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Chapter 10: Intelligent compliance automation and dynamic regulatory framework alignment

10.1. Introduction to Intelligent Compliance Automation

Financial compliance with regulatory obligations is resource-intensive, requires human expertise, and experiences delays. Despite document-centric and process-centric traditional automation solutions, the rapid expansion of regulatory obligations across borders, verticals, and oversight changes continue to create a massive and diverse set of obligations to adhere to. Integrated into business processes, continuous and real-time compliance that takes organizational and regulatory data context into consideration is notoriously difficult to implement. This capability is key to effective risk management, but is currently available only for niche or localized use cases. Automation technology is still primarily focused on document-centric initiatives, which results in major gaps in coverage. Conversational AI tools however are new and provide company knowledge as well as external industry knowledge to business teams and can integrate to related tools and asset and metadata repositories. They play the dual role of seamlessly browsing and gathering information to back-testing decisions, while ensuring effective change communication and training for senior management and teams involved in operational execution (Ali et al., 2024; Balakrishnan, 2024; Ajmal et al., 2025).

Conversational AI tools that support human-in-the-loop efforts and have access to knowledge management and assurance tools can assist with critical semi-automated reverse augmentation and cross-validation of outputs created by currently available advanced AI and other automation solutions for key areas of financial compliance. Organization-specific training is required to include the necessary risk assessments and controls, suitable process design and operationalization, specific AI exercise and monitoring, cyber security, data governance, tech-enabled business enablement and knowledge management, risk lessons learned and assurance, investor and stakeholder engagement and assurance, as well as other intelligence topics. These capabilities would need to be integrated into day-to-day business processes, using business process driven checkpoints for feedback flow between associates and the AI and other automation

solutions as they execute their work.Over the coming chapters, we will propose an innovative compliance automation framework that strives for real-time regulatory framework alignment across a number of disciplines and markets while maximizing the coverage of good management principles and the managerial credibility of ethical organizations, enabling real-time oversight (Kulkarni et al., 2021; Onoja et al., 2021; Kothandapani, 2025).

Fig 10.1: Dynamic Regulatory Framework Alignment

10.1.1. Background and Significance

Regulations define the framework for how organizations make decisions regarding economic activity and risk management, including the need for disclosure. Regulatory violations can lead to outlier organizational behavior and result in economic transgressions that damage consumers, markets, and society as a whole. Courts, regulatory agencies, politicians, whistleblowers, the media, and data analytics increasingly monitor organizations, demanding compliance with thousands of regulations that require regular updates published in dozens of languages. Companies are using technology to keep their compliance personnel apprised of every legal and technological change, but even with full-time professionals dedicated to compliance, modern organizations seem to be repeatedly caught on the wrong end of company behavior that ends badly for consumers, shareholders, employees, states, and other

countries. The need for advanced technology that can provide intelligent oversight in response to and as a function of the quagmire surrounding rapid legal and situation changes has never been clearer.

A limitation of our economy is that regulation is retrospective rather than prospective – making sure that the rules have been followed after the fact, not striving to keep organizations on the straight and narrow going forward. As we'll discuss, our current regulatory framework is ambiguous, unethical, and doesn't strive for optimal externalities because the potential negative economic, social, and external risk events from compliance failures typically are managed and owned by others.

10.2. Understanding Regulatory Frameworks

Regulatory compliance is the process by which a business or organization ensures that it observes and complies with the external statutory laws and regulations as well as other best practice guidelines. Within the context of laws and regulations that govern business operations, compliance requirements are typically established by governments and regulatory bodies. The regulatory compliance landscape is characterized by formal and unofficial policies across multiple countries governed mainly by governments and regulators. Governments lay down the relevant laws and frameworks through various means such as legislative acts, criminal code, civil codes, or establishing independent agencies with formal goals and missions. Regulatory bodies, otherwise known as depositories, are established by government legislation or power to create, supervise, and enforce compliance with various laws. Indirectly public agencies, whose statutes impose compliance obligations on public agencies and enterprises, also contribute towards establishing the compliance landscape. Apart from such formal channels, the compliance landscape is characterized by various enabling disclosures, voluntary guidelines, voluntary relief schemes, internal and external voluntary surveillance opportunities, and so on. Though the above channels represent the major forces shaping the regulatory compliance landscape, other entities like certification authorities, accreditation agencies, industry bodies, and informal sectors also contribute towards establishing and implementing compliance.

Compliance-going beyond mere adherence to laws and regulations-has emerged as a strategic priority, touching on every aspect of an organization's operations, with regulatory risk now considered an important component of enterprise risk management. The rising incidents of infractions and emergent issues, including the exploitation of corporate tax loopholes or employing child labor by corporate members of various business alliances, have increased scrutiny on multinationals to lead from the front in matters of compliance. The compliance that Industry 4.0 brings about is, however, fundamentally different and far more rigorous than previous practices.

10.2.1. Research design

This project is centered around qualitative analysis of the literature on domestic and cross-border banking law and global regulatory frameworks addressing cross-border bank capital and resolutions pertaining to Global Systemically Important Banks. In addition to resolving pertinent patterns – specifically how domestic regulatory interests are negotiating or accommodating cross-border issues that may have bearing on a G-SIB's home or host state – the objective is to also engage key players in the regulatory space. The gaps and shortcomings as well as interpretation issues on which such an interview is premised will find consideration within this chapter as well as subsequent ones. These gaps and shortcomings are permitting large team transnational banks to literally multi-jurisdiction bank and unsafe and unsound practices. The regulatory interest in having measures that the G-SIBs have to subscribe to when the risks are located in the cross-border banking space is warranted. Since the home or host G-SIB regulatory authority may not capture all risks that the business model in question is delivering to the international financial architecture, the interviews would be validating those gaps and shortcomings as well as the regulatory impulses underlying them.

The data collected from chapter 3 will allow soliciting pertinent risk-related questions while fine-tuning the anticipated interviews. By expounding on a small number of interviewee questions in advance with this preliminary data, the goal is to inviting feedback thereon to write the final question list based on that initial critique. The option of a hybrid structure of interviews could also be pursued. While much of the interview format will be semi-structured, a short list of precise questions may also be included for keeping the discussion on track.

10.3. The Role of Technology in Compliance

Many companies own large amounts of data that comply with the condition as defined in Section 5. Why not letting technology optimize resources while increasing regulatory compliance? This section explains the role of technology in compliance and how it can change the inefficiencies in the current compliance scenario. Legal technology, compliance automation, and semantic search are some of the phrases frequently associated with the concept of technology in compliance. This section describes the role of AI, machine learning, or statistical analysis applied to different kinds of data that can help support companies or institutions in the regulatory compliance endeavor.

The importance of compliance for organizations is increasingly growing. Compliance is important to others: namely customers, business partners, investors, other stakeholders, and society at large. Many organizations cite two key motivations behind their establishment of a business compliance program: to ensure compliance with law,

regulations, and other requirements, and to avoid negative impacts of non-compliance on customers and employees. However, developing and managing such programs can be resource and cost-heavy efforts, especially for organizations that need to comply with regulations in multiple jurisdictions and sectors. Companies have begun establishing compliance programs at global levels. The increasing complexity of compliance concepts and processes associated with regulatory compliance can be better supported through advanced technology.

Technology can support and help automate compliance work in different ways: solve specific compliance work problems; eliminate inefficiencies or lack of optimization from the compliance with simple tasks; help optimize compliance work through cross-organization collaboration and optimization; scan in the background reports or papers that may be highly relevant to an organization and that describe a business, topic, concept, or process of interest; optimize the management of specific compliance work through compliance work management platforms; and apply probabilities of drawing conclusions that are relevant to compliance work.

Fig 10.2: Role of Technology in Compliance

10.3.1. Artificial Intelligence in Compliance

In the diverse and expansive landscape of compliance, the aspiration towards AI automating and guiding compliance is gathering momentum. The prospect for this desire or vision to materialize appears strangely familiar, as we are influenced by the ubiquitous ability of AI to influence myriad aspects of business and society. But what makes the aspirations for AI in compliance distinct is the deeply felt inadequacies to which compliance is prone, related to inadequacies of depth, focus, resources, and quality—aspects which are at the heart of the compliance dilemmas faced by directors and officers of organizations. There are many actual attempts at AI automating disparate corners of compliance, both from fintech and regtech approaches, and driven by internal and external compliance requirements. These range from automating the search for violations of employment law in talent management, generating disclosures from machine readable data to respecting the privacy of user-generated data and protecting IP on the other side of the interface, to developing the ability of intelligent agents to observe the communications and behavior of staff and contractors, polygraphically enabling assessment of codes of conduct adherence. Delegating aspects of compliance automation to AI requires a coherent set of legal, practical, and ethical guidelines. Sociotechnical AI design is about providing such infrastructure, and there are innumerable considerations for Compliance-CRA architects and developers.

At the Core, integrative and collaboration patterns will guide, govern, and constrain the AI–human interaction burden. Guided by multi-modal communication between AI agents and their human overseers, supervision will dictate digital dialogue as much as drawing clear borders of expertise and capabilities for where humans will be called to make calls, decisions, and endorsements. The Compliance experience will inform the training of insight and foresight competencies, for AI models learning from compliance processes to make recommendations and decisions. Organizations today are adopting corporate AI principles, as they traverse the various pathways for what tasks and decisions AI should be delegated to perform, with what levels of autonomy, feedback, collaboration, and transparency. The actions of employees and agents of the organization, both in their formal relationship as well as within their social networks—all public domains have developed rich policy frameworks.

10.3.2. Machine Learning and Data Analysis

Understanding patterns in historical data, not previously discernable, is powerful knowledge. It creates an opportunity for organizations to make effective predictions about the future, whether this relates to compliance violations, is a driver of increased risk, or is a predictive indicator of increased severity or duration of future operational disruptions or regulatory sanctions. Various forms of Machine Learning modelling can

be used to explore historical organizational and ecosystem data, as well as public data related to the regulatory environment, to create prediction models. From these predictions, automated alerts can be generated for the organization, its business managers, or its compliance officers. These alerts can be structured or unstructured and can point the attention of the model user to the greatest potential for risk in the organization. These alerts may take the form of compliance hot spots or high probability predictive violations. Those alerts might relate to specific regulatory restrictions or other risk controls. They may also relate to specific employees, activities, or locations that pose the highest risk for repeat violations or the most severe or longest duration consequences, or some combination of these predictive factors. The ML capabilities are so varied that a Chief Information Security Officer casually observed, during an interview, "It's like Hogwarts at IBM Watson." More generally about AI developments and implementation, a Chief Risk Officer explained, "Everyone is chasing after every idea, but it needs careful and thoughtful implementation."

10.4. Dynamic Regulatory Frameworks Explained

The Dynamic Regulatory Framework is a new type of compliance framework that streamlines the publication and management of content, simplifies the process of compliance knowledge gathering and consolidation, and supports the management of compliance within organizations. Organizations operate through different business functions and processes that aim to meet various organizational goals. This also necessitates certain obligations to comply with — for example, obligations associated with laws and regulations, international treaties and conventions, local laws, regulations and standards, etc. The metadata associated with each obligation, detailing the scope, nature, classification, and sources, as well as consequences of compliance failure, etc., provide immense knowledge necessary for firms to apply governance. However, as technology and communications evolve, the number of obligations, their source and nature, obligations' metadata, etc., are ever-changing. For example, the rise of the digital, cyber, and metaverse economy calls for continuous update to the legislative frameworks, international treaties, and conventions regulating, and calling obligations — for adherence to ethical and lawful behavior by the organizations. These changes could either encompass new regulations or amendments to proposed laws for the digital economy, and related spaces. Moreover, these changes may arise suddenly such as with the sudden demand for organizations to help the affected nations during wars, or the sudden widespread use of content generation tools.

Data from compliance research shows that with the non-stop publication of the compliance regulatory framework, the number and diversity of organizations using such frameworks is set to grow. Nevertheless, organizations have to deal with these

frameworks on a continuous basis, where compliance is associated with having the necessary capabilities in order to respond to notices at the time of requirement. The frameworks are changing the very business landscape for organizations, where they need the capabilities to not just do business, earn profits and wealth, but also ensure compliance with respect to organizational behavior, towards avoiding malicious, harmful and unethical practices, and supporting the infrastructure and economy of the other vulnerable nations — for enabling their profitability. It is this changing landscape and requirement for continuous awareness of compliance, that demands Dynamic Compliance Management formulation and development. Thus, we start with a needs driven approach, for formulating the dynamic regulatory framework. We base our Dynamic Compliance Management development on Smart Technology Enablement, where certain AI and Expert Systems have been researched and developed to provide the needed management support.

10.4.1. Characteristics of Dynamic Frameworks

Dynamic frameworks transform current transactional regulatory frameworks to a permanent relational configuration of regulatory agencies and regulated firms embedded in Trust and Knowledge Networks. Within the new configuration, regulated firms cooperate with government agencies to design the future framework of rules and automated controls applying to their activities. While there is an entrepreneurial relational interaction, the parameters of the formal supervisory authority of the regulator and the information exchange between firms and regulatory agencies are permanently discussed and updated, representing a mutual risk assessment process. This managerial relationship represents a networked Supervisory Authority within which the authority to decide sanctions, conditions and other forms of punishment is decentralized to the specific company. The continuous relationship between firms' agents responsible for compliance work and the specialized units of the supervisory agency supports the formation of a Trust and Knowledge Network, focusing on the continuous assimilation of regulatory knowledge specialists and appeasing their frustration about corporate behavior. Such a configuration decreases both the frustration of the regulatory specialists using knowledge and their compliance. The intense discussion helps to efficiently operate sanctions. That is, the supervisory authority can efficiently promote compliance by firms.

10.4.2. Impact on Businesses

Dynamic regulatory frameworks are primarily concerned with cost-cutting and increasing business efficiency through the implementation of risk-based approaches to

societal and operational processes. As such, they reflect the priorities of politicians and larger state authorities, aiming to ameliorate organizational concerns through a better fit between requirements and risk profiles. When implementing dynamic regulatory frameworks for compliance automation, one overarching question needs to be considered: at what point does risk not warrant disruption due to regulatory intervention? Furthermore, compliance automation concerns the implementation of algorithms that expand the remit of authorities, both for monitoring societal behavior and for sanctioning deviance. Such measures affect organizations directly due to the potential for loss of custom from exposed clients, and indirectly as algorithms monitor for exposure among the organizations' suppliers and service businesses. The temptation for these algorithms to pivot away from their original purpose, toward sanctioning errors of enforcement, is significant.

From a compliance automation perspective, self-interest and selfishness are too often conflated. Regulatory frameworks must function on the basis of what the organization can do to conform with the rules set down by the state. Ethical behavior around environmental or labor standards is paramount. If regulations do not allow this to happen, they become merely market share propping through cost-cutting. It is through stakeholder influence that the cost of regulatory intervention can be recouped. Economists should model groups of stakeholders and discuss how the intervention benefits them. By losing touch with such factors, economics ceases to be of service to society and becomes instead disconnected science – or worse, disconnections on behalf of vested interests. When establishing intelligent compliance automation, the ethical component of compliance must be given due weight.

10.5. Challenges in Compliance Automation

Achieving efficient compliance, whether through compliance provisioning or monitoring (or a combination of the two) has its challenges. Regulatory agencies express their concerns about regulatory observance via the rules that they issue. Companies must then enact their change detection, risk assessment, control automation, and control testing functions around these as a basis. In turn, technology that drives these functions from a company's perspective must necessarily also be developed based upon the way in which regulators express their requirements. Adopting emerging technology to deliver compliance automation can at times seem daunting, both due to the complexity of the regulations and the hesitation on the part of regulated entities regarding the consequences of invalid policy application or incorrect sanction. This feeling is exacerbated by regulatory restraint. Rules tend to overuse vague language, as trying to anticipate every detail of an organization's operation is simply impractical. Accordingly, debates persist over the specific operational meaning of the words used in providing the regulations.

The impediments associated with striking the right balance have so far inhibited the more complete technology adoption that companies are capable of in order to achieve compliance efficiencies. For organizations that are regulated entities, confidence in the selection of a tech package to govern automation is as big a challenge as implementation.

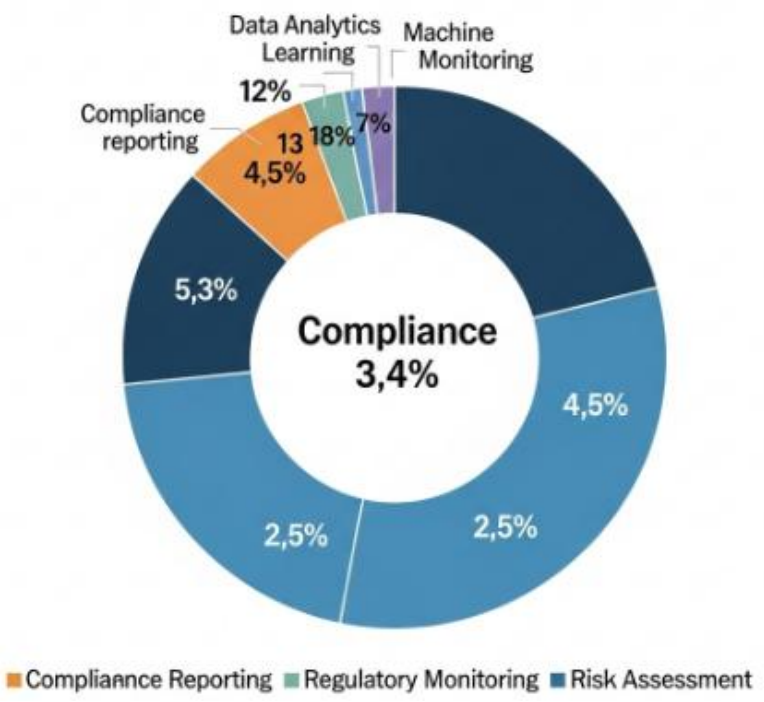

Fig : Intelligent Compliance Automation and Dynamic Regulatory Framework Alignment

For an organization regulated specifically by one agency, under-preparedness for compliance technology outside of the agency's purview may also result in ineffectiveness. The hospitality industry suffered numerous cybersecurity breaches while receptively working on implementing a patchwork of compliance technology driven by more sophisticated attorneys and tech developers, which could address the requirements of various industry agencies. The operations of hospitality organizations are of a unique type but, unsurprisingly, the sanctions for being out of compliance are grave, more so since any major breach would result in numerous violators hitting cyber potholes at once.

10.5.1. Data Privacy Concerns

Compliance automation platforms must deal with inherently sensitive information. Sensitive data is typically more valuable than non-sensitive data, and is often the target

in cybersecurity attacks due to its potential for harm and exploitation. Furthermore, compliance automation platforms often aggregate sensitive data across different organizations and industry sectors, exacerbating its risk. This creates the challenge that the compliance automation process may create more security holes than it protects. Sensitive business information, insights into intellectual property risks from sensitive transactions, and identity data belonging to individual employees are only some of the types of sensitive data that compliance automation platforms deal with, and often these compliance solutions are processing this data at the most sensitive level while assumptions about security are only at the least sensitive level. There is little tooling available to directly support organizations in achieving and maintaining compliance for sensitive data processing workflows, even though achieving and maintaining compliance is the first step toward accelerating sensitive data processing – and compliance automation – for business use cases.

The regulations that govern sensitive data are numerous and restricted by region and industry. Current methodologies and toolsets for data governance, management, and helping with privacy by design are insufficient for helping organizations achieve compliance for sensitive data processing. For example, while privacy-enhancing computation tools such as homomorphic encryption, secure multiparty computation, or secure enclaves that support data sharing for analytics help companies reduce sensitive data usage risk, the onus of ownership lies with the organization that processes this sensitive data. These tools are also insufficient for decrypting or untracking sensitive data, instead focusing on allowing organizations to process sensitive data while the data is encrypted. Furthermore, the current approach for achieving compliance is one-size-fits-all when in practice each sensitive data use case often has widely different underlying risks and assumptions.

10.5.2. Integration with Existing Systems

A significant challenge in fully automating compliance processes is integrating them with existing systems. If existing systems do not contain the wide range of data needed to fully automate compliance processes, compliance automation is limited to the organization's ability to enhance those systems. Often, organizations rely on multiple or disparate systems. It is not uncommon for organizations to utilize multiple vendors of similar services for similar use cases for reasons such as avoiding lock-in with a single vendor. In addition to multiple vendors, organizational needs change over time and more often than not, a practical solution for the change is to implement an entirely different solution rather than enhance the existing system, leading to the theoretically sanitizing "point solution" plague companies face. This piecemeal approach will lead to an organization adopting a patchwork of cybersecurity solutions and processes that have no

interconnectivity or communication, lessening, if not negating, the organization's overall cybersecurity posture and risk management.

It is crucial for cybersecurity threat intelligence, compliance tools, and risk management systems to produce output data that can be leveraged by other departments for proactive security operations. A proper integration will allow for automatic compliance and regulatory fines to get fed into risk management systems for accurate metrics, allowing for continuous assessments of the operation. This means that information security and compliance teams will be able to conduct continuous security assessments for localization of threats originating from business interactions. The primary use case for a synergized solution is for operational leadership to clearly understand the risk, potential impact, as well as the severity and level of urgency for remediation surrounding all open exposures.

10.6. Conclusion

Fully automated compliance relies on three essential enabling technologies: intelligent and accessible regulatory knowledge; passive and adaptive surveillance of processes and control; and in-process, non-intrusive and control-honouring intervention. While these can be deployed separately, most of the currently available solutions for automation support merely static rule evaluation rather than the dynamic behavior need that is associated with deeper automation as a radical game-changer for the modern digital organization.

The building blocks for intelligent compliance automation are available but have been realized at a showroom level only. Important trends and developments to address the bottlenecks of intelligent compliance automation will come from the areas of knowledge graphing technology, responsible AI, hyper automation, process intelligence, continuous process monitoring, and lightweight process adaptation and intervention.

The first technology concerns intuitive and easily accessible semantic knowledge representation, authoring, and management. It enables non-expert knowledge engineers to create semantic regulatory knowledge resources that are based on natural language constructs, connecting regulatory requirements with corresponding business process structures, controls, and sufficient context information. At present, these capabilities are not available, and knowledge bases are created in semantic formalisms requiring expert knowledge engineering. The majority of existing semantic knowledge bases are therefore data- rather than knowledge-centric, comprising lists of regulatory terms, notions, etc., which are insufficient to make such knowledge accessible and useful for decision makers and IT infrastructure automated decision and execution support.

10.6.1. Emerging Trends

The increasing complexity and instability of the regulatory compliance landscape has highlighted the imbalance between business growth acceleration and regulatory oversight needs. It indicates a significant need to accelerate regulatory evolution with a smart decision support system, enabling dynamic regulatory alignment. Regulatory compliance for products, services, and technologies including cybersecurity, privacy, and data protection used by the financial sector is also rapidly evolving and converging across jurisdictions. Regulators are administrating expectations and requirements that are new, unevenly developed, and inconsistent across jurisdictions. Regulated institutions may come to market with new products, services, and technologies only to be required ex post to become compliant with lists of requirements, or in need of regulatory annotations or approvals. Governance programs may find themselves in constant motion trying to keep up with their varying expectations.

Regulated institutions challenge regulators to be more anticipatory with their evolving expectations and requirements, even while their oversight roles are necessary for risk management, prevention, and protection. Institutions call on regulators to refine or forgo rulemaking processes that engage participants for regulatory soundness of frameworks and models but result in no product-specific tailoring or innovation. Institutions find they cannot keep pace with increased speed to market for innovative products and services that are necessities for ubiquity of financial participation by customers without guidance and direction for reusability of unified compliance models, irrespective of jurisdiction. In the absence of consensus expectations or requirements across jurisdictions, organizations can expend excessive financial and human capital resources in their governance programs in order to comply with such lists and avoid operational friction. The use of technology-enabled organizations that conform their actions using dynamic compliance monitoring capabilities significantly help mitigate that excess burden and protection.

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