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Think Simple. Build Powerful.

AS400
THE WAY FORWARD

ABSTRACT

A long-overdue modernization that businesses have delayed for decades. Here, we try to list down the paths that you, as an AS400 iSeries user, should tread to maximize your machine's potential or migrate to a more flexible & modern tech stack. We also touch upon some real-world scenarios for you to relate better.

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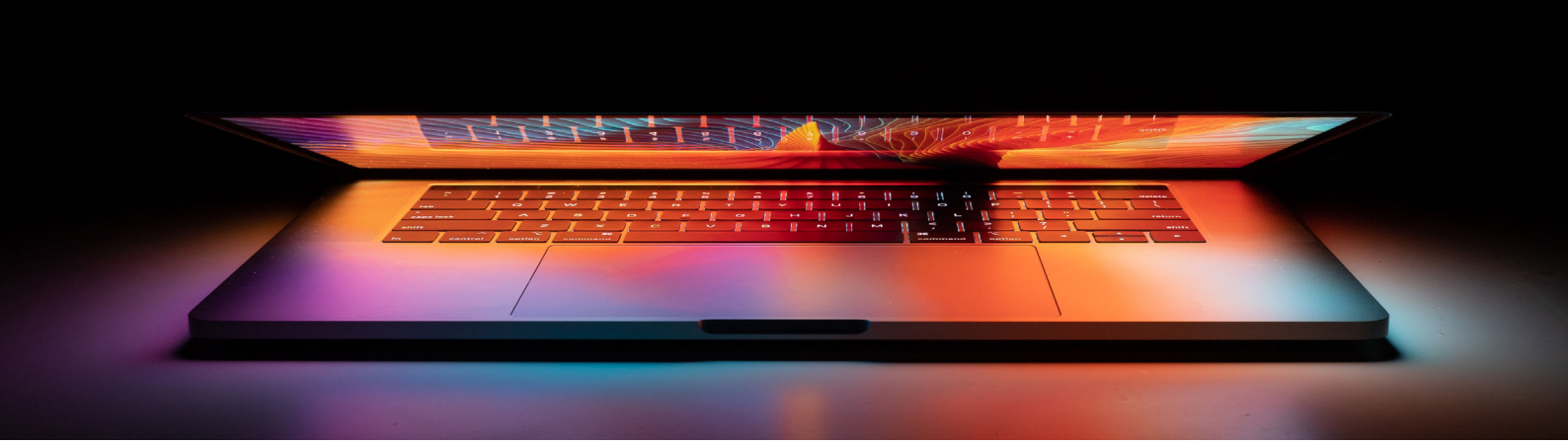

ABOUT THE

AUTHORS

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Sarthak has been addressing various challenges of the Information Technology industry by evaluating their business context for the past many years. He works closely with IBM iSeries enterprises across different industries, helping them grow their business and gain a competitive edge by augmenting their capabilities through meaningful IT services. He has helped several reputed organizations strategize and plan their roadmap to harness the IBM i operating environment for optimum outcomes.

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Bharath Alluru is a subject matter expert in IBM AS/400 technologies at Nalashaa Solutions. He brings in 14 years of experience with extensive business knowledge of enterprise-wide applications using ILE, RPGLE, and CLLE programming languages. He has been exposed to the entire AS400 technology continuum with experience in Modernization, Migration, Design, and Maintenance of enterprise solutions. He has primarily worked on designing solutions for Insurance, Retail, and Club Management Industries. Being passionate about technology, he evaluates & implements strategic and innovative ideas to enable enterprises to better utilize their AS400 by improving the machine's scalability, agility, and performance.

IBM iSERIES/AS400

SOME LIGHT TOWARDS THE END OF THE LEGACY TUNNEL

There is light at the end of every tunnel, some are just longer than the others. One such tunnel is within which most enterprises using the IBM iSeries/AS400 are currently sitting. Ever since enterprises started using applications to manage operations, IBM has played a vital role.

With a series of periodic updates, we are in the iSeries generation which is the heart of countless enterprises and helps organizations run their operations.

Considering the modern IBM server, i.e. the IBM i, you would notice the use of 'iSeries' on most occasions in this paper. However, the ideas here resonate with System 36/38, AS400, Power Systems, and of course the more advanced iSeries

Due to years of usage, such solutions store large volumes of critical data and core business logic of enterprises. With data sitting in silos in databases for years, organizations are looking to leverage and reap the maximum benefits from this accumulated information. Organizations using the IBM i machines face certain limitations from a user experience & modernization standpoint due to the tightly coupled code and the legacy green screens. This poses challenges in supporting the machines and ensuring high productivity of iSeries users. iSeries applications are usually the core of an organization and are critical for its end-to-end operations. However, with modern users governing industries, such systems look architecturally obsolete and can obstruct business growth.

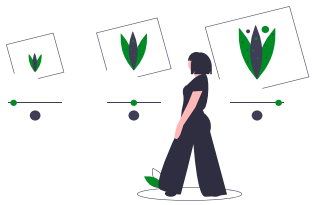
WHY IS iSERIES
STILL ONE OF THE BETTER ENTERPRISE SYSTEMS?

Legendary iSeries performance & reliability

IBM iSeries was introduced for enterprises to ensure security and timely transactions, with the machine hardware idle at the upper end of the server line. Another reason for its popularity is its high-performance CPU. For complex applications like an ERP that require extremely high performance and low downtime, these features are ideal.

Data security on IBM i

The AS/400 environment itself has never been infected with viruses that affect other environments. Server security has become the new focus of enterprises owing to the threats they are faced with today. The natural security framework offered by Power Systems is an effective defense against hacks/attacks. Infor conducted a recent survey that showed that 98.9% of Power System users are safe from viruses and haven't experienced any threat so far. The object-based design has been the heart of Power Systems since the first generation and remains the key to its IT security to this day. Viruses often penetrate systems in the form of data and not objects.



Scalability brought to the table

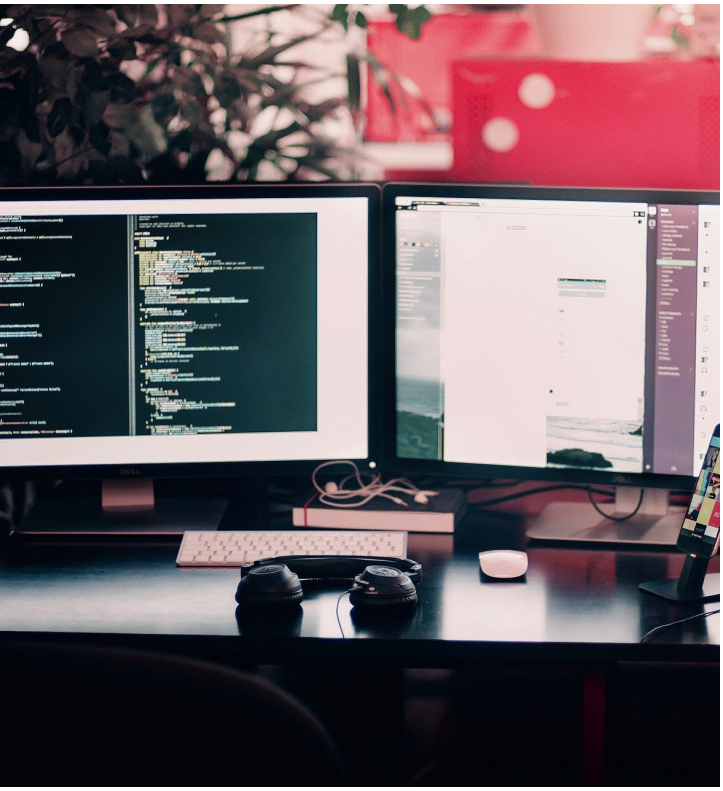
iSeries is architected to evolve as businesses progress. For example, businesses might go for minimal iSeries usage to start with, while exploring the possibilities of a new platform. As the organizational requirements evolve, the 'small' system can be enhanced with capabilities to coordinate higher data loads. Faster and more intelligent processors are typically added to increase the system efficiency and computing pace for improved operations. iSeries introduces a 'logical partitioning' concept that supports multiple iSeries systems within the same box (sharing hardware and processor resources being implicit). It also gives the option of adding multiple operating systems to work as a server farm, where adding users doesn't have a commercial impact.

AREAS WORTH CONSIDERATION
AS AN ENTERPRISE

USING iSERIES

Do we have enough AS400 resources?

Enterprises on iSeries have been facing a scarcity of skilled resources, or they might be short of support once their current employees approach the retirement age. Most of the reliable veterans who built these solutions are no longer available or are approaching retirement, forcing enterprises to look for options to ensure smooth operations. Losing the accumulated knowledge of AS400 experts is something enterprises must be wary of and address before it's too late.



Is our machine efficient enough?

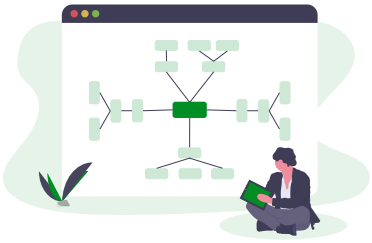
iSeries from IBM has been one of the most reliable and better-performing systems built for enterprises. However, with decades of operations and data, these systems are getting stuck with bottlenecks and data clogs. With regular firefighting in ensuring smooth operations, IBM i admins rarely work towards improving the system's performance. Techniques such as 'node visualization' and 'IBM i performance data analysis' provide visibility into systems, applications, and hardware performance, which currently isn't the focus of most enterprises.

Are we at any business risk?

IBM i continues to be one of the most reliable operating systems and it rarely faces amateurish issues. However, with time and digital advancement across industries, iSeries poses some risks to enterprises, not performance-based but more to do with the people and IBM's models.

Resource Management

With 20-year old codes, 40-year old hardware, and 60-year old staff, this isn't something organizations would be excited about. iSeries systems, being the core application in businesses, play a primary role in managing the daily operations. The lack of skilled iSeries experts has imposed a risk that executives must address before it becomes a point of failure. From a skill standpoint, businesses can either continue with the unsafe option of their current staff or train a bunch of millennials who would have quite a big learning curve.



Risk Diversification

Risk mitigation is vital, and technology is no exception. Scarce skills result in those who develop these systems becoming indispensable, and thus a single point of failure. Moreover, training new iSeries folks without prior knowledge of the current system requires more overhead. Additionally, due to the lack of documentation of these systems, business folks cannot understand and define the system behavior. Changes in the code are typically followed by chaos, some patchwork, and sleepless nights for all the parties involved.

Integrations

Reluctance to move from legacy systems has made it difficult for enterprises to seamlessly exchange data with systems. With newer solutions reigning the market and newer information exchange standards surfacing, seamless and automated operations have become resource-hungry and error-prone with iSeries machines.

Rising Cost

The monolithic nature of the iSeries codebase has created several limitations when it comes to modernizing the machine. IBM green screens and the tightly coupled business logic are among the challenges organizations face during a phased approach to modernization. These, along with the rising costs of Server and OS upgrades, form a huge roadblock for enterprises in planning their modernization roadmap. Businesses on AS400 require a strategic approach that reduces the Total Cost of Ownership (TCO) and increases system agility while delivering consistent business value.

Usability

The usability of iSeries and Power Systems depends on the actual user base. There are many enterprises and processes that haven't changed in decades and their users continue to work on the green screens. That is jarring for today's user who keeps experience at the center and wants intuitive and pleasant-looking screens. From a consumer's perspective, the speed of information and data access, and the dependency on people for releases are factors that organizations look to address by improving the user experience of the solution.

Is it Change That We Fear?

Owing to the series of updates during the past few decades, organizations depend on their limited resources for handling the machine. Eventually, when these folks retire, organizations face serious business risks. iSeries applications form a large footprint in organizations with millions of lines of code residing and running business-critical tasks. For such an enormous system, there always lies a dilemma whether renewing makes more sense than migrating, and hence organizations live with the fear of change. Also, migrations are not always technical; change management that involves managing the internal users is a challenge that businesses face while planning a migration or a technological update.

INTERIM OPTIONS
UNTIL 'IBM i' IS SUNSET

Optimize iSeries

Enterprises using AS400 have usually focused on the performance side, ensuring that the machine does what it's supposed to do. But with minimal or no change since its implementation, its true potential has largely remained unutilized. To enhance the user experience, many IBM i users have uplifted the front-end, saving users from looking at green screens; however, this does not help from a system performance/optimization standpoint. Most IBM i systems today require optimization that is realized by improving the 'lines of code' and the day-to-day performance of the machine.

With years of operations and data in Db2, iSeries machines occasionally take a performance hit due to the bottlenecks in processes. With data not getting cleaned every day (rather increasing), it's time to tune in to the disk usage on IBM i and evaluate system performance. This requires a complete analysis of the machine and disc usage, and the evaluation of the source code to diagnose the bottlenecks in different areas and processes.

A few potential ways:

- *Automated Monitoring*
- *Storage visibility*
- *Audit & Cleanup*

Migrate iSeries to the Cloud

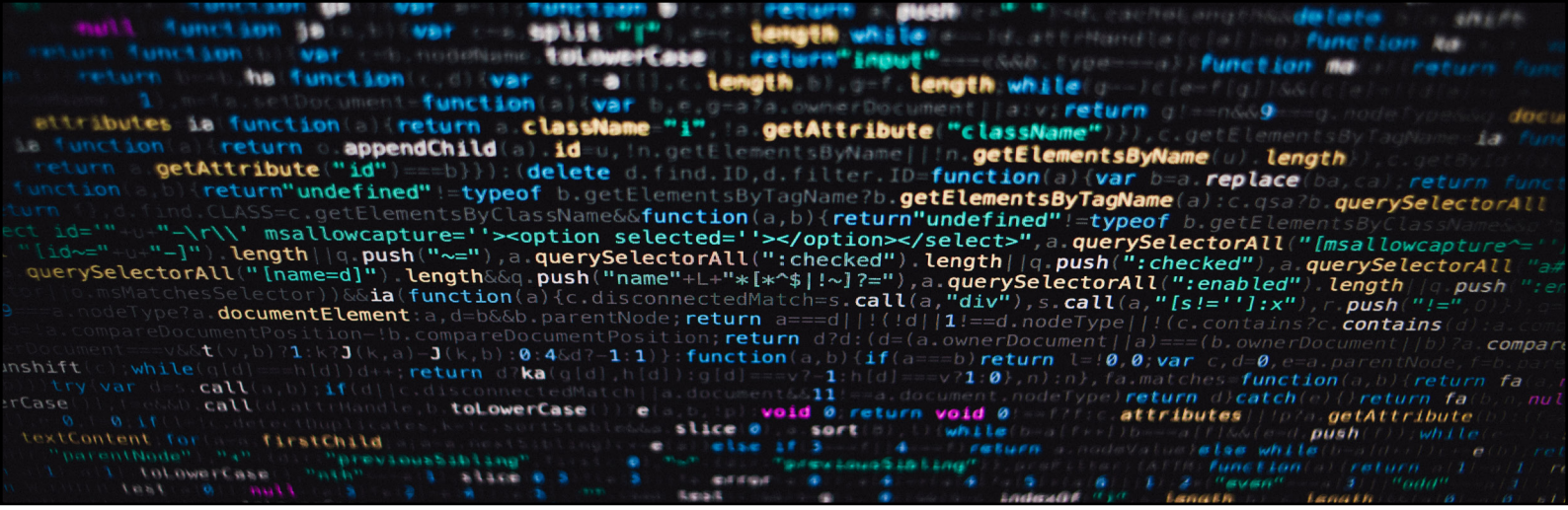
Modernization of the iSeries can revolve around the software or the hardware. There may be multiple types of modernization endeavors that you may undertake depending on your business needs and industry requirements. Some of these are:

Re-hosting

Many organizations have been wanting to escape the AS400 hardware (the battle-zone). Re-hosting with the help of AS400 emulators such as 'Infinite i' helps enterprises realize cloud benefits. This does not require any change in the existing interfaces or functionalities. AS400 emulators are a suite of services that help in the migration of programs onto the cloud, including migration at multiple levels and also Db2 migration. All smaller application components such as reports, hardware, etc. can also be replicated in the cloud environment. Without much of a rewrite effort, enterprises can leverage the benefits of cloud around scalability, elasticity, security, etc., keeping the original functionality as is.

Some obvious benefits:

- **Cost**: Low maintenance cost for using cloud services and no IBM license/ hardware impact
- **Availability**: Better availability with automated failover
- **Agility**: Agility in infrastructure to start or terminate a cloud instance in minutes and the potential to implement a Continuous Integration/Continuous Delivery framework (CI/CD).
- **Resources**: Legacy applications built on RPG, COBOL, Fortran, etc. need retention of their technology resources during the transition exercise of the platform, ensuring smooth data and functionality migrations.



Re-engineering

Data management resides at the core of any business. Similarly, financial transactions (EDI) and data engineering (ETL data processing along with ad-hoc report generation) form one of the most business-critical areas of iSeries applications. However, most of these have low business value, resulting in lower agility and high costs. Such batch job patterns hold the initial position in the queue for cloud migration endeavors including:

- Moving data-related jobs involved in processing transactions (ETL, data quality, etc.).
- Data archival and reporting analytics job transition (operations, financial, etc.).
- Functions that require data management and distribution (such as EDI).
- Move the ODS (operational data source) logic that acts as the ad-hoc reporting engine.

There are two typical batch job patterns for AS400 that are widely inherited:

- **File-based processing**: This functions like an on-premises iSeries system. However, the generated files are later pushed to the cloud environment for the users to access them later during processing and analytic activities. Data analytics can then be performed by leveraging any of the modern tools and techniques. To make sense out of the generated reports later, the output can be added to the database and referred when required.
- **Near real-time processing**: During real-time processing, there are multiple datasets such as services, activities, etc. that are pushed to the cloud platform. This process can be executed and analyzed by leveraging tools such as 'Apache Spark Streaming' and can be later loaded into the NoSQL databases for reporting or data analytics. Also, for organization-wide data engineering, datasets can be dumped into a warehouse for reports and predictive analytics.

Re-architect

With the ever-changing technology ecosystem, building a future-proof architecture is a primary focus of businesses. Re-architecting the system and ensuring that it is processed as a cloud-native workload helps in leveraging real cloud benefits. Typically, in cases where the AS400 application is not able to address the business and industry requirements, and re-hosting doesn't qualify as a prudent solution, re-architecting the entire system is one of the potential routes for improved performance and maintenance of industry standards.

Below are the key elements involved in Re-Architecting AS400 applications (with some added value):

- **Microservices**: Modern applications run logics without worrying about the hardware & servers, and the computing time is inversely proportional to the costs involved. This, for an AS400 system, can be done by using any of the API gateways (eg., AWS Lambda, Azure Functions). These gateways are the heart of the new re-architected system and there are adapters and parsers built to talk to the on-premises AS400 system. These applications built without a server architecture in place usually work on event-driven algorithms.

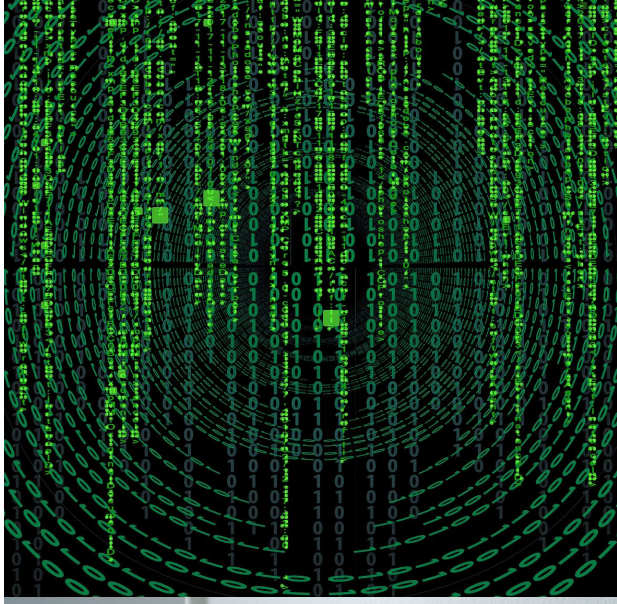
- **Application, containers, and queues**: The cloud container services (also known as dockers) along with message queues are core to the execution of any process & application service. These can decouple business functionalities and can be managed at larger scales using services that open source clouds offer.

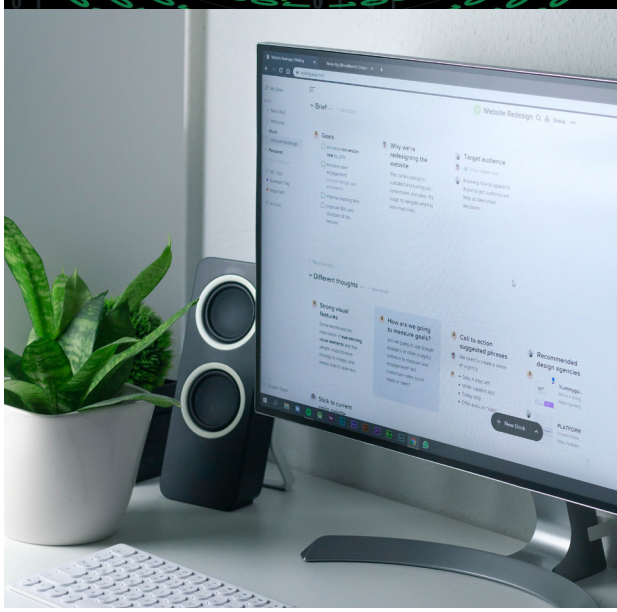
- **Data persistence & Data lake**: Cloud helps utilize and infuse data into data management platforms to generate business intelligence reports for better decision-making.

- **Data analytics, artificial intelligence & machine language**: Once the data is checked for health and quality, the next step is to generate multiple insights for decision-making. Newer methods and rule-driven techniques such as machine learning and artificial intelligence can help organizations perform predictive analytics and implement intelligence-driven automation on top of the current system operations.

Modernize the front-end

Modern users demand modern interfaces to work on and generate results. With over 90% of users comfortable with a GUI, the 5250 applications act as an anticatalyst to their efficiency. Many businesses willing to modernize these systems do not intend to touch the RPG code or the IBM hardware due to the uncertainty w.r.t. the system. Some businesses have taken a different and simpler route by creating modern web interfaces to the application, adding new business functionalities, and thus, empowering their workforce to access the 5250 applications anywhere. Transforming the 5250 screens into webpages without impacting the source code gives a new look to the iSeries systems and improves user experience. Furthermore, mobile access to the web application and IBM i database access via browsers are some of the added advantages of front-end modernization.





Suggested Tools:
Profound | Web-Facing | Infinite

Technology upgrade

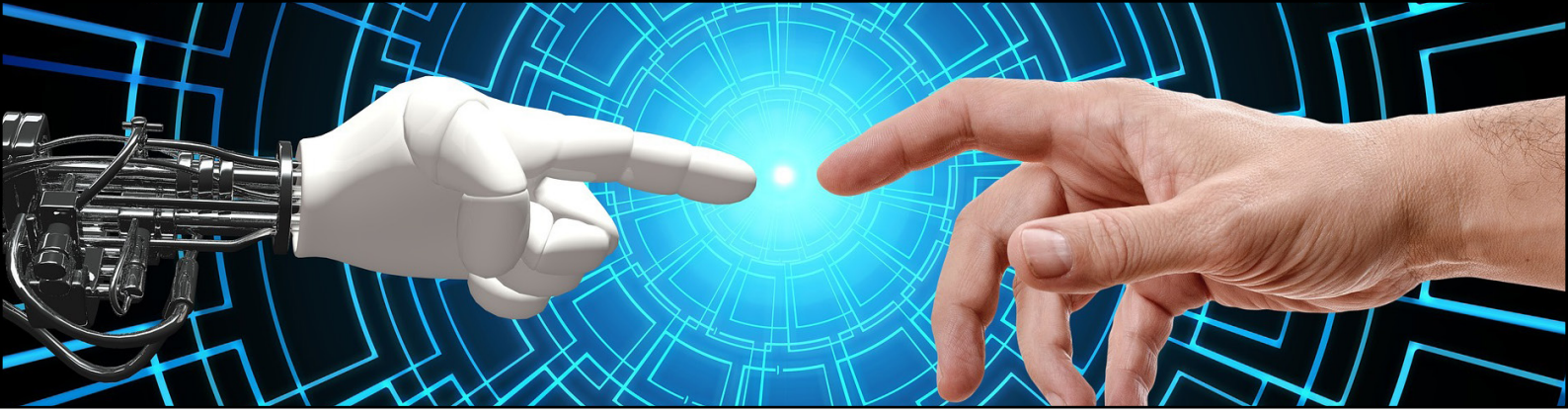
RPG upgrade

Most organizations have been using IBM AS400 servers for decades with RPG as the primary programming language. Over time, RPG has evolved to produce several updates and versions from RPG I to RPG IV, and recently the free RPG. Over the years, businesses have accrued multiple RPG versions of code, making applications monolithic and difficult to maintain. Also, IBM has stopped extending support for versions older than RPG IV. Therefore, upgrading the version becomes an obvious priority and businesses must leverage tools that modularize and decouple programs, and implement ILE over applications.

DB2/400 upgrade

AS400 applications developed over many years are tightly coupled with their database. Any tweak to the database component requires a recompilation of the complete application. This dependency impacts system efficiency due to factors such as low flexibility & agility, reduced performance, and poor quality. Hence, a possible approach to DB2/400 upgrade can be:

- DDS to DDL conversion
- Application program modernization using embedded SQL



Automation (using RPA)

RPA (Robotic Process Automation) is a technology that businesses across industries are leveraging to automate mundane tasks that are currently keeping their staff occupied. The technology, being platform-agnostic, can be used to automate processes within the AS400/ iSeries too. It helps automate data extraction and task execution-related tasks on various terminals (Mainframe/AS400, TN3270/TN5250/VT).

A few potential areas where RPA adds value: terminal wizard, terminal activities, supported providers

COMPLETE MIGRATION

WHAT MIGHT BE IMPEDING YOU?

iSeries is a world-class application server with proven robustness, scalability, reliability, security, and low cost of ownership. As new technologies and devices emerge to transform the way we conduct business, there is an increasing demand to modernize iSeries applications to harness greater value. With this known, businesses must plan the migration comprehensively and ensure that there isn't any data loss in the transition. The big question is 'Who bells the cat?' after putting in a lot of money and efforts into the system. The most common causes for such delays include:

- The uncovered reality inside the AS400 with limited access
- Lacking an innovation plan to address industry expectations
- Not sure of the impact and business risks it might cause
- Lack of adequate budgets for IT to support such endeavors
- No clarity on the business value and experience the change would bring in

REWRITE & MIGRATE

FROM IBM iSERIES

An approach

With time, AS400 has become a machine that needs extensive hardware/software maintenance. Running critical business-centric applications on an iSeries is a risk if access to the right set of resources is minimal. Upgrading is not always sustainable due to the hardware and software changes it involves. Migration to a custom solution offers scalability, agility, and flexibility along with significant cost benefits. It might sound like an overwhelming exercise but here's a summary of what it might actually look like. Below is a brief 4-stage migration approach that facilitates the execution of the endeavor iteratively to reduce conversion risks and obtain better user acceptance.

Assess

- Business purpose
- Dependencies
- Business process impacted
- Stakeholders
- Functional experts
- Technical experts

Analyze

- Business Value delivered
- Impact of failure
- Maintainability
- Performance
- User interface flexibility
- Ease of integration
- Skill set for maintenance

Objectives

- Better maintainability
- Superior UX
- Improved code management
- Better performance
- Better DB control

Plan of Action

- Prioritize the inventory according to the goals
- Create a project charter
- Define RACI matrix
- Establish processes
- Identify CSFs

Cost assessment

Depending on the organizational IT landscape and environment, the total cost to upgrade might be higher than that of a migration exercise. Also, upgrades do not provide much scalability & agility, and a future-ready architecture. To help enterprises find a solution, here is a cost assessment framework that yields a cost-benefit comparison between upgrade and migration. This would help businesses choose the option that best suits their case.

Item	2021	2022	2023	2024	2025	Total
Continue with AS400	$1,250,000*	$200,000	$200,000	$22,000	$1,250,000*	**$3,100,000**
Migrate from AS400						
Software Dev. Cost	$1000000	$0	$0	$0	$0	$0
Other Costs	$275000	$0	$0	$0	$0	$0
Infrastructure Cost	$250000	$0	$0	$0	$0	$0
Support and Maintenance	$150000	$150000	$0	$0	$0	$0
Yearly Costs	$1675000	$150000	$150000	$150000	$150000	**$2,275,000**

Total Benefit in 5 Years	**$825,000**

(Numbers shown are ball-park) | *Note: Periodic iSeries Upgrade costs added

CONCLUSION

Ever since IBM introduced mainframes, these systems have been the preferred machines to run operations in enterprises. But with businesses expanding and modern technologies raising serious questions on legacy systems, enterprises are leaning towards lowering the cost of supporting and maintaining their iSeries/AS400 applications. This, coupled with the need for faster solution delivery, is forcing enterprises to evaluate options outside the current setup. Modernizing can be limited to upgrades or can extend to migration and re-writing of the system. Every enterprise has its business case and limitations towards making any change and a decision should be made only after a careful analysis of the different factors involved.

Why us?

Nalashaa has been playing an influential role in technology innovation across industries. Besides the typical plain vanilla technology services, we specialize in consulting enterprises that use IBM i to enable them to plan their strategic technology roadmap better. So far, we have analyzed enterprise processes for reputed clients across industries and suggested solutions that make business sense.Nalashaa's IBM i experts will engage with you to help you with a viable solution considering all critical factors and business cases.

Talk to our experts today!

ABOUT US

Think Simple, Build Powerful

That's not just a philosophy, it's our way of life. We are determined to meet your needs and expectations by delivering simple solutions; solutions that help you derive meaningful insights and better outcomes for your business.

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