

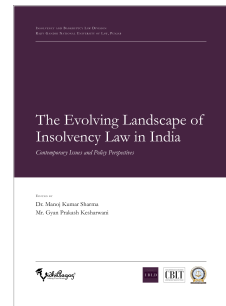
## CHAPTER 18

# Smart Defaults: An AI – Pre-Insolvency Early Warning System Integrated with India’s Information Utilities

Chirkankshit Bulani and Aryan Sharma

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CHAPTER 18

# Smart Defaults: An AI – Pre-Insolvency Early Warning System Integrated with India’s Information Utilities

CHIRKANKSHIT BULANI\* AND ARYAN SHARMA\*\*

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*This paper shall advocate for solving the need for a predictive and data driven approach to insolvency in India. While the IBC, 2016 has transformed the landscape, it is noticed that the legislation only arrives into the picture after a significant default has already occurred. As per the data available by December of 2024, more than 8000 CIRPs have been admitted, but with an average lowly rate of creditor recovery at 32.8 percent and nearly 44 percent of closed processes ending with liquidation. In comparison, jurisdictions like EU and UK have begun their integration of AI-powered Early Warning Systems (EWS), enabling timely intervention and reduction in value erosion.*

*This paper shall intend to propose a roadmap for design and implementation of an AI-powered Early Warning System integrating India’s digital infrastructure including Information Utilities. The proposed system would combine data from GST filings, MCA records, NeSL agreements, Credit Scores with the use of supervised learning models to generate risk scores and explainable dashboards. The paper shall also conduct a critical examination of technical and legal challenges such as data silos, privacy and consent under the DPDP Act, 2023 and regulatory harmonization among other related statutes.*

*By conducting a comparative analysis with the EU’s Directive 2019/1023, the UK’s Red Flag Alert, and Singapore’s MAS-backed AI systems, the paper shall adjudicate on the feasibility and impact of such a system, while offering a phased implementation strategy beginning with Large Corporate NPA-holders and recommend legal interventions for recognition of AI-EWS outputs as advisory triggers for pre-insolvency mediation or restructuring. It will also comment on algorithmic fairness, stakeholder consultation and effective redressal mechanisms.*

*By moving towards a predictive insolvency regime from a reactive one, Indian insolvency landscape can prevent value erosion, improve recovery and enhance stability in the framework. The research will provide actionable insights for policy makers, regulators, practitioners, contributing to technological intervention in the current traditional insolvency regime.*

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*Keywords:* Pre-Insolvency Framework, Distress Prediction, AI-Powered Early Warning System

## 1 INTRODUCTION

The Insolvency and Bankruptcy Code of 2016<sup>1</sup> was a transformative legislation, which reshaped India's approach to corporate distress. It brought India from a debtor-in-control to creditor-in-control model. It intended to streamline corporate insolvency, where there was faster resolution and value maximisation. However, as it currently stands now, IBC takes on a reactive nature. The triggering of the Corporate Insolvency Resolution Process (CIRP) is a reactive measure which can be initiated once the default is above the value of 1 Crore.<sup>2</sup> This reactive approach often puts the stakeholders on the back seat, only bringing it to notice when a certain amount of damage is unavoidable. What also contributes to the damage is the prolonged litigation which engulfs the CIRP process. The mandate for completing the CIRP process is 330 days as per Section 12(3) of the IBC<sup>3</sup> while data from the quarterly newsletter of IBBI for the months of January – March 2025 showed that the average time taken is 597 days.<sup>4</sup> This particular reactive nature and then the extended timelines taken for CIRP contribute to damages which include value erosion, delays in resolution and sub-optimal recovery for creditors.

The data explains the real story. As of the end of 2024, over 8,175 CIRP cases had been admitted, while a good statistic is that 3,485 cases were closed through either resolution plans or withdrawal, over 2,707 cases were referred to liquidation, with less than half, precisely around 1,274 were fully liquidated. Creditors on an average, only realised 31.4% of their claims, which is equivalent to 162.8% of the liquidation value. With nearly 44% of closed CIRPs ending in liquidation, this stands as a concern among the stakeholders of the system.<sup>5</sup> This particular data is a reflection of the short-comings of India's reactive insolvency framework, where action is only considered long after the threat becomes imminent and the extended timelines for processes such as the CIRP defeat the purpose of insolvency, which is value preservation and revival of the corporate debtor. An AI-EWS system, as discussed later, can avoid liquidation, but can also help avoid the lengthy process of CIRP, preserving both value and time.

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<sup>1</sup> Insolvency and Bankruptcy Code, 2016.

<sup>2</sup> *Id.* § 4.

<sup>3</sup> *Id.* § 12(3).

<sup>4</sup> INSOLVENCY AND BANKRUPTCY BOARD OF INDIA, QUARTERLY NEWSLETTER vol. 34 (Jan.–Mar. 2025), <https://ibbi.gov.in/uploads/publication/912e97d4d9f96651386541fb7059203b.pdf>.

<sup>5</sup> *Analysis of Insolvency Cases Under IBC as on 31.12.2024: CIRP Initiation, Closures, Recovery and Yield from Resolution Plan and Liquidation*, IBC LAWS (Mar. 19, 2025), <https://ibclaw.in/analysis-of-insolvency-cases-under-ibc-as-on-31-12-2024-cirp-initiation-closures-recovery-and-yield-from-resolution-plan-and-liquidation/>.

Globally, there is a recognition of the downsides of being purely reactive to corporate defaults, and there is an inclination towards data-driven solutions. Countries in the European Union<sup>6</sup>, the United Kingdom<sup>7</sup>, and Singapore<sup>8</sup> have explored integration of Artificial Intelligence-powered early warning systems in their insolvency frameworks. These systems hold the potential to predict insolvencies, allowing for timely intervention, thereby improving chances of revival of the corporate debtor instead of liquidation which becomes the norm as value erosion happens. The rapid emergence of digital infrastructure in India such as the National e-Governance Services Ltd. (NeSL) as the country's first Information Utility (IU) under the IBC<sup>9</sup>, presents a ripe opportunity for India to jump on the data-driven bandwagon.

This paper shall be an attempt to prescribe the implementation of an AI-powered Early Warning System (AI-EWS), which shall rely on data from India's information utilities. The system shall endeavour to recognise signs of financial distress before the default occurs, enabling timely interventions by insolvency stakeholders. The analysis shall describe the technical, legal, ethical, and institutional challenges which may accompany such an ambitious exercise, and resolving the lacunae and limitations through phased implementation and necessary regulatory reforms. In the next section, this paper shall highlight how the pre-insolvency situation is lacking in the Indian landscape.

## 2 THE PRE-INSOLVENCY GAP IN INDIA

While the implementation of the Insolvency and Bankruptcy Code (IBC)<sup>10</sup> has brought upon significant achievements, at present, India doesn't have a mechanism for early pre-insolvency interventions.<sup>11</sup> The existing indicators are usually studied in a retrospective sense, such as the Non-Performing Assets (NPAs) or credit ratings. This retrospective perspective only brings in attention when the company has incurred substantial losses and significant value has been eroded, making recovery and value maximisation incredibly challenging.

There are multiple reasons as to why there are delays in addressing financial distress. Firstly, there is reluctance among debtors and creditors. Debtors are wary of the stigma

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<sup>6</sup> Directive 2019/1023, of the European Parliament and of the Council, 2019 O.J. (L 172) 18 (EU) [hereinafter EU Restructuring Directive].

<sup>7</sup> Corporate Insolvency and Governance Act 2020, c. 12 (UK).

<sup>8</sup> Insolvency, Restructuring and Dissolution Act 2018 (No. 40 of 2018) (Sing.).

<sup>9</sup> Nat'l E-Governance Servs. Ltd., *India's First Information Utility Under IBC*, <https://www.nesl.co.in/> (last visited July 26, 2025).

<sup>10</sup> IBC.

<sup>11</sup> Antonia Menezes et al., *Under Pressure: Integrating Online Dispute Resolution Platforms into Preinsolvency Processes and Early Warning Tools to Save Distressed Small Businesses*, 45 VIKALPA 79 (2020).

associated with a formal insolvency, and the creditors may opt for evergreen loans or informal restructuring.<sup>12</sup> Secondly, the lack of clear legal framework for pre-insolvency resolution creates a grey area, with no formal mechanisms for debtors in financial distress. Thirdly, given the fact that a debtor essentially loses control of his company when the insolvency process begins, a strong incentive is required for them to avail early recognition options, which do not currently exist within India's legal framework.<sup>13</sup>

## 2.1 Comparative Analysis: Global Approaches to Early Warning Systems

While India welcomed its insolvency code in 2016, the advanced jurisdictions have recognised the importance of early intervention mechanisms, so goals such as value maximisation and revival of the corporate debtor can be realised. A few examples are:

- *European Union (EU)*: In the EU, the Directive 2019/1023<sup>14</sup> lays down the groundwork for Early restructuring frameworks. It states that these frameworks should assist enterprises to restructure before a default occurs and insolvency begins, thus limiting unnecessary liquidation. The objective is essentially to recognise enterprises which might get sick and encouraging action before enterprises default.
- *Singapore*: The Insolvency, Restructuring and Dissolution Act (IRDA), 2018<sup>15</sup> is the comprehensive legal framework which governs aspects such as corporate and individual bankruptcy in Singapore. The legislation is a big facilitator in pre-default restructuring, with the help of mechanisms such as Schemes of Arrangement (Part 5, Division 5) and Judicial Management (Part 7)<sup>16</sup>. Under Section 211B of the Act<sup>17</sup>, a company is allowed to apply for a moratorium even if it has not entered formal insolvency, allowing it to restructure without discontinuing operations. In addition to this, the Monetary Authority of Singapore (MAS) is actively engaged in promotion of AI-powered risk prediction tools within the financial sector. The authority has also issued what are called the FEAT Principles in 2018, where FEAT stands for Fairness, Ethics, Accountability, and Transparency<sup>18</sup>. The authority has also issued an information paper

<sup>12</sup> M.P. Ram Mohan & Muskaan Wadhwa, *Stigma, Corporate Insolvency and Law: International Practices and Lessons for India* (IIM Ahmedabad Working Paper No. 14701, 2021), <https://ideas.repec.org/p/iim/iimawp/14701.html>.

<sup>13</sup> M.S. SAHOO & ANURADHA GURU, *INDIAN INSOLVENCY LAW* (2020).

<sup>14</sup> EU Restructuring Directive.

<sup>15</sup> Insolvency, Restructuring and Dissolution Act 2018 (No. 40 of 2018) (Sing.).

<sup>16</sup> *Id.* pt. 5 div. 5 & pt. 7.

<sup>17</sup> *Id.* § 211B.

<sup>18</sup> MONETARY AUTH. OF SING., FEAT PRINCIPLES: PRINCIPLES TO PROMOTE FAIRNESS, ETHICS, ACCOUNTABILITY AND TRANSPARENCY IN THE USE OF AI AND DATA ANALYTICS IN SINGAPORE'S FINANCIAL SECTOR (2019), <https://www.mas.gov.sg/-/media/MAS/News-and-Publications/Media-Releases/2019/FEAT-Principles.pdf>.

in 2024 addressing specific concerns related to use of Artificial Intelligence in financial institutions.<sup>19</sup>

- *United Kingdom (UK)*: In the UK, the “Red Flag Alert” system, developed by the Begbies Traynor Group, is a resource for financial health ratings,<sup>20</sup> which can correlate to predictions of insolvency risk and alerting if either the customer’s or the supplier’s risk sees an increase. It considers factors like payment behaviour, strength of the balance sheet and other relevant factors.

The primary hindrance in embracing AI-EWS in Indian jurisdiction is the fragmented data silos among financial and corporate data repositories. Information remains fragmented among entities such as the National e-Governance Services Ltd. (NeSL), which is India’s first Information Utility and a key pillar of Indian insolvency regime, the Goods and Services Tax Network (GSTN), which holds transactional data from GST filings<sup>21</sup>, the MCA21 portal by the Ministry of Corporate Affairs, and last but not the least, the banks, which hold a great amount of information in regards to credit histories and NPA Classifications.

This particular fragmentation of crucial data, is what hinders real-time risk assessment.<sup>22</sup> In addition, stakeholder resistance from banks, Insolvency professionals, and judiciary to accommodate new data sharing mechanisms which involve AI based assessment is another crucial factor. This particular resistance stems from concerns such as algorithmic bias, lack of human judgement, which shall be dealt with in detail later in this paper. Now, in the next section, the paper shall analyse the specifics of the proposed AI-EWS.

### 3 PROPOSAL: AI-POWERED EARLY WARNING SYSTEM (AI-EWS)

This paper proposes an AI-Powered Early Warning System (AI-EWS), which will be an attempt to leverage advanced data analytics based on integrated data sets to recognise patterns and signs of financial distress, exercising a proactive stance rather than a reactive one. Under this particular heading, the paper will analyse the proposal, elaborating upon, firstly, the data sources and their integration, secondly, model design, thirdly, expected outcomes and benefits to stakeholders, and lastly, addressing the resistance to integration of this

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<sup>19</sup> MONETARY AUTH. OF SING., ARTIFICIAL INTELLIGENCE MODEL RISK MANAGEMENT: OBSERVATIONS FROM A THEMATIC REVIEW (2024), <https://www.mas.gov.sg/publications/monographs-or-information-paper/2024/artificial-intelligence-model-risk-management>.

<sup>20</sup> BEGBIES TRAYNOR GROUP, RED FLAG ALERT REPORT – Q1 2025: UK BUSINESSES UNDER PRESSURE AHEAD OF IMPENDING TARIFF AND TAX CHANGES (Apr. 25, 2025), <https://www.begbies-traynorgroup.com/news/business-health-statistics/red-flag-alert-report-q1-2025-uk-businesses-under-pressure-ahead-of-impending-tariff-and-tax-changes>.

<sup>21</sup> Tanya Gupta, *What Is GSTN (Goods and Services Tax Network)?*, CLEAR TAX, <https://cleartax.in/s/what-is-gstn/> (last visited Sept. 29, 2026).

<sup>22</sup> *Addressing Data Silos with Governance Frameworks in Financial Organizations*, 24 WORLD J. ADV. RSCH. & REVS. (2024).

technology. Before that, the authors shall attempt to explain a hypothetical scenario of how the proposed system will work.

### 3.1 Hypothetical Example: Scenario Walkthrough

Under this particular heading, the authors shall attempt to explain the scenario through a hypothetical study. This is as follows:

Suppose there exists a company named 'X' which manufactures automobile parts. In the current scenario, the company has displayed the following:

- *GST Portal:* There has been a 40% drop in turnover filings
- *Banking Sources:* There is an increase in utilisation of credit available and frequent cheque bounces in standing transactions.
- *Credit bureau:* The bureau has lowered the credit score with disputes arising.

Then the following steps are carried out:

*Step 1:* The AI-EWS integrates the following data and runs an in-depth analysis, after which it flags the company as at-risk.

*Step 2:* When the flagging happens, a confidential alert is issued via the secure portal to involved stakeholders such as the management of the company, the financial creditors and regulatory authorities. However, the company is provided additional information as to how much contribution was given by the factors under consideration to result in an increase in each score. The top management also gets the option for appeal against this score.

*Step 3:* This is the stage where on the basis of the factors contributing to the score, a stakeholder consultation can be called to discuss performance and restructuring options if need be.

*Step 4:* If the risk score is contested, independent validation exercise can be initiated by the stakeholders. It is reiterated that no punitive actions are allowed at this stage.

*Step 5:* The EWS shall continue to update with new data. If the metrics improve, it will de-risk the company and if not, the score shall increase, initiating new notifications to stakeholders.

### 3.2 Data Sources and Integration

This proposed warning system shall attempt to predict deteriorating financial patterns by training its algorithm on diverse datasets. The proposed system shall intend to rely on a comprehensive set of data, compiled from critical sources such as:

- *GST Filings*: These often provide real-time insights into a company's revenue and expenses. This would allow the warning system to identify distressing patterns.<sup>23</sup>
- *MCA Balance Sheets and Annual Filings*: This particular information offers statutory financial health indicators, including profitability, liquidity, and debt levels.<sup>24</sup>
- *NeSL Agreements and Records of Default*: Serving as one of the most crucial storehouses of information which would be imperative to carry out insolvency, NeSL records shall form the foundational information of the warning system, providing crucial patterns and examples. These can be utilised as training data.
- *Sectoral Trends and Macroeconomic Indicators*: Forming an important data set, any prediction of financial distress cannot be bereft of the macroeconomic understanding of the underlying industry.<sup>25</sup> These will allow broader data, which shall contextualize individual performance and identify systematic risks. This will be particularly in context of volatile industries like aviation.

However, compilation of these data sets and then training the algorithm on these shall be a significant undertaking. There shall be technical challenges, including but not limited to incompatibility of systems across various data holders, varying and often outdated data formats, which would not be possible due to the lack of standardized data definitions.<sup>26</sup> To address the challenges associated, it calls for a multi-pronged approach. Firstly, is the need for data standardization. As the primary governing body under the IBC, the Insolvency and Bankruptcy Board of India (IBBI) must conduct consultations with different stakeholders and issue clear mandates for data standardization for all involved entities. Secondly, are the concerns regarding data sharing. To that effect, a dedicated committee comprising representatives from the Reserve Bank of India (RBI), the Securities and Exchange Board of India (SEBI), and the Ministry of Corporate Affairs (MCA) and the IBBI must be established under the oversight of IBBI. This particular committee would oversee ethical data governance, transfer and define common standards and protocols.

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<sup>23</sup> Neba Bhalla, Rakesh K. Sharma & Inderjit Kaur, *Effect of Goods and Service Tax System on Business Performance of Micro, Small and Medium Enterprises*, 13 SAGE OPEN 1 (2023), <https://doi.org/10.1177/21582440231177210>.

<sup>24</sup> M. Krishnamoorthi & Porika Venkatesh, *An Evaluation of Liquidity and Profitability in Selected Indian Companies*, 2017 J. ADV. RSCH. DYNAMICAL & CONTROL SYS. (2017), [https://www.researchgate.net/publication/319036971\\_An\\_Evaluation\\_of\\_Liquidity\\_and\\_Profitability\\_in\\_Selected\\_Pharmaceutical\\_Companies\\_in\\_India](https://www.researchgate.net/publication/319036971_An_Evaluation_of_Liquidity_and_Profitability_in_Selected_Pharmaceutical_Companies_in_India).

<sup>25</sup> Burcu Hacibedel & Ritong Qu, *Understanding and Predicting Systemic Corporate Distress: A Machine-Learning Approach* (IMF Working Paper No. 22/153, 2022), <https://www.elibrary.imf.org/view/journals/001/2022/153/article-A001-en.xml>.

<sup>26</sup> ReBIT Publishes GSTN Data Schema for the Account Aggregator Framework, SAHAMATI (June 21, 2023), <https://sahamati.org.in/rebit-publishes-gstn-data-schema-for-the-account-aggregator-framework>.

### 3.3 Model Design and Validation

After establishment and compilation of required data sets, the next step would be to create the model design. In its essence, the warning system shall employ supervised learning models, which shall be trained on extensive historical insolvency data, which shall comprise of cases of insolvency, liquidation, cases of revival plans being accepted and the time durations along with other relevant factors such as the nature of the industry. These models would be trained to identify patterns of financial distress, drawing correlations between the current entity at hand and cases of other entities at the same stage. These patterns would be based on two key indicators, namely, financial and alternative indicators.

- *Financial Indicators:* These indicators would include key indicators of a business' health, such as Earnings Before Interest, Taxes, Depreciation, and Amortization (EBITDA), declining revenue and ratios such as debt-to-equity and liquidity ratios.
- *Alternative Indicators:* These indicators would be different from pertinent financials, and would include trends such as delayed payments to operational creditors, litigation history, frequent management changes and market sentiment. While difficult to quantify, these factors play a crucial role in initiation of insolvencies under any jurisdiction.

#### 3.3.1 Limitations of AI

However, given the current limitations of artificial intelligence, it is imperative that the models be designed and understood in such a manner that they are robust and reliable. AI Algorithms often suffer from certain limitations, which are explained below:

- *Lack of appropriate data sets or incorrect categorization:* AI algorithms often depend on categorised data sets which includes examples of what they are meant to identify. To explain with an example, if an algorithm is to be trained upon to identify what is an apple, it is often shown multiple pictures of both apples and non-apples (can be anything, an orange or anything for that matter.) The algorithm is rewarded for correctly identifying the apple, and discouraged for identifying other things as an apple. This makes the data sets and their categorization incredibly important. Without these, it might learn wrong associations, show false positives or false negatives where intervention is required.<sup>27</sup>
- *The Black Box problem:* The Black Box problem is the problem where we are exposed to decision taken by AI, but we aren't aware as to how AI reached that particular decision. The thinking process of the algorithm isn't transparent, and hence, there

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<sup>27</sup> R. Stuart Geiger et al., "Garbage In, Garbage Out" Revisited: What Do Machine Learning Application Papers Report About Human-Labeled Training Data?, QUANTITATIVE SCI. STUD. (Nov. 5, 2021), <https://arxiv.org/abs/2107.02278>.

cannot be an explanation to the decision it has reached.<sup>28</sup> Forming one of the most crucial limitations of current age AI, it is the reason to the suspicion of adoption of AI in industries like healthcare and finance.<sup>29</sup>

It is crucial that to foster adoption of the EWS, these limitations be resolved or mitigated. In order to do this, firstly, there needs to be a redressal of the data imbalance. Insolvency events are certainly a rare occurrence in comparison to healthy corporate functioning, which can skew data sets, leading the algorithm to categorise all entries as healthy, and still being accurate. This would lead to the algorithm deviating from its actual function. To counter this, techniques like Synthetic Minority Over-sampling Technique (SMOTE)<sup>30</sup>, can be utilised. This technique allows for creation of a specific minority data set. In simplicity, it captures the specific characters of the minority, which would be the distressed entities in this case. This would allow for the model to accurately predict events which are a rarity in usual nature.<sup>31</sup>

Secondly, trust and explainability is something which is paramount. To counter the black box problem, the solution which warrants exploration is the introduction of explainable AI techniques. Techniques such as SHAP (SHapley Additive exPlanations) values can be integrated within the warning system.<sup>32</sup> This technology in its essence, studies the process of thinking employed by the algorithm and determines which factor led to what amount of impact upon a particular response. This can explain which particular information or data set contribute most significantly to a company's risk score, making predictions by AI explainable and actionable.<sup>33</sup>

Thirdly, the paper advocates for pilot studies before wide scale implementation of the warning system. The paper advocates for a phased implementation, focusing initially on large corporates and sectors which are volatile and prone to NPAs such as aviation. These pilots shall give an assessment of the limitations of the model, assessing its effectiveness in real world scenarios and quantifying its impact on value preservation.

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<sup>28</sup> Sheikh Rabiul Islam et al., *Infusing Domain Knowledge in AI-Based "Black Box" Models for Better Explainability with Application in Bankruptcy Prediction* (May 27, 2019), <https://arxiv.org/abs/1905.11474>.

<sup>29</sup> Editorial: *Explainable Artificial Intelligence Models and Methods in Finance and Healthcare*, FRONTIERS ARTIFICIAL INTELL. (2022), <https://www.frontiersin.org/articles/10.3389/frai.2022.970246/full>.

<sup>30</sup> N. V. Chawla et al., *SMOTE: Synthetic Minority Over-Sampling Technique*, 16 J. ARTIF. INTELL. RES. 321 (2002), <https://www.jair.org/index.php/jair/article/view/10302>.

<sup>31</sup> W. I. Sabilla & C. B. Vista, *Implementation of SMOTE and Under Sampling on Imbalanced Datasets for Predicting Company Bankruptcy*, JURNAL KOMPUTER TERAPAN 92 (Aug. 2022), <https://doi.org/10.35143/jkt.v7i2.5027>.

<sup>32</sup> Christoph Molnar, *Interpretable Machine Learning: A Guide to SHAP*, in INTERPRETABLE MACHINE LEARNING ch. 18, § SHAP (2019), <https://christophm.github.io/interpretable-ml-book/shap.html>.

<sup>33</sup> *Balancing Techniques for Advanced Financial Distress Detection Using Artificial Intelligence*, 13 ELECTRONICS 1596 (2024), <https://www.mdpi.com/2079-9292/13/8/1596>.

### 3.4 Outputs and Stakeholder Benefits

The AI-EWS is expected to generate quantifiable and actionable outputs in the form of risk scores and explainable dashboards. These outputs can be of great relevance to all concerned stakeholders. For Creditors, both financial and operational, the system can provide alerts, especially when dealing with multiple debtors, and allow to keep trace on potential investments. It can allow for initiating pre-insolvency restructuring discussions and renegotiation of terms. This can improve recovery rate before value erosion occurs. For Debtors, confidential early warnings can act as moments of introspection, where they may seek expert opinions, seek support and restructure opportunities before creditors show up to the door.

For regulators such as IBBI, RBI and other government entities, this data analysis can predict industry slow-downs, both across sectors and in one specific sector, allowing for timely policy intervention. The AI-EWS can also focus on macro-economic data, forming an important source for policy makers and regulators to rely on, aiding them to introduce reform both for the overall landscape and sector-wise. Lastly, the benefits to the Insolvency professionals and the judiciary would include data compilations and deeper insights, which would be valuable for adjudicatory bodies like NCLT. However, in consonance with established principles on adoption of AI in judicial processes, such as those released by the Kerala High Court recently, judicial function must not be delegated to Artificial Intelligence, and human oversight is mandatory at all times.<sup>34</sup>

### 3.5 Addressing Resistance

This paper acknowledges the limitations of AI, which are bound to arise in case of adoption of new and upcoming technologies. To reduce this resistance and foster usage of AI-EWS and its engagement in India's insolvency sphere, the paper proposes the following strategies:

- *Stakeholder Engagement:* Forming one of the most crucial strategies, is stakeholder consultation. Without transparent consultation which is continuous in nature, apprehension to the technology is bound to arise. All stakeholders such as banks, corporate debtors, insolvency professionals must be consulted, and clearly conveyed the benefits and limitations of the proposed AI-EWS.
- *Phased Implementation:* It is imperative that the AI-EWS be introduced in a phased manner, where implementation should have volatile sectors and big corporate entities as the primary focus in the first phase. With gradual expansion, improvements and changes can be introduced for better effectiveness and impact.

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<sup>34</sup> THE HIGH COURT OF KERALA, POLICY REGARDING USE OF ARTIFICIAL INTELLIGENCE TOOLS IN DISTRICT JUDICIARY (July 19, 2025), [https://images.assettype.com/theleaflet/2025-07-22/mt4bw6n7/Kerala\\_HC\\_AI\\_Guide-lines.pdf](https://images.assettype.com/theleaflet/2025-07-22/mt4bw6n7/Kerala_HC_AI_Guide-lines.pdf).

- *Collaborative Threshold Setting:* The thresholds, which would trigger a warning to explore pre-insolvency frameworks should be set in accordance with the specific requirements and unique nature of each sector and industry. These must be set in accordance with experts and regulators, ensuring they are practical and relevant.
- *Complementary Role:* One of the most crucial factors to reduce resistance to adoption is to emphasise the complementary role of the AI-EWS. The role of the warning system should be to supplement human judgement, not act as its replacement.

## 4 LEGAL AND ETHICAL CONSIDERATIONS

The paper under this heading shall attempt to analyse the legal and ethical considerations associated with the use of an AI-EWS. With the adoption of a technology such as Artificial Intelligence, multitude of considerations are bound to arise. This paper will, firstly, analyse the legal foundations, secondly, considerations as to privacy and data protection, thirdly, algorithmic bias and accountability, and then lastly, concerns as to regulatory coordination.

### 4.1 Admissibility and Legal Foundation

Before the integration of an AI-EWS into India's insolvency landscape, it is imperative to establish a sound foundation in law. This is a critical aspect that these outputs should serve as advisory triggers for pre-insolvency restructuring discussions, and shouldn't be relied on as sole and conclusive evidence for institution of the CIRP. This distinction is important to prevent the EWS from defeating the intention behind IBC and creating unfounded apprehension as to future of corporate enterprises. The formalization of this advisory role shall be accompanied by amendments to existing legislation. As AI-EWS is integrated into the insolvency landscape, the amendments to the IBC<sup>35</sup> should clarify upon the advisory nature of the warning system and lay them as grounds for institution of pre-insolvency mediation or restructuring talks, and not as conclusive grounds for initiation of CIRP. Additionally, to corroborate this, amendments to the Bharatiya Sakshya Adhiniyam 2023<sup>36</sup> must be made to address evidentiary value of AI-EWS risk scores, providing them a corroborative or indicative nature, in comparison to them getting a conclusive nature of evidence.

### 4.2 Privacy and Data Protection

As India introduced its first data protection legislation in 2023, with draft rules open for stakeholder consultation in January 2025, any future legislation which integrates usage of

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<sup>35</sup> IBC.

<sup>36</sup> Bharatiya Sakshya Adhiniyam, 2023, [https://www.indiacode.nic.in/bitstream/123456789/59406/1/the\\_bharatiya\\_sakshya\\_adhiniyam%2C\\_2023.pdf](https://www.indiacode.nic.in/bitstream/123456789/59406/1/the_bharatiya_sakshya_adhiniyam%2C_2023.pdf).

data must be Digital Personal Data Protection Act (DPDPA)<sup>37</sup> compliant. Given that the data which would be utilised to train the EWS would be mostly financial data, the sensitivity of the data warrants that robust data protection measures be put in place, both within design and operation. The following aspects demand consideration:

- *Consent Mechanisms:* The Act elaborates for free, specific, informed, and unconditional consent for processing personal data. For collection of data sets to train the warning system, mechanism for collection of data must abide by the principles and conditions as provided under the Act. As far as consideration of the data exists, the collection of such data without explicit consent may be justified under the potential public interest, which provides an exception under section 7 of the DPDPA<sup>38</sup>. However, this condition is subject to further development by subsequent judgements, and must balance public interest and individual privacy.
- *Governance:* A very crucial aspect in any kind of processing with personal data involved is data governance. Any data which is utilised by the EWS must be subject to principles enshrined in the Draft National Data Governance Framework Policy (2022)<sup>39</sup> and the DPDPA<sup>40</sup>. This would include establishing clear protocols for use, processing and breach of data scenarios, along with implementation of strict audits to ensure public trust and accountability.

### 4.3 Bias, Fairness, and Accountability

Forming one of the most crucial considerations to use of an AI-EWS is the algorithmic fairness, unbiased data sets and accountability. This is imperative to prevent the EWS from delivering a disproportionate or discriminatory impact, particularly considering the Micro, Small, and Medium Enterprises (MSMEs) and startups, which are vulnerable entities. To ensure safeguards against bias, the paper advocates for independent audits of AI models, along with their underlying data. A public dashboard which displays key performance metrics of the AI-EWS would enhance public trust, foster better adoption of the warning system. Additionally, a dedicated portal for redressal would allow for debtors to seek help against wrongful evaluations. Additionally, usage of insights from the EWS should be

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<sup>37</sup> Digital Personal Data Protection Act, 2023, [https://www.indiacode.nic.in/bitstream/123456789/60377/1/digital\\_personal\\_data\\_protection\\_act\\_2023.pdf](https://www.indiacode.nic.in/bitstream/123456789/60377/1/digital_personal_data_protection_act_2023.pdf).

<sup>38</sup> Digital Personal Data Protection Act, 2023, § 7, <https://indiankanoon.org/doc/62814281/>.

<sup>39</sup> MINISTRY OF ELEC. & INFO. TECH. (MEITY), DRAFT NATIONAL DATA GOVERNANCE FRAMEWORK POLICY (May 2022), [https://static.mygov.in/static/s3fs-public/mygov\\_165363436397687021.pdf](https://static.mygov.in/static/s3fs-public/mygov_165363436397687021.pdf).

<sup>40</sup> Digital Personal Data Protection Act, 2023, [https://www.indiacode.nic.in/bitstream/123456789/60377/1/digital\\_personal\\_data\\_protection\\_act\\_2023.pdf](https://www.indiacode.nic.in/bitstream/123456789/60377/1/digital_personal_data_protection_act_2023.pdf).

governed by the IBBI model code of conduct for Insolvency Professionals<sup>41</sup>, ensuring that they exercise professional judgment rather than delegating their job to AI.

#### 4.4 Regulatory Coordination

Forming at the root of the proposed AI-EWS, is regulatory coordination. This particular warning system relies on regulatory coordination between multiple stakeholders and government entities, such as the RBI, Ministry of Corporate Affairs, IBBI and entities like SEBI. To ensure harmonization, it is imperative that all entities play their parts well. With RBI operating its own EWS for banks<sup>42</sup>, SEBI having mandated disclosures, and MCA monitoring corporate risk, a joint regulatory committee having stakeholders from all these organizations can go for a unified approach to financial distress detection.

### 5 COMPARATIVE MODELS AND EMPIRICAL EVIDENCE

The paper submits that the concept of an AI-EWS is not theoretical, but is rather inspired from existing mechanisms from advanced jurisdictions. These jurisdictions include advanced insolvency frameworks, such as the EU, Singapore, China, France etc. These have been elaborated upon:

- *European Union (EU)*: the European Union in its EU Directive 2019/1023<sup>43</sup> called for member states to adopt a proactive intervention rather than a reactive one, recognising the need for pre-insolvency frameworks. This mandate has caused many member states like Netherlands to explore early restructuring mechanisms, reducing both time taken and value erosion.
- *Singapore*: The IRDA<sup>44</sup> and Monetary Authority of Singapore (MAS) have attempted to integrate AI based warning systems into overall fintech framework, which assist financial institutions to recognise signs of financial distress and initiate appropriate intervention. This makes the financial landscape more resilient.

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<sup>41</sup> Insolvency and Bankruptcy Board of India (IBBI), *Code of Conduct for Insolvency Professionals* (under IBBI (Insolvency Professionals) Regulations, 2016, as amended up to Apr. 3, 2025), <https://www.ibbi.gov.in/en/legal-framework>.

<sup>42</sup> Reserve Bank of India, Master Direction on Fraud Risk Management in Commercial Banks (July 2024) (mandating mandatory implementation and board oversight of integrated Early Warning System and Red Flagged Account frameworks, with data analytics units, CBS integration, and CRILC reporting), [https://www.rbi.org.in/Scripts/BS\\_ViewMasDirections.aspx?id=12702](https://www.rbi.org.in/Scripts/BS_ViewMasDirections.aspx?id=12702).

<sup>43</sup> EU Restructuring Directive.

<sup>44</sup> Insolvency, Restructuring and Dissolution Act 2018 (No. 40 of 2018) (Sing.).

- *Italy*: Italy has introduced reforms to its insolvency framework with the Legislative Decree No. 14/2019<sup>45</sup> and subsequent amendments<sup>46</sup>, which are also called as 2021 Bankruptcy law reforms. These reforms generate automated notifications for stakeholders involved about emerging distress indicators. While the law doesn't mandate the use of an AI-based system, in procedure, technology is widely leveraged to save time and for accuracy.
- *China*: As pilots of leveraging AI for predictions run in China, empirical studies advocate for hybrid AI models, including random forest algorithms combined with evidence theory to provide AI based risk detection within the framework established by Enterprise Bankruptcy Law<sup>47,48</sup>. These systems enable early alerts and notifications which are data driven.
- *France*: The French Insolvency Law Reforms through its legislations, the “Loi de Sauvegarde” (Law No. 2005-845)<sup>49</sup> and the “Loi Macron” (Law No. 2015-990)<sup>50</sup>, enabled for pre-insolvency restructuring along with Articles L611-1, L611-2 of French Commercial Code<sup>51</sup>. While the legal system doesn't mandate use of AI driven systems, they are widely used by professionals. These allow courts to take intervention measures upon distress notifications.

While these foreign jurisdictions do highlight the importance of an AI-EWS, it wouldn't make a convincing case for its implementation in India. However, India's experiences with its insolvency substantiate the need for an early warning system. Firstly, the Bankruptcy Law Reforms Committee (BLRC) in its 2015 report studied the default vs balance sheet tests, justifying the choice of the default test for providing legal certainty.<sup>52</sup> There was a recognition for identification of stress indicators, which were skipped in the final code. Secondly,

<sup>45</sup> Legislative Decree No. 14 of Jan. 12, 2019, Codice della crisi d'impresa e dell'insolvenza (Italy), repealing Royal Decree No. 267 of Mar. 16, 1942, <https://www.gazzettaufficiale.it/eli/id/2019/02/14/19G00007/sg>.

<sup>46</sup> Legislative Decree No. 83 of June 17, 2022 (Italy) (implementing Directive (EU) 2019/1023 into national law and amending Decree No. 14/2019 to introduce preventive restructuring frameworks, effective July 15, 2022), <https://www.gazzettaufficiale.it/eli/id/2022/07/01/22G00090/sg>.

<sup>47</sup> Enterprise Bankruptcy Law of the People's Republic of China (adopted Aug. 27, 2006, effective June 1, 2007), English translation published by Supreme People's Court, [https://english.court.gov.cn/2015-08/17/c\\_761434.htm](https://english.court.gov.cn/2015-08/17/c_761434.htm).

<sup>48</sup> Chi Zhang et al., *A Method for Financial System Analysis of Listed Companies Based on Random Forest and Time Series*, MOBILE INFO. SYS. (2022), <https://doi.org/10.1155/2022/6159459>.

<sup>49</sup> Law No. 2005-845 of July 26, 2005 (France), Loi de sauvegarde des entreprises (introducing procédure de sauvegarde, a preventive restructuring mechanism analogous to pre-insolvency frameworks), <https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000000632645>.

<sup>50</sup> Law No. 2015-990 of Aug. 6, 2015 (France), Loi pour la croissance, l'activité et l'égalité des chances économiques (“Loi Macron”) (establishing procedural reforms such as specialized insolvency courts and cram-down powers in restructuring), <https://www.legifrance.gouv.fr/loda/id/JORFTEXT000030978561>.

<sup>51</sup> Commercial Code (Code de commerce) art. L 611-1–L 611-2 (Fr.), <https://french-business-law.com/french-legislation-art/article-l611-1-of-the-french-commercial-code/>.

<sup>52</sup> MINISTRY OF FINANCE, GOV'T OF INDIA, THE REPORT OF THE BANKRUPTCY LAW REFORMS COMMITTEE: VOLUME I – RATIONALE AND DESIGN ch. 4.3 (2015).

as far as data driven decisions in the financial sector is concerned, the Indian example of State Bank of India (SBI) substantiates the benefits of data driven decisions. SBI being the largest public sector bank, it has implemented its own EWS in regards to NPA data, where the system assesses risk in accounts, and alerts to make early intervention possible.<sup>53</sup> This is a clear application of benefits of data driven mechanisms. Additionally, in plethora of cases of Indian insolvency, such as Jet Airways<sup>54</sup> and Bhushan Steel<sup>55</sup>, it is observed that protracted delays often lead to value erosion which cannot be prevented, warranting a pre-insolvency intervention. This can only be possible and feasible with the use of an AI-EWS.

The comparative jurisdictions coupled with domestic experiences lay down strong grounds for adoption of an AI-EWS. These systems can greatly enhance the financial landscape, allowing for a better insolvency framework.

## 6 INSTITUTIONAL & REGULATORY RECOMMENDATIONS

For the implementation of an AI-EWS, a concerted effort is required on the institutional and regulatory fronts. To that extent, the paper makes the following recommendations:

- *Legal Reform:* In regards to legal reforms to Indian statutes, the paper recommends, firstly, amending the IBC 2016<sup>56</sup> for formal recognition of the outputs and dashboard associated with the AI-EWS as corroborative evidence. The outputs should hold only advisory weight in affecting the decision to start pre-insolvency talks. Secondly, concurrent amendments shall be made to the Bharatiya Sakshya Adhiniyam 2023<sup>57</sup>. These amendments would ensure that AI based outputs hold a corroborating value instead of a conclusive one. Thirdly, the IBBI regulations must be updated to mandate data standardization, sharing and storage protocols among stakeholders. This is imperative for the functioning of the AI-EWS.
- *Data Governance:* Forming a crucial part of given recommendations, is the compliance of the procedure of creation and usage of the AI-EWS with data privacy regulations. The paper recommends that data collection and processing should be DPDPA<sup>58</sup> compliant, complying with data collection and retention policies. Secondly, data

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<sup>53</sup> STATE BANK OF INDIA, ANNUAL REPORT 2020–21 (Credit Monitoring), <https://sbi.bank.in/corporate/AR2021/assets/PDF/English/11-3-Core%20Operations.pdf>.

<sup>54</sup> Jet Airways (India) Ltd. v. State Bank of India, Company Appeal (AT) (Insolvency) No. 707 of 2019 (NCLAT Sept. 26, 2019).

<sup>55</sup> Comm. of Creditors of Bhushan Power & Steel Ltd. v. Tata Steel Ltd., Company Appeal (AT) (Insolvency) No. 1063 of 2019 (NCLAT Feb. 17, 2020).

<sup>56</sup> IBC.

<sup>57</sup> Bharatiya Sakshya Adhiniyam, 2023, [https://www.indiacode.nic.in/bitstream/123456789/59406/1/the\\_bharatiya\\_sakshya\\_adhiniyam%2C\\_2023.pdf](https://www.indiacode.nic.in/bitstream/123456789/59406/1/the_bharatiya_sakshya_adhiniyam%2C_2023.pdf).

<sup>58</sup> Digital Personal Data Protection Act, 2023, § 7, <https://indiankanoon.org/doc/62814281/>.

governance must be done as per prescribed standards, with regards to data localization, procedures to be followed in case of data breach. This is crucial due to sensitive nature of financial data.

- *Regulatory Oversight:* The paper stresses on the need of regulatory oversight and exercise of expert judgement on use of AI-EWS models. The paper recommends that, firstly, a robust framework must be established for certification and validation of AI-EWS models, with set standards for model accuracy, fairness, regular audits and mandatory pilot projects. Secondly, the paper reiterates the need for a joint regulatory committee made from representations from stakeholders for better coordination and data sharing.
- *Stakeholder Engagement:* This paper highlights the crucial nature of stakeholder engagement before the implementation of AI-EWS, with development of capacity building programmes organised with Insolvency Professionals, Financial Institutions like banks, Adjudicating authorities, Educational Institutions and the like. This would be crucial to educate the stakeholders as to how to interpret the outputs and results given by the AI-EWS as well as its limitations. Secondly, regular channels need to be established for continuous stakeholder consultation to resolve grievances and gather feedback as to the functioning of the AI-EWS.
- *Pilot Implementation:* The next recommendation pertains to phased implementation of the AI-EWS. Acknowledging the size of the undertaking as well as the limitations of technology, it is imperative that the project goes through a phased implementation, primarily restricted to specific sectors and big corporates in the first phase. This will allow for redressal of issues that may arise before the AI-EWS is implemented nationwide. Additionally, the phased rollout must be accompanied by clearly defined metrics for evaluation of pilot projects, such as reduction in value erosion, reduction in time etc.
- *Ethical Safeguards:* The paper recommends upholding ethical safeguards as to transparency, grievance redressal and professional standards. The performance metrics of the AI-EWS must be shared with utmost transparency in accordance with applicable law, along with establishment of an efficient redressal mechanism for debtors to challenge their risk scores. Additionally, professional standards in regards to insolvency professionals and judiciary must be upheld when interacting with the AI-EWS.
- *International Collaboration:* The paper recommends adoption of best practices from international jurisdiction with modifications if required by the Indian landscape. Also, global standards, both in respect of financial systems and AI governance must be upheld to position India as an accountable AI power.

## 7 LIMITATIONS AND MITIGATION STRATEGIES

While the paper advocates for adoption of an AI-EWS, it also acknowledges the limitations of technology and procedural issues that may arise with it. To that extent, the paper suggests mitigation strategies which may eliminate the limitations to a great extent. These are:

- *Data Integration Challenges:* Forming one of the foremost challenges in establishing AI-EWS, is the character of legacy systems and outdated data formats for India's legal and financial data. The data is in fragmented format and exists in various data formats across various information hubs such as the MCA, GSTN, NeSL etc. This is a particular challenge as this data needs standardization before algorithms are trained on it. To mitigate this particular challenge, the paper recommends a phased rollout strategy, firstly using readily available data, and subsequently mandating data standardization for better unification of data silos existing across various authorities. These mandates must have clear timelines and specifications.
- *Stakeholder Resistance:* Forming one of the foremost challenges to implementation of AI-EWS, is resistance from stakeholders. Stakeholders like banks would be apprehensive due to privacy concerns and regulatory obligations, debtors would be apprehensive of stigma of risk scores, as well as apprehension from judges and insolvency professionals towards use of AI and technology. To mitigate this, the adoption may be incentivised by tangible benefits and implementation of capacity building programmes to increase awareness and familiarity to tech related aspects of AI-EWS. It must be communicated clearly that AI is being used to supplement, not supplant.
- *Regulatory Overlaps:* As highlighted earlier, the AI-EWS would function by coordination of multiple government agencies, which risks regulatory overlaps. This might result in confusion over the management, and result in conflicting guidelines and jurisdictional overlaps. To mitigate this, the authors recommend establishment of a joint regulatory committee (IBBI-RBI-SEBI-MCA), which can mandate clear protocols for data standardization, sharing, storage and protection. This will allow for a unified approach.
- *Ethical Risks (Bias, Fairness, Accountability):* As adoption of AI technology takes the front lead, it is imperative to acknowledge the ethical use of AI and implement necessary safeguards in use of AI models. AI models can suffer from biases on basis of their creation and data sets they are trained on, which can lead to discriminatory outcomes. This can be particularly damaging for vulnerable entities like MSMEs. To mitigate this, the authors recommend continuous audits of AI model for bias detection and development of transparent reporting mechanisms to explain the AI-EWS better. This will allow for better adoption of the AI-EWS.

- *Credit Access Risks:* There might be an apprehension among debtors that high risk scores might reduce their credit limits, stifling business ecosystem. This is also true when even though recovery is possible, still credit availing ability is restricted. To mitigate this, the authors recommend regulatory prohibition on misuse of EWS scores, mandating human review and comprehensive assessment. The EWS must facilitate revival of the corporate debtor, not be used for punitive measures against them.

## 8 CONCLUSION AND FUTURE OUTLOOK

As things presently stand, the Indian insolvency landscape has seen a turn for the better after the introduction of the IBC in 2016. However, with the advent of new technologies, a new era of insolvency is at the horizon, and with the introduction of AI-powered Early Warning System (AI-EWS) for its insolvency landscape, India can stand at the forefront. By using this, it can significantly convert a reactive framework to a pro-active one, which prevents value erosion and not only prevents the liquidation of the corporate debtor, but prevents the lengthy value-eroding CIRP altogether. The current approach, which enables the mechanisms after a lot of value has already eroded, results in delays, suboptimal outcomes, and doesn't leave much incentive for creditors to make their focus on the revival of the corporate debtor.

Taking lessons from advanced jurisdictions can greatly aid India's AI-powered Early Warning System (AI-EWS) and provide a solid foundation of principles to build it on. Lessons can be taken from jurisdictions such as EU, UK and France and modified to fit special needs of India's insolvency landscape. With the use of its own digital infrastructure which is seeing a boom currently, India can let go of traditional approach and approach the new age of insolvency.

However, as highlighted earlier, no technology comes without its own limitations, and the same must be said for this. There will be a plethora of challenges such as data integration, ethical use of AI, regulatory coordination and more. However, these can be addressed with the use of modern technologies and a proactive intent and management. It must be ensured that AI remains in an advisory role, its bias be limited to a minimum and data privacy principles are upheld. These will build trust in the system and encourage people to adopt it.

With a meticulously planned system, phased implementation, along with stakeholder consultation and grievance redressal, India can overcome the challenges it faces and make a system which can be an inspiration for countries in Asia, Africa and South America. This

will set a new global benchmark, with India being the harbinger of new age of technology-based insolvency landscape.

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