data analytics to cross-check beneficiary information across multiple databases, ensuring real-time validation and reducing redundancy. Research also highlights the benefits of integrating geospatial analysis and remote sensing technologies to verify the physical presence and eligibility of beneficiaries in specific locations, particularly in rural and hard-to-reach areas. Furthermore, scholars discuss the importance of interoperability between different government agencies to create a unified, secure, and transparent database that minimizes duplication and fraudulent claims. Despite these advantages, literature also addresses challenges such as cybersecurity risks, ethical concerns regarding data privacy and the digital divide that may exclude certain vulnerable populations from accessing automated services. To address these challenges, researchers propose a hybrid approach that combines automation with human oversight, strong policy frameworks, and user-friendly digital literacy programs.

V. MODULES USED

An Automated System for Validating Beneficiaries and Safeguarding Government Resources can be designed with several key modules to ensure efficient validation, fraud prevention, and secure resource distribution. Below are the essential modules for such a system:

1. User Registration & Identity Verification Module

Captures beneficiary details, including biometric data (fingerprints, facial recognition, iris scan). Verifies identity using government-issued IDs, tax records, or civil registration databases. Implements two-factor authentication (OTP, email, or biometric validation).

2. Eligibility Assessment & Means Testing Module

Cross-checks financial records, employment status, and social security data to determine eligibility. Uses AI to analyze income levels, dependents, and location-based eligibility criteria. Automates periodic re-evaluation to prevent ineligible individuals from continuing to receive benefits.

3. Fraud Detection & Risk Management Module

Uses machine learning to detect anomalies such as duplicate registrations, fake identities, or exaggerated claims. Flags suspicious activities like multiple registrations from the same household or sudden account changes. Provides real-time alerts to authorities for investigation and fraud prevention.

4. Data Integration & Cross-Verification Module

Integrates with national databases (tax, banking, social welfare, and healthcare) for real-time validation. Uses block chain to ensure data integrity and prevent tampering or duplication. Conducts geo-tagging and residency verification to ensure only eligible citizens receive benefits.

5. Secure Disbursement & Payment Management Module

Manages benefit distribution through direct bank transfers, mobile wallets, or digital vouchers. Implements token-based or QR code authentication for secure transactions. Tracks and logs all transactions to prevent unauthorized access and misuse of funds.

6. Monitoring & Reporting Module

Provides real-time dashboards for government officials to track beneficiary numbers, fund usage, and fraud trends. Generates periodic reports on program performance, compliance, and policy impact.
Uses predictive analytics to improve resource allocation and future decision-making.

7. User Support & Grievance Redressal Module

Offers a self-service portal for beneficiaries to check eligibility status, update details, and submit grievances. Provides chat bots and AI-based assistants for real-time support.

8. Beneficiary Validation Modules

Identity Verification – Uses biometrics, national ID, or other means to confirm the beneficiary's identity. Eligibility Assessment – Cross-checks income, employment status, and other criteria against government databases. Duplicate Detection – Prevents multiple registrations using AI and fuzzy matching techniques.

9. Data Security & Fraud Prevention Modules

Fraud Detection & Risk Analysis – Uses AI/ML to flag suspicious activities. Audit & Compliance Tracking – Logs actions for accountability and regulatory compliance. Secure Data Encryption – Ensures sensitive information is encrypted and protected.

10. Integration & Data Management Modules

Inter-Agency Data Sharing – Connects with other government databases (e.g., tax, health, social welfare). Real-Time Data Processing – Provides instant validation and approvals. Data Analytics & Reporting – Generates insights for decision-making and policy formulation.

11. User & Stakeholder Modules

Beneficiary Self-Service Portal – Allows beneficiaries to check their status and update details. Government Officer Dashboard – Enables officials to review, approve, and monitor applications. Communication & Notification System – Sends SMS, emails, or app notifications for updates.

12. Resource Allocation & Monitoring Modules

Fund Disbursement & Tracking – Ensures rightful beneficiaries receive allocated resources. Supply Chain & Inventory Monitoring – Tracks distribution of non- monetary benefits (e.g., food aid, medical supplies). Performance & Impact Assessment – Measures program effectiveness and beneficiary impact.

VI. FLOW CHART

This flowchart represents an Automated System for Validating Beneficiaries and Safeguarding Government Resources. It outlines the process of verifying and approving beneficiaries for government assistance while ensuring transparency and security. Here's a step-by-step explanation:

1. Start – The system begins the process of validating a beneficiary.
2. Gather Data – Collects relevant data from the applicant, including personal details and supporting documents.
3. Verify Identity & Receive Beneficiary Data – The system checks the applicant's identity using national databases, biometrics, or other verification methods.
4. Check Eligibility – The system evaluates whether the applicant meets the predefined eligibility criteria for government benefits.
5. Decision Making – The system performs Identity Verification – Confirms the applicant's identity. Eligibility Check – Ensures the applicant qualifies based on program rules. Fund Approval – Determines if the applicant is eligible for financial or resource allocation.
6. Output (Validation Results) – The system processes the results:

Terminate Invalid Accounts – Removes fraudulent or ineligible applicants. Monitor Performance – Tracks the efficiency and impact of the system.

7. Approve or Reject – The system finalizes the decision, either approving or rejecting the application based on validation results.

8. Stop – The process ends after approval or rejection.

VII. OUTPUT

An Automated System for Validating Beneficiaries and Safeguarding Government Resources is a cutting-edge solution designed to enhance the integrity, efficiency, and transparency of government welfare programs. The system automates the process of verifying beneficiaries, ensuring that only eligible individuals receive financial aid, subsidies, or other government support. By integrating with national databases, biometric authentication, and artificial intelligence, it minimizes errors, prevents fraudulent claims, and optimizes resource distribution.

The system operates by collecting and analyzing beneficiary data, verifying identity through secure authentication methods, and assessing eligibility based on predefined government criteria. It cross-references applicant details with existing databases to detect duplicate registrations, incorrect information, or attempts at fraud. If discrepancies are found, the system automatically flags or rejects the application. If approved, funds or benefits are disbursed securely, reducing delays and manual intervention.

A key feature of the system is its ability to continuously monitor beneficiary accounts, ensuring that individuals remain eligible over time. It automatically detects changes in financial status, employment, or other critical factors and takes necessary actions, such as suspending or terminating ineligible accounts. Additionally, it generates detailed reports for policymakers, providing valuable insights into program effectiveness, fund utilization, and areas for improvement.

By implementing this system, governments can significantly reduce financial losses due to fraud, streamline beneficiary management, and enhance public trust in social welfare programs. It also improves service delivery by offering beneficiaries a seamless application process, real-time status updates, and secure access to their records. Ultimately, this automated approach ensures that government resources are allocated efficiently, benefiting those who truly need assistance while maintaining transparency and accountability in public service programs.

CONCLUSIONS

The implementation of an automated system for validating beneficiaries and safeguarding government resources is a crucial step toward ensuring transparency, efficiency, and accountability in public service delivery. By leveraging technologies such as artificial intelligence (AI), machine learning (ML), blockchain, and biometric verification, governments can significantly reduce fraud, corruption, and resource misallocation. An automated system streamlines the verification process by cross-referencing beneficiary data with national databases, detecting duplicate or fraudulent claims, and ensuring that only eligible individuals receive government aid or benefits. This not only enhances operational efficiency but also minimizes human errors, bureaucratic delays, and opportunities for manipulation. Furthermore, safeguarding government resources through automation ensures that funds and services are directed toward their intended purpose, promoting social equity and economic stability. A well-designed system fosters public trust by demonstrating fairness and accountability in resource distribution. In conclusion, adopting an automated system for beneficiary validation is a transformative solution that strengthens governance, prevents financial leakages, and maximizes the impact of public welfare programs. It is a necessary step toward building a more transparent and efficient government that effectively serves its citizens. The Automated Beneficiary Validation and Fraud Prevention System is a transformative solution that enhances the efficiency, transparency, and security of social security fund disbursements.

By leveraging real-time integration with death registration databases, Aadhaar authentication, and digital life certification, the system ensures that only eligible beneficiaries receive payments, preventing fraudulent claims and unauthorized fund transfers.

This approach not only safeguards government resources but also promotes transparency and public trust in welfare initiatives

REFERENCES

[1] A. Omar, V. Weerakkody, and A. Daowd, ‘‘Studying transforma- tional government: A review of the existing methodological approaches and future outlook,’’ *Government Inf. Quart.*, vol. 37, Apr. 2020, Art. no. 1014582020, doi: 10.1016/j.giq.2020.101458.

[2] S. Lee-Geiller and T. Lee, ‘‘Using government websites to enhance democratic e-governance: A conceptual model for evaluation,’’ *Gov- ernment Inf. Quart.*, vol. 36, no. 2, pp. 208–225, Apr. 2019, doi: 10.1016/j.giq.2019.01.003.

[3] A. Alvarenga, F. Matos, R. Godina, and J. C. O. Matias, ‘‘Digital transfor- mation and knowledge management in the public sector,’’ *Sustainability*, vol. 12, no. 14, p. 5824, Jul. 2020, doi: 10.3390/su12145824.

[4] Y. Gong, J. Yang, and X. Shi, ‘‘Towards a comprehensive understand- ing of digital transformation in government: Analysis of flexibility and enterprise architecture,’’ *Government Inf. Quart.*, vol. 37, no. 3, Jul. 2020, Art. no. 101487, doi: 10.1016/j.giq.2020.101487.

[5] S. Curtis, ‘‘Digital transformation—The silver bullet to public service improvement?’’ *Public Money Manag.*, vol. 39, no. 5, pp. 322–324, May 2019, doi: 10.1080/09540962.2019.1611233.

[6] P. C. Verhoef, T. Broekhuizen, Y. Bart, A. Bhattacharya, J. Qi Dong, N. Fabian, and M. Haenlein, ‘‘Digital transformation: A multidisciplinary reflection and research agenda,’’ *J. Bus. Res.*, vol. 122, pp. 889–901, Jan. 2021, doi: 10.1016/j.jbusres.2019.09.022.

[7] J. R. Gil-Garcia and M. Flores-Zuniga, ‘‘Towards a comprehensive understanding of digital government success: Integrating implementation and adoption factors,’’ *Government Inf. Quart.*, vol. 37, no. 4, 2020, Art. no. 101518, doi: 10.1016/j.giq.2020.101518.

[8] I. Mergel, ‘‘Digital service teams in government,’’ *Government Inf. Quart.*, vol. 36, no. 4, Oct. 2019, Art. no. 101389, doi: 10.1016/j.giq.2019.07.001.

[9] D. J. Teece, G. Pisano, and A. Shuen, ‘‘Dynamic capabilities and strategic management,’’ *Strategic Manag. J.*, vol. 18, no. 7, pp. 509–533, Aug. 1997.

[10] K. M. Eisenhardt and J. A. Martin, ‘‘Dynamic capabilities: What are they?’’ *Strateg. Manag. J.*, vol. 21, nos.

10–11, pp. 1105–1121, Dec. 2000, doi: 10.1002/1097-0266(200010/11)21:10/11<1105::AID- SMJ133>3.0.CO;2-E.

[11] D. J. Teece, ‘‘Explicating dynamic capabilities: The nature and micro- foundations of (sustainable) enterprise performance,’’ *Strategic Manag. J.*, vol. 28, no. 13, pp. 1319–1350, Dec. 2007, doi: 10.1002/smj.640.

[12] C. E. Helfat and M. A. Petrify, ‘‘The dynamic resource-based view: Capability lifecycles,’’ *Strategic Manag. J.*, vol. 24, no. 10, pp. 997–1010, Oct. 2003, doi: 10.1002/smj.332.

[13] A. Karman and A. Savaneviciene, ‘‘Enhancing dynamic capabilities to improve sustainable competitiveness: Insights from research on organisa- tions of the Baltic region,’’ *Baltic J. Manag.*, vol. 16, no. 2, pp. 318–341, Mar. 2021, doi: 10.1108/BJM-08-2020-0287.

[14] E. L. Chen, R. Katila, R. McDonald, and K. M. Eisenhardt, ‘‘Life in the fast lane: Origins of competitive interaction in new vs. established markets,’’ *Strategic Manag. J.*, vol. 31, no. 13, pp. 1527–1547, Dec. 2010, doi: 10.1002/smj.894.

[15] D. J. Teece, ‘‘Dynamic capabilities: Routines versus entrepreneurial action,’’ *J. Manag. Stud.*, vol. 49, no. 8, pp. 1395–1401, Dec. 2012, doi: 10.1111/j.1467-6486.2012.01080.x.

[16] T. O. Salge and A. Vera, ‘‘Small steps that matter: Incremental learning, slack resources and organizational performance,’’ *Brit. J. Manag.*, vol. 24, no. 2, pp. 156–173, Jun. 2013, doi: 10.1111/j.1467-8551.2011.00793.x.

[17] J. Song, K. Lee, and T. Khanna, ‘‘Dynamic capabilities at Samsung: Optimizing internal co-opetition,’’ *California Manag. Rev.*, vol. 58, no. 4,
pp. 118–140, Aug. 2016, doi: 10.1525/cmr.2016.58.4.118.

[18] T. Felin and T. C. Powell, ‘‘Designing organizations for dynamic capabil- ities,’’ *California Manag. Rev.*, vol. 58, no. 4, pp. 78–96. Aug. 2016, doi: 10.1525/cmr.2016.58.4.78.

[19] J.-H. Lim, T. C. Stratopoulos, and T. S. Wirjanto, ‘‘Path dependence of dynamic information technology capability: An empirical investiga- tion,’’ *J. Manag. Inf. Syst.*, vol. 28, no. 3, pp. 45–84, Dec. 2011, doi: 10.2753/MIS0742-1222280302.

[20] J. H. Dunning and S. M. Lundan, ‘‘The institutional origins of dynamic capabilities in multinational enterprises,’’ *Ind. Corporate Change*, vol. 19, no. 4, pp. 1225–1246, Aug. 2010, doi: 10.1093/icc/dtq029.

[21] C. E. Helfat and J. A. Martin, ‘‘Dynamic managerial capabilities: Review and assessment of managerial impact on strategic change,’’
J. *Manag.*, vol. 41, no. 5, pp. 1281–1312, Dec. 2015, doi: 10.1177/0149206314561301.

[22] L.-C. Hsu and C.-H. Wang, ‘‘Clarifying the effect of intellectual cap- ital on performance: The mediating role of dynamic capability,’’ *Brit.*
J. Manag., vol. 23, no. 2, pp. 179–205, Jun. 2012, doi: 10.1111/j.1467- 8551.2010.00718.x.

[23] C. Gaimon, G. F. Özkan, and K. Napoleon, ‘‘Dynamic resource capabilities: Managing workforce knowledge with a technology upgrade,’’ *Org. Sci.*, vol. 22, no. 6, pp. 1560–1578, Dec. 2011, doi: 10.1287/orsc.1100.0598.

[24] C. E. Helfat and R. S. Raubitschek, ‘‘Dynamic and integrative capa- bilities for profiting from innovation in digital platform-based ecosys- tems,’’ *Res. Policy*, vol. 47, no. 8, pp. 1391–1399, Oct. 2018, doi: 10.1016/j.respol.2018.01.019.