Creating Data Infrastructures for Government Analytics

CASE STUDY 9.2 HRMIS CASE STUDY: FEDERAL PAYROLL CONTROL AND COMPLIANCE (BRAZIL)

Luciana Andrade, Galileu Kim, and Matheus Soldi Hardt

SUMMARY

In 2019, a public-private partnership between a federal payroll auditing team and a consulting firm resulted in the development of a novel payroll irregularity detection system. The solution included an integrated data pipeline to train a statistical model to detect irregularities as well as automated identification of violations of payroll regulations. The fraud detection system was used to assist payroll auditors in their daily work. This complementary approach enabled auditors to better detect irregular payroll entries, increasing savings and improving efficiency.

INTRODUCTION

Governments are responsible for the accurate and timely disbursement of payroll to civil servants. As the volume and complexity of payroll increase, manual approaches to quality control are not sustainable. In 2019, the Department of Compensation and Benefits (DEREB), a federal agency in Brazil, was responsible

Luciana Andrade is a senior regulatory agent with Anvisa. Galileu Kim is a research analyst in the World Bank's Development Impact Evaluation (DIME) Department. Matheus Soldi Hardt is a partner at EloGroup.

for overseeing over 80 million paychecks annually. To improve the process, DEREB introduced a new technology to support payroll analysts in their quality checks, which combined machine learning and automation. The Federal Payroll Digital Transformation project ultimately increased recovery rates on inconsistent paychecks and is used daily by payroll analysts in Brazil's federal government.

This case study describes how the project improved the workflow for control and compliance in payroll, a foundational module in a human resources management information system (HRMIS). Although the project had a narrow focus compared to the case of Luxembourg (case study 9.1), this limited scope enabled the development of a highly specialized solution to payroll management, analogous to the case of the United States (case study 9.3). This specialization allowed for the relatively quick and low-cost deployment of the solution. However, it also meant that the project was context specific and not necessarily scalable to other modules in the HRMIS.

Here are the key lessons from the case. First, the foundational steps of problem definition and scope were conducted through extensive dialogue with end users. Payroll analysts who would ultimately use the technology were consulted and offered input to the solution itself. Second, an iterative approach reduced risk aversion and secured buy-in from leadership in public administration. Because the payroll system was complex and the analysts themselves did not have complete knowledge of it, the team opted for gradual refinement of the solution. Finally, reliance on external actors allowed for rapid implementation, but due to this external reliance, the solution was not further developed once the intervention was finalized. In-house technical capacity was never built.

The case study is structured as follows. First, we provide institutional context about the federal payroll system. Section 2 outlines the solution. Section 3 highlights the rollout strategy for the solution. Section 4 describes risk aversion in bureaucratic organizations and how iterative disruption overcame it. Section 5 outlines the impact of the solution. Section 6 draws some lessons and cautionary observations about the external implementation of digital solutions. Finally, we conclude.
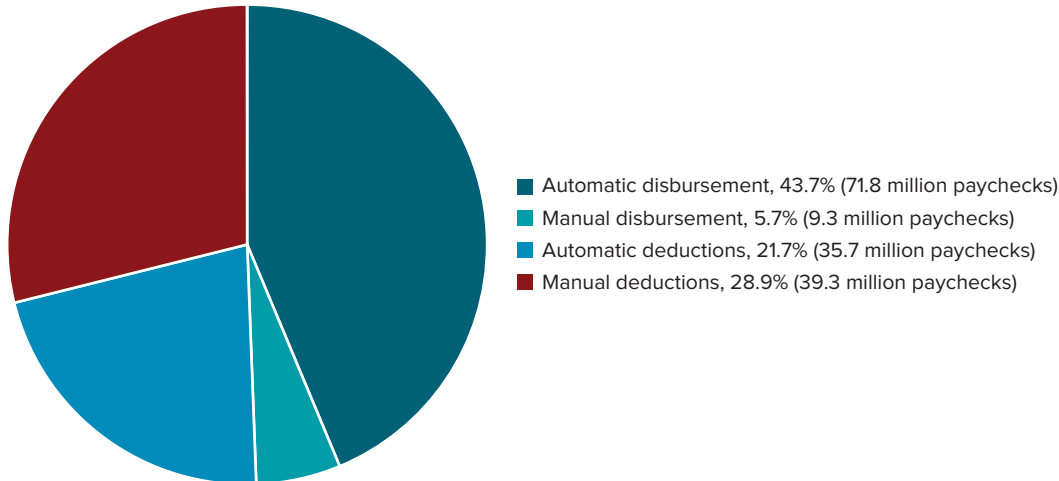
INSTITUTIONAL CONTEXT OF THE FEDERAL PAYROLL SYSTEM

Brazil's federal government disburses over R$150 billion (US$30 billion) in the federal payroll every year, accounting for 1.4 percent of the national GDP in 2019. Of the total paychecks issued, over 43 percent are fully automated, meaning that payments are automatically disbursed according to pre-established rules and procedures (figure 9.9). However, 5.7 percent are still manually submitted entries, amounting to 9.3 million manual entries in 2018. While payroll data are centrally stored and managed by the Ministry of Finance, disbursement and deductions are submitted through claims by human resource (HR) departments in different federal agencies.

As noted in chapter 9, one of the foundational modules in an HRMIS is payroll compliance and control. In Brazil's federal government, payroll quality control is the responsibility of DEREB, which is overseen by the Department of Personnel Management and Performance (SGP). While it does not have the mandate to punish infractions, DEREB flags paycheck inconsistencies prior to disbursement, which must be addressed by HR departments in federal agencies.

The task is challenging. The case volume is large, with tens of thousands of individual disbursements transacted daily. Additionally, a complex set of regulations governs how payments should be disbursed. To enforce these rules and detect inconsistencies, a team of payroll analysts individually verify each paycheck. Over the course of a day, analysts check hundreds of entries to verify whether the values are in accordance with the existing rules, whether the amount issued is too high, and whether the public servant that would receive the value has the actual benefit, among other inconsistencies.

Before project implementation in 2019, payroll monitoring was done through a combination of selecting the highest-value paychecks and random sampling. At this stage, DEREB first determined the

FIGURE 9.9 Brazil's Federal Payroll, 2018

- Automatic disbursement, 43.7% (71.8 million paychecks)
- Manual disbursement, 5.7% (9.3 million paychecks)
- Automatic deductions, 21.7% (35.7 million paychecks)
- Manual deductions, 28.9% (39.3 million paychecks)

Source: Original figure for this publication.
Note: Payroll excludes the municipal government of Brasília (GDF) and state-owned enterprises.

number of manual entries to be verified based on the productivity of each payroll analyst multiplied by the number of payroll analysts working that day. DEREB would then select payroll entries according to the following rules: 90 percent of the sample was selected from the highest-value entries and the remaining 10 percent was randomly selected. This approach was designed to reduce workload and maximize fund recovery since large entries were overrepresented in the sample.

Although this legacy approach represented an initial attempt to automate the sampling of entries for monitoring, it identified few inconsistencies. In total, only 2 percent of entries were notified for corrections, and of those, 40 percent were corrected. In total, inconsistencies that represented less than R$10 million per year were corrected, less than 0.1 percent of the total amount disbursed by the federal payroll. Management at DEREB wanted to improve this process and opted for an HRMIS reform project in collaboration with a consulting firm.

THE SOLUTION: FEDERAL PAYROLL DIGITAL TRANSFORMATION

The Federal Payroll Digital Transformation project changed the workflow for payroll quality control through the implementation of new technologies. The project was a public-private partnership between DEREB and the consulting firm EloGroup. At its core, the solution generated flags and rankings for federal payroll analysts in their effort to detect and notify agencies of potential inconsistencies in their payrolls. The solution was open source and deployed through cloud technology. The development cycle took approximately eight months to complete.

The solution relies on two complementary approaches: qualitative flagging of regulations governing payroll and quantitative analysis through anomaly-detection statistics. The development of the business-rules module relied on translating regulations governing payroll into automated flags indicating whether an infraction has occurred. The quantitative approach adopts statistical techniques developed by credit card companies to detect anomalies in payments. Payroll values that are far off from a predicted value are assigned a greater risk score and prioritized for payroll analysts.

The solution is executed daily. The first step in the pipeline is the extraction of data on paychecks created in the previous working day, reduced to the subset of manually imputed disbursements (figure 9.10). The data

FIGURE 9.10   Brazil's Solution Workflow
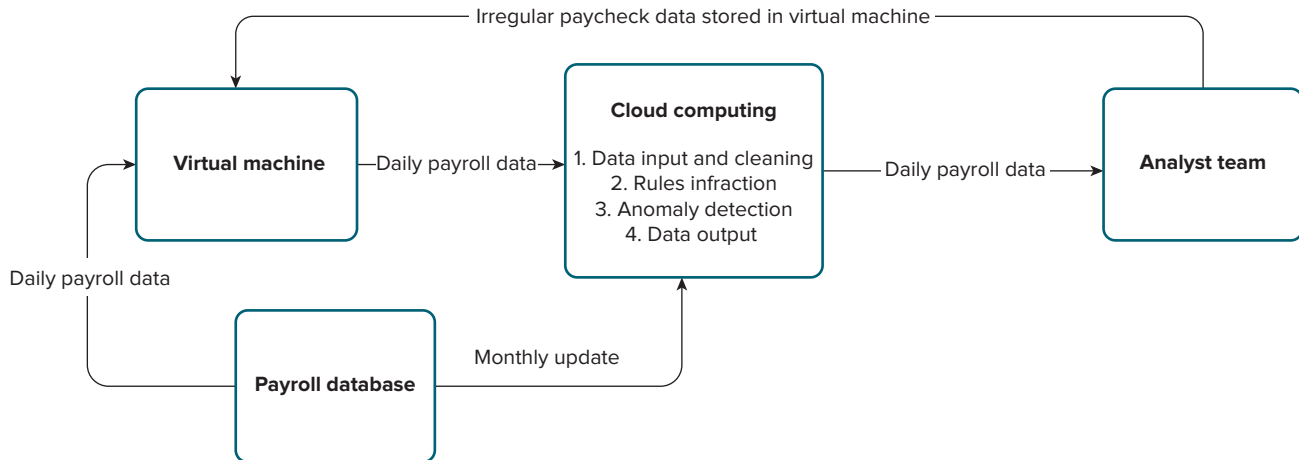
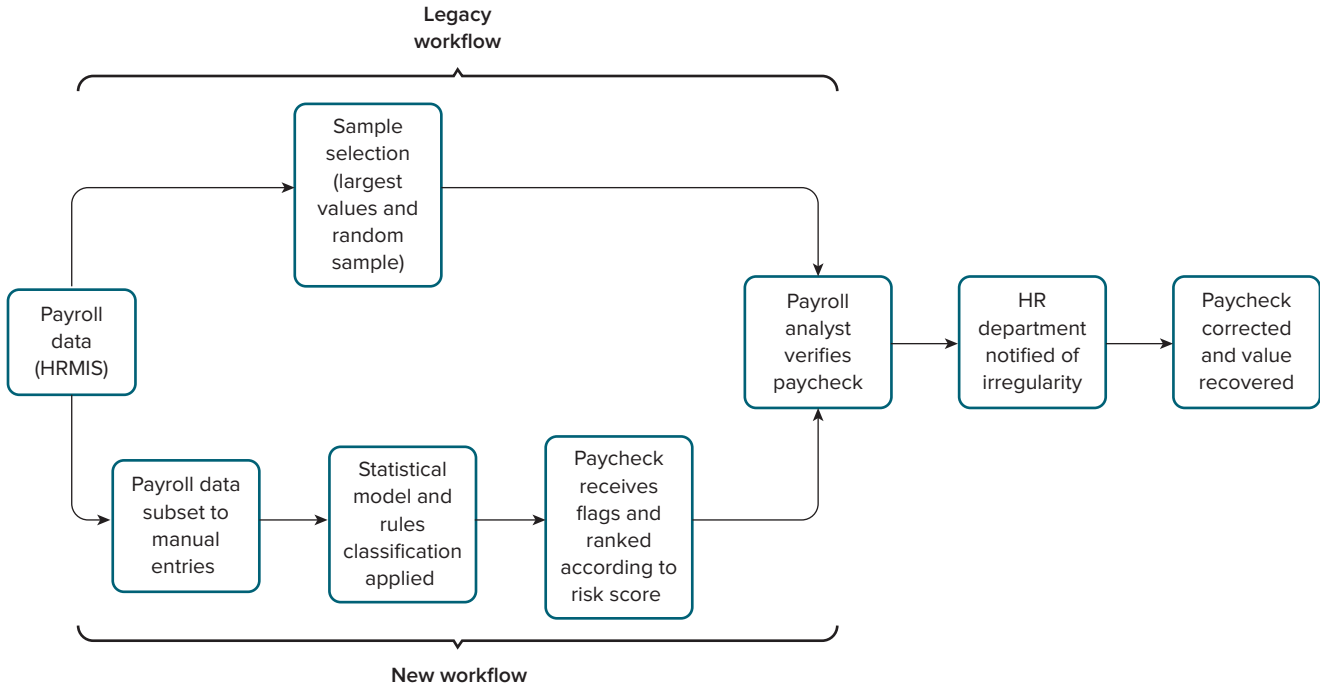*Source:* Original figure for this publication.

are fed directly from the payroll database into a virtual machine (VM), which receives and stores the daily payroll data. The data are then transferred to a computing cluster in the cloud, where a set of tasks is performed. The data are first cleaned and then go through a rules-infraction module, where they are flagged for potential violations. For example, one rule may be that civil servants are not allowed to claim over 1,000 reais in reimbursement for travel expenses. If the rules-infraction module detects claims that exceed that threshold, it would flag that paycheck and send it directly to the payroll analyst team, indicating that this rule has been violated. If no rule infractions are detected, the paycheck is fed into a machine-learning model that classifies paychecks as anomalous, attributing to them a risk score.

Once the business rules and the statistical model classification are applied, paychecks that are considered most likely to be inconsistent are ranked first and sent to the analyst team. The format in which the data are exported is a simple worksheet, with predetermined labels identifying the risk score and the rule-infraction flags, as well as usual paycheck fields, such as issuing agency and beneficiary. Payroll analysts have discretion over which paychecks to verify and can rank paychecks according to priority, regardless of the classification exercise. It is only at this stage that paychecks are verified and flagged for additional verification by the issuing agencies. Note that the decision to issue a flag remains under the jurisdiction of the analyst.

As a result, the workflow from the analyst's perspective has not changed significantly. The value added is curated information for the analyst, through automated rule-compliance flags and risk scores to facilitate the analyst's decision-making process. Each step in the solution workflow outlined in figure 9.10 is an additional layer of verification, which transparently encodes how the data are cleaned and classified before reaching the analyst's visual dashboard. This choice of design was agreed upon by the monitoring team and the data science team, who opted to make insights from the solution accessible and easy to use. Figure 9.11 compares the new approach with the legacy one.

The machine-learning model and the rules classification do not replace the monitoring team—rather, they enhance its workflow by automating procedures before the data even reach the individual analyst. This complementarity between analog and digital processes is what enabled the new workflow to be well received and adopted by analysts, in contrast to other experiences of technological innovation in which human decisions are eliminated. This hybrid solution provides a more gradual approach toward the goal of digital transformation, accommodating the need for preserving human autonomy while increasing humans' productivity through the use of technology.

FIGURE 9.11   Comparison between Brazil's Legacy and New Payroll Workflows

Source: Original figure for this publication.
Note: HR = human resources; HRMIS = human resources management information system.

ROLLOUT STRATEGY AND SEQUENCING

The director of DEREB decided to improve the existing monitoring system by leveraging the use of digital technologies. Given the agency's capacity constraints and lack of familiarity with technological innovation, the director outsourced the implementation and rollout strategy for the solution to an external consulting firm. The initial legal groundwork was crucial. The director of the consulting firm EloGroup leveraged its experience in the development of digital technologies for other government agencies and guided the drafting of the proposal. The General Coordinator for Special Projects of the Secretariat of Public Policies for Employment was familiar with the regulatory process and provided guidance on obtaining legal approval and initial funding for the solution.

The political environment was favorable for the project. Senior leadership was committed to fighting inefficiency and possible cases of corruption, and the federal payroll was under scrutiny due to its large size and perceived inefficiency. The SGP leadership team gave wide discretion to DEREB regarding the HRMIS reform to be enacted. This autonomy allowed the director of DEREB to make difficult decisions regarding personnel, who initially resisted modifying the existing monitoring process. To obtain funding for the project, the team submitted a project proposal to a technology company that provided seed funding for the project.

The monitoring system was developed by a small but agile team of technology consultants at the consulting firm EloGroup. The initial goal was to design a prototype of the workflow outlined in figure 9.10 to detect inconsistencies that would validate the approach. An intensive consultation process preceded the implementation of the technical solution. Workshops and open discussions with federal agencies highlighted what data would be available to develop the prototype, what unique identifiers there were for merging the data, and what kinds of variables would be available to the machine-learning algorithm. An initial workshop covered

problem definition and project scoping, defining how the solution would be embedded into the monitoring tasks performed by the auditors.

Once the project was launched, it faced resistance from staff. Personnel within the monitoring team at DEREB expressed concern regarding the proposed solution because they feared displacement and the disruption of existing procedures. Staff also worried that the digital update would lead to a technological dead end, as had occurred in previous collaborations with external consulting firms. Anecdotally, there was a perception among participating Brazilian public servants that private initiatives introduced off-the-shelf solutions without considering the needs or opinions of public servants who had worked for years in the area.

A collaborative design aimed to assuage these concerns. During the kickoff workshop with multiple federal agencies, staff from different areas within DEREB were able to express their views on the flaws and strengths of the payroll system. On more than one occasion, a public servant in one area identified that his challenge was shared across departments. These open conversations made even the most reluctant employees of the project express interest, or at least not boycott the initiative. In making these concerns transparent and sharing them in an open forum, the team included payroll analysts in the development of the project. Obtaining buy-in within and across departments proved crucial to the success and sustainability of the solution.

Buy-in was necessary not only for personnel but for upper management as well. Due to budget constraints, Brazil's federal bureaucracy had only limited access to cloud resources, for which agencies needed to petition. As a result, after the initial seed funding was spent, it was necessary to secure access to cloud computing through a formal project proposal. To do this, the team presented the results of the initial stage of the solution, highlighting the benefits of the approach and how it could assist the government in saving money. This effort was ultimately successful, securing additional funding to complete the solution.

RISK AVERSION AND ITERATIVE DISRUPTION

Bureaucratic agencies are risk averse, and with good reason: they perform key roles in government and, while doing so, comply with rules and regulations. A task executed improperly or failure to abide by existing norms can have severe consequences, both for the general functioning of the state apparatus and for the individual careers of civil servants. The solution for this project was not to revamp the regulatory framework or standard operations. Instead, the reform team identified small opportunities to improve the workflow of the analyst team through multiple cycles of disruption.

Coordination was key to this approach. The consulting team was responsible for implementing the solution in terms of software and data engineering. Meanwhile, the payroll analysts and the management team at DEREB provided feedback and prototyped beta versions of the solution. To strengthen this partnership, communication channels between both teams were reinforced. The method deployed for the development of the solution was short but agile.

One of the main challenges in implementing the solution was a mutual lack of knowledge between DEREB and EloGroup regarding the other's area of expertise. For the consulting team, the payroll data and governance structures of Brazil's federal bureaucracy were so complex that most of their initial effort focused on learning how the payroll system operated. To address this, the consulting team had to communicate extensively with the monitoring team at DEREB to ensure that relevant data were extracted and that regulations were incorporated into the automated rules and statistical model.

On the other hand, the monitoring team at DEREB had limited exposure to statistics and software development and therefore needed to be introduced to novel techniques without prior knowledge. Conversations

revolved around how to formalize the substantive knowledge of analysts in software, but ultimately, analysts had to rely on the consulting team to implement the solution. Lack of familiarity with software development and the platform meant that when bugs in the operations were identified, the consulting team had to address them, and workflow was interrupted.

With the initial data pipeline designed, the business rules and the statistical model were put into production. Anomalous paychecks were sent directly to the monitoring team for validation. The initial results were positive, with the algorithm-empowered monitoring consistently outperforming the previous approach, based on the size of paychecks. As additional resources were necessary to expand the project, the director of DEREB presented the results to government leadership as promising evidence that the approach was correct. This initial buy-in proved key: having an actual solution in production and demonstrating results reduced uncertainty in higher levels of management.

The deployed solution combines two key insights: first, it formalizes existing laws and regulations governing payments in an automated pipeline. This means that the analyst no longer has to verify whether a paycheck complies with regulations; the business-rules module does this automatically. Second, the anomaly-detection algorithm relies on statistical modeling to leverage information about public servants, their departments, and their payment histories. This process fully leverages the information methodically collected by the Brazilian government on its payroll and public servants without imposing additional burdens on the analyst team.

Additionally, the current algorithm is designed to reduce workload and help analysts prioritize paychecks with higher risk. This complementary approach to improving payroll analysts' workflow is key: after initial resistance regarding these changes, the monitoring team realized the benefits of the new digital approach over previous approaches. This hybrid model, incorporating both analog and digital processes, can provide a template for public sector technological innovations.

IMPACT OF THE SOLUTION

The clearest gains from the solution were in efficiency: despite the reduction in personnel, performance increased. Due to staff attrition unrelated to the project, the team of payroll analysts had been reduced in size. Despite this reduction, the reduced analyst team could flag the same amount of resources as inconsistent compared to a larger team, while dedicating less time to each task. This reduction in the cost and maintenance of performance was an important selling point to other departments within the federal bureaucracy, highlighting the gains in efficiency from technological innovation.

An unintended consequence of the project was an increase in data literacy and a change in mindset. Users of the dashboard displayed greater interest in learning how the solution was implemented, with analysts expressing willingness to learn how to code to better understand the data. This growth in data literacy resulted from initial exposure to a set of techniques that had not been available before. Additionally, because of data integration, new linkages were formed between DEREB and other departments in the bureaucracy. Because the solution relied on data generated in other departments, there was a need for communication and transparency to make it work.

Finally, there was a shift in mindset regarding how to monitor payrolls. While previously, analysts had relied on their accumulated experience and intuition, the solution complemented this approach by emphasizing the use of data and regulatory infractions. The analytical framework of the solution provided a new template that analysts could use to assess whether a paycheck was indeed inconsistent. In a sense, the new technology changed the way payroll analysts approached their task.

SUSTAINABILITY OF EXTERNAL IMPLEMENTATION

External solutions are brittle. They introduce dependency on the technical know-how of external actors, and once the engagement is finalized, the beneficiary is no longer able to maintain or improve on the external solution. In this case, technical know-how—including software and data engineering—for the implementation of the project remained with the consulting team once it left. The analyst team at DEREB did not acquire the necessary skills or capacity to develop the solution further, even though it was open source. Although data literacy in the monitoring team increased, the analyst team was not formally trained to modify or further develop the software.

Additionally, changes in the management structure of DEREB after the implementation of the technical solution put the sustainability and continued development of the project at risk. While the previous director locked in the current version of the solution, it has not evolved since. Turnover in management and a contract-based approach meant that desirable additions to the solution—such as the extension of automation to all HR departments across federal agencies—were never implemented. The loss of institutional leadership and the lack of in-house capacity meant that while the product survived, it did not continue evolving.

CONCLUSION

Technological innovation is disruptive, but the costs and uncertainty associated with it can be reduced by adopting a gradual approach. Risk aversion—an important feature of bureaucracies—can be overcome through communication and small modifications to existing workflows. The Federal Payroll Digital Transformation project outlined in this case study showcases this approach. Instead of a complete transformation of the payroll monitoring process, the technology focused on complementing existing workflows by payroll analysts.

A collaborative approach helped build trust in the relevance of the solution and its applicability to daily operations by end users. Iterative cycles of feedback and adaptation ensured that the algorithm proposed was appropriate to the use case and understood by payroll analysts. In addition, this reduced resistance to the final adoption of the solution. Technological disruption can thus be managed and incorporated into existing procedures, giving rise to hybrid solutions that provide a stepping stone for more extensive and intensive solutions.

While the current version of the solution has been finalized, its future development is uncertain. Due to the project's outsourcing, the necessary expertise to implement and develop the solution was not developed in-house. Technological innovation through a public-private partnership therefore comes with associated costs and benefits. There is a trade-off between the agility and rapid gains from outsourcing to external agents and the lack of development of in-house expertise to continue growing solutions. External solutions therefore generate dependency on external actors for developing solutions, lowering the likelihood of maintenance and expansion in the long run.

Finally, the implementation team has emphasized the need for spaces within public administration to incubate technological innovation. These spaces would allow for calculated risks—and mistakes—within the public sector. While the team identified and opened spaces within which the solution could grow, it is important to ensure that those spaces are already set in place. This would incentivize not only managers willing to lead innovations but also staff members, who would prove more willing to engage in changes without fear of reprisal. It would also create incentives for agencies to develop the in-house capacity for technological innovation and reduce dependence on external actors.