Astadia FastTrack Methodology

For Migrating Mainframe Applications to Cloud

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Astadia joined Amdocs Cloud division in November 2023.

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1. The FastTrack Solution

Astadia's FastTrack Methodology is a proven process that significantly reduces risks associated with software transformation projects. Because FastTrack does not introduce any business disruption, it becomes possible for an application to undergo a complex cross-platform transformation concurrently with regular application maintenance.

We use the FastTrack Methodology together with the FastTrack Factory, a powerful software platform that combines tools, processes and technologies to accelerate and standardize a successful application transformation project.

The Factory builds on CodeTurn tools for source-to-source translation and the DataTurn suite for data conversion. Furthermore, two automation testing tools are used to verify and prove the correctness of the performed code transformation and data conversion: TestMatch for online applications and message-based application interfaces such as MQ, and DataMatch for batch applications.

2. Most Significant Characteristics of Astadia's Tools

2.1 Tools are Fast

The CodeTurn source-to-source transformation tools use fast parser generators, are programmed with highly optimized generic programming languages, and have powerful command line interfaces. How does this benefit you? Simply put, this equates to superb runtime performance. For example, a single entry-level PC that costs less than $1000 and equipped with CodeTurn tools is capable of processing many millions of lines of code overnight.

This core benefit translates into the reassurance that if and when, during the migration project, changes are made to your applications in production, these changes can easily be integrated into the migrated system in a matter of hours or days, not weeks or years. Armed with such a capability, organizations are assured the smallest "code freeze" periods possible and maximum flexibility for the applications that run their business.

2.2 Tools are Consistent

Automation also ensures consistency: both in the code transformation (CodeTurn) as in the data conversion (DataTurn). Additionally, advanced tools to compare the generated source code with the previous generation ensure that previously transformed code or manually tuned code doesn't create conflicts between consecutive transformation iterations.

Consistency to this level of precision leads to the benefit of being able to work in cycles without the onerous chore of identifying, extracting, or transforming deltas. With such a capability, organizations are assured a predictable, repeatable process that furthermore gets easier each time it is executed.

2.3 Tools are Customized for Your Project

All Astadia migration projects involve systems that have been in production for decades and have seen multiple changes and upgrades in the underlying infrastructure (hardware and/or software) and sometimes even suppliers. This combination results in an environment that is, by now, quite unique. The same goes for the chosen target technology stack, where the combination of infrastructure and product versions creates a one-of-a-kind system. Naturally, this means that CodeTurn and DataTurn used for your target infrastructure are also customized to fit your individual migration project.

This customization of the Astadia tools for your application migration is part of the service Astadia provides. Throughout a migration project, these tools become increasingly smarter and continuously reach higher levels of automation.

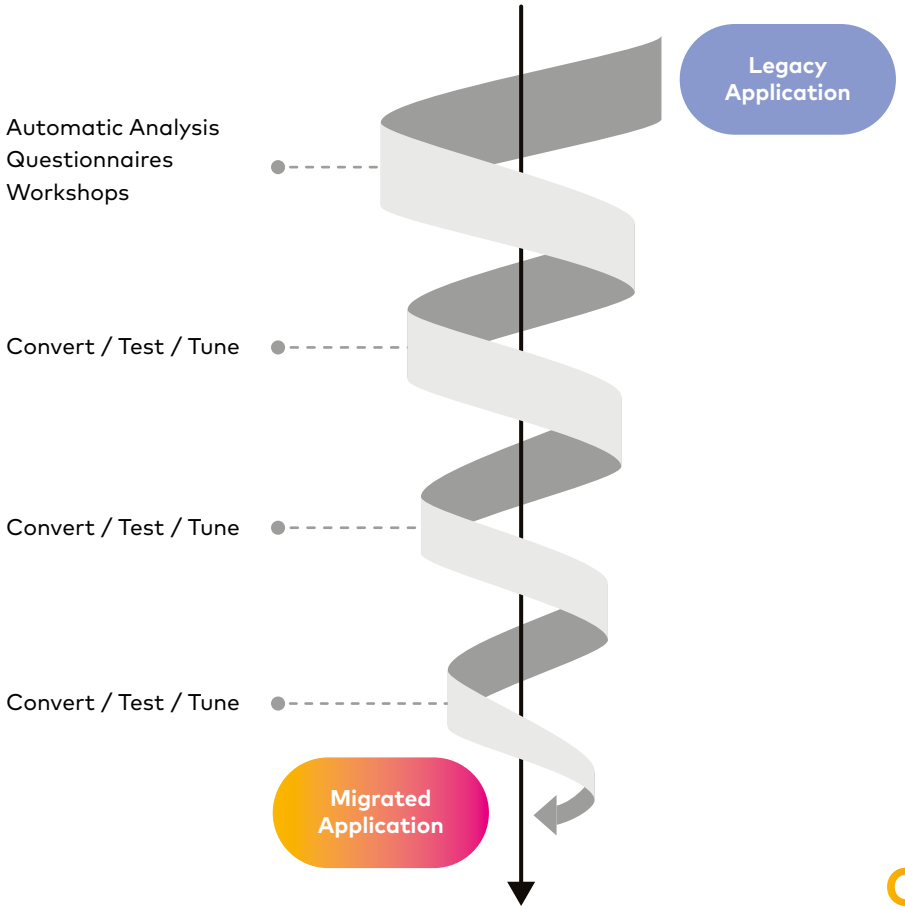
3. No Interruption to Your Ongoing Release Schedules

A key concept within FastTrack is that of the migration staging area: an environment dedicated solely to the migration project. In this staging area, a coheren t version of the application is installed – this version is called a snapshot, and such snapshot includes all the programs, data structures, and data. The usage of this staging area ensures the artefacts in development, test, and production are left undisturbed while the migration is in progress.

By working with these snapshots, it is possible for the regular maintenance release cycles and the migration release cycles to happen independently of each other. This separation assures maximum efficiency of both the maintenance and migration processes. The migration always aims to achieve functional equivalence with the latest snapshot installed in the staging area, and not with the live production system. As time progresses and CodeTurn advances, the snapshot migration involves less work, which makes each iteration naturally go faster than the one before it.

The image on the next page visually summarizes this effect starting from the Legacy Application near the top, towards the Migrated Application that is Live (i.e. in production). The overview also introduces the key project phases throughout the project on the right side (including the focus of each phase):

- Factory Certification
- Factory Exit
- System Integration Test
- User Acceptance Test



0 **Pre-Migration Assessment**
- Establish scope, strategy, roles & responsibilities
- Establish project plan
- Legacy documentation

1 **Factory Certification**
- Target data model defined & data migrated
- Migration Tools parameterization
- Establish coherent codebase
- 100% compilable output code

2 **Factory Exit (semantic correctness)**
- Migration Tools customization
- Automated testing (TestMatch, DataMatch)
- Automated regactoring
- Preparation of Integration Topics (Job Scheduler, Printing, Interfaces,...)

3 **System Integration Test (functional correctness)**
- Application like-for-like (iso-functional)
- Performance test and tuning
- Semi-automated refactoring
- 1:1 tests current and future platform

4 **User Acceptance Test (overall correctness)**
- Operational use cases correct
- Periodical use cases (day end, year end, etc.) correct

Code Freeze

Go Live **Final Data Migration**

4. An Iterative Process

What takes place during an iteration? Each iteration involves the consistent ordering of an identical number of steps.

1 The first step in any iteration is to take a snapshot of the development artefacts currently in production and make a copy to the migration staging area.

2 The second step is verifying the completeness and correctness of this snapshot by Astadia's CodeTurn analysis tools.

3 The third step is to transform code and data structures using the CodeTurn tools to the level at which they have been customized at that moment, and to convert the application data.

During data conversion, DataTurn creates a new database, and populates it with either (anonymized) data from the production environment or a specific set of test data.

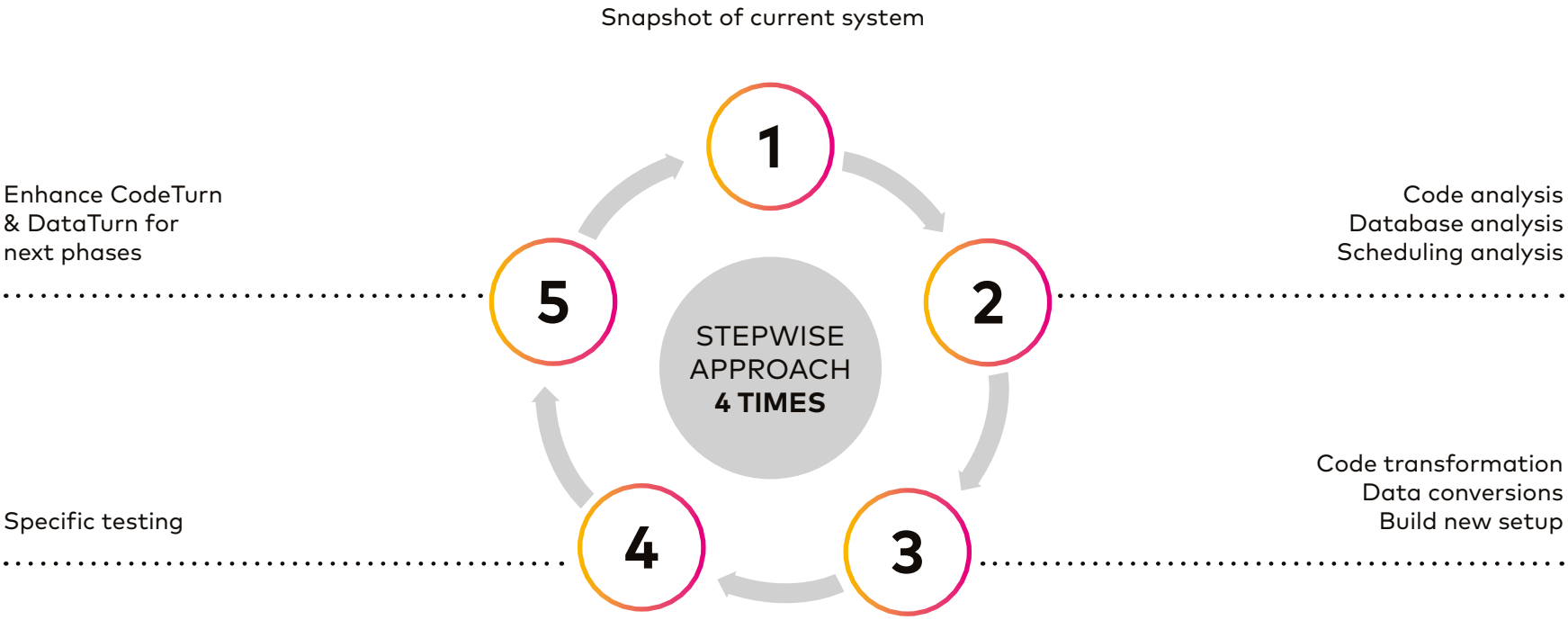
During code transformation, CodeTurn converts all source artefacts that were part of the most recent snapshot. The migrated application is compiled and prepared for automated testing.

4 In the next step, the Astadia testing tools TestMatch and DataMatch measure the correctness of the migrated application (both in terms of speed and stability and in terms of number of remaining issues). Any differences are analyzed and issues are logged in a problem tracking system. This yields concrete and measurable results very early in the project, and provides a clear indication of progress over time. A difference may result in adjusting transformation parameters, the tuning or customization of CodeTurn tools, or perhaps the addition of source artefacts that were missing from the snapshot.

This may start a new "transform-test-tune" mini-iteration, until functional equivalence between this iteration's snapshot and the resulting migrated application is proven. At that point, a new major iteration can start.

Typically, there are four major iterations during an entire migration project, where a snapshot is taken and migrated. Small iterations may happen much more often, sometimes even several times a day. This allows for very fast response to reported issues and a continuous validation of the entire conversion result.

Every step follows the same structure



5. A Commonsense Approach to Organizational Risk

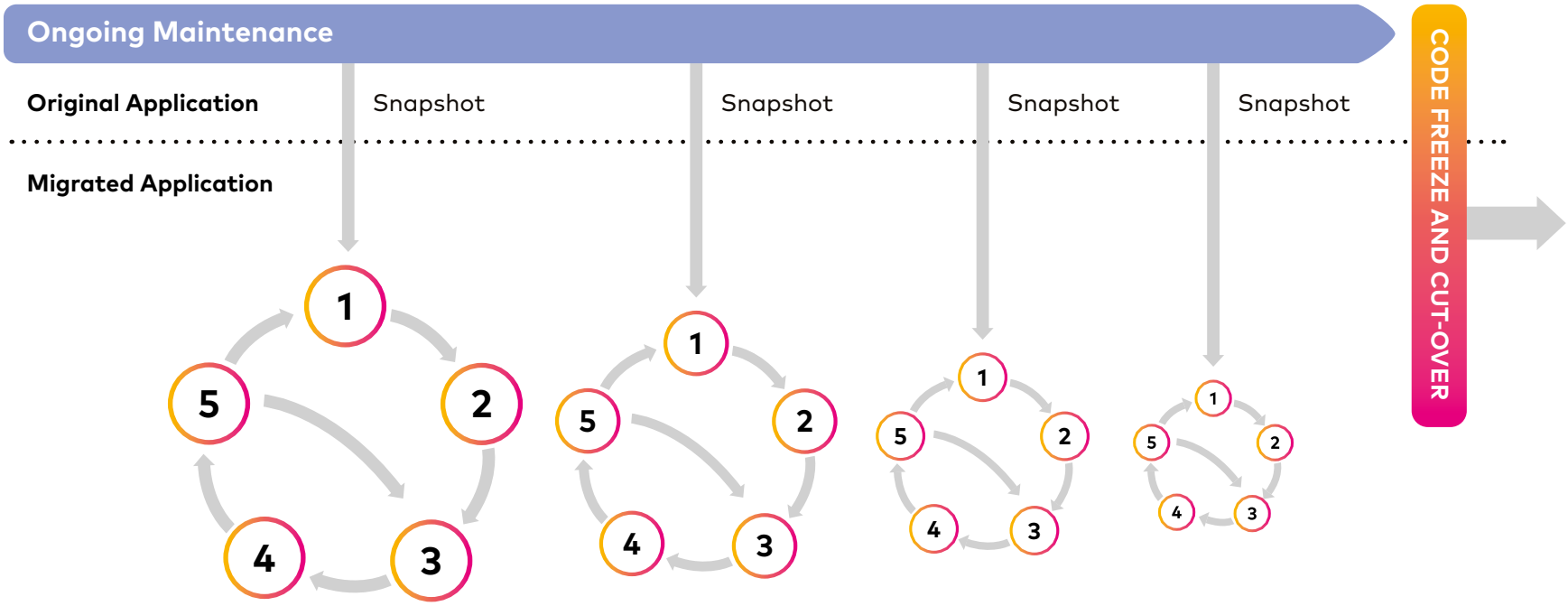
The combination of speed, consistency, and customization means that any change to the original programs' functionality can be taken through to the target platform and regression testing started without the functionality ever being manually identified or analysed. As a matter of fact, it is possible with such tools to re-migrate the entire application and automatically resolve most of the version conflicts, even for a very large application, in a few days. Manual work is reduced, not only by the tools that process the lines of code in bulk, but also by the merge tools that combine the start of each new iteration with the result of the previous one.

As customization makes smarter tools, an intense cycle of efficiency ensues as:

- Each iteration goes faster since there is less work and tuning, and
- This speedup means the merging phase of each subsequent iteration will go even faster since there is less time available in which the application in production can evolve.

After a number of such iterations, CodeTurn and DataTurn become so closely aligned with the particular migration project that an entire iteration is completed in a matter of days. When everyone involved in the project and throughout the company witnesses transformations of such scale happening successfully in such a short timeframe, the "risk" perception of such migration projects in the organization shifts fundamentally. Now it is no longer a question of "will it work"; rather, the primary concern becomes how the final iteration, i.e. the final conversion of the production data to the target platform, can be tuned to minimize downtime of the system for the business users – or to completely eliminate downtime.

Astadia FastTrack Process Summary

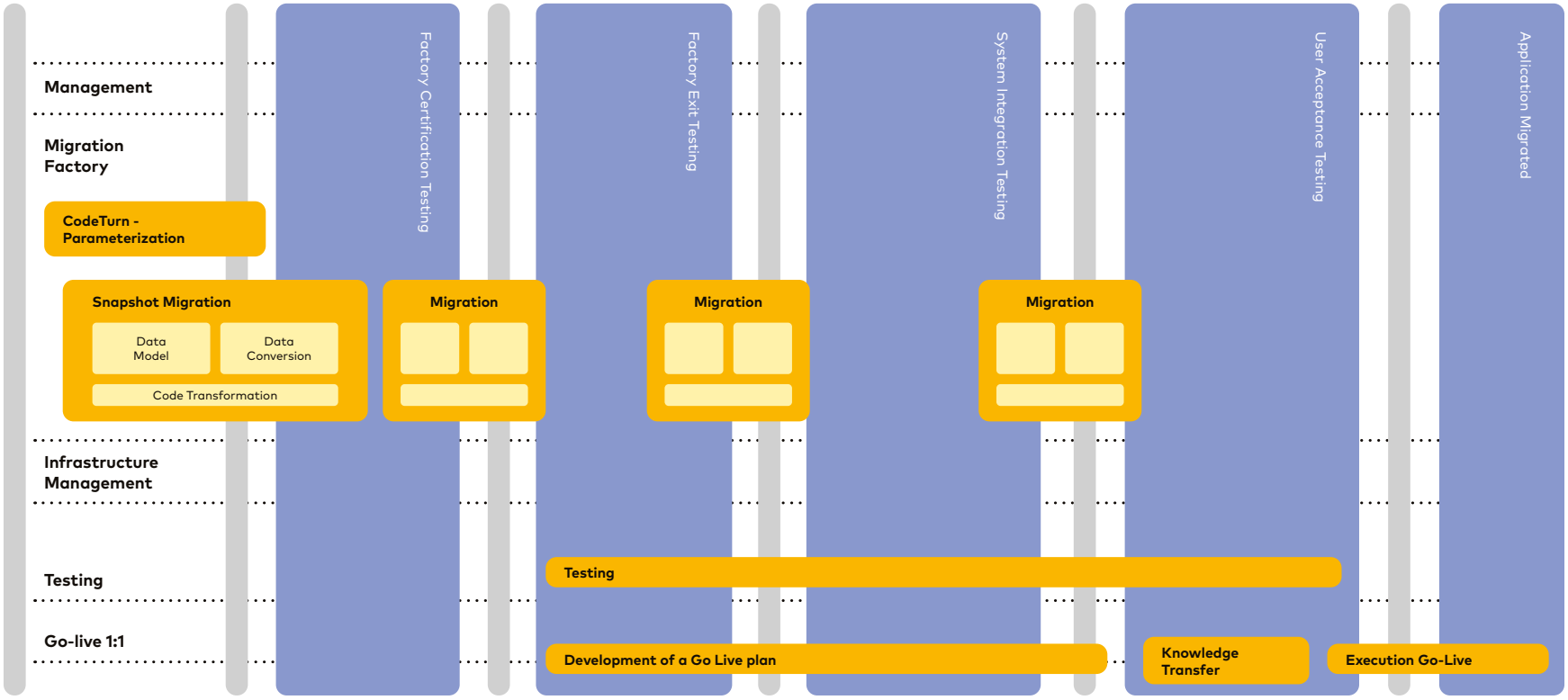


6. Application Migration in a Project Timeline

6.1 Overview

The four key project phases introduced above in Section 2 form the backbone of the planning for each legacy migration project. The high-level plan can be visually represented as follows:

- Vertically the identified project phases are plotted
- Horizontally the main project streams are plotted



The elapsed time required to complete each phase varies depending on the exact scope and complexity of the project. For the first two phases (Factory Certification and Factory Exit), Astadia's FastTrack Methodology impact on the progress is highest. In those projects where the customer is well prepared (e.g. delivers source code quickly, has reference test dataset, ...) the below project timing can be achieved:

- Factory Certification in 2 months
- Factory Exit in 2-4 months

6.2 Factory Certification Case Study

6.2.1 Scope Overview

The main code transformation with CodeTurn focuses on the transformation of over 3,000 IBM Mainframe COBOL programs and over 6,000 copybooks to Java 8. These COBOL programs use various technologies such as embedded SQL to DB2 and CICS statements for which a transformation is required as well.

A limited set of over 50 of these programs contains specific data access. At the start of the project, CodeTurn did not yet have support for these constructs. This makes that 100% transformation and correctly compiling at the end of FC is not possible, but there is a maximum of 98.21% of programs that can be transformed and compiled. This maximum was communicated and agreed with the customer.

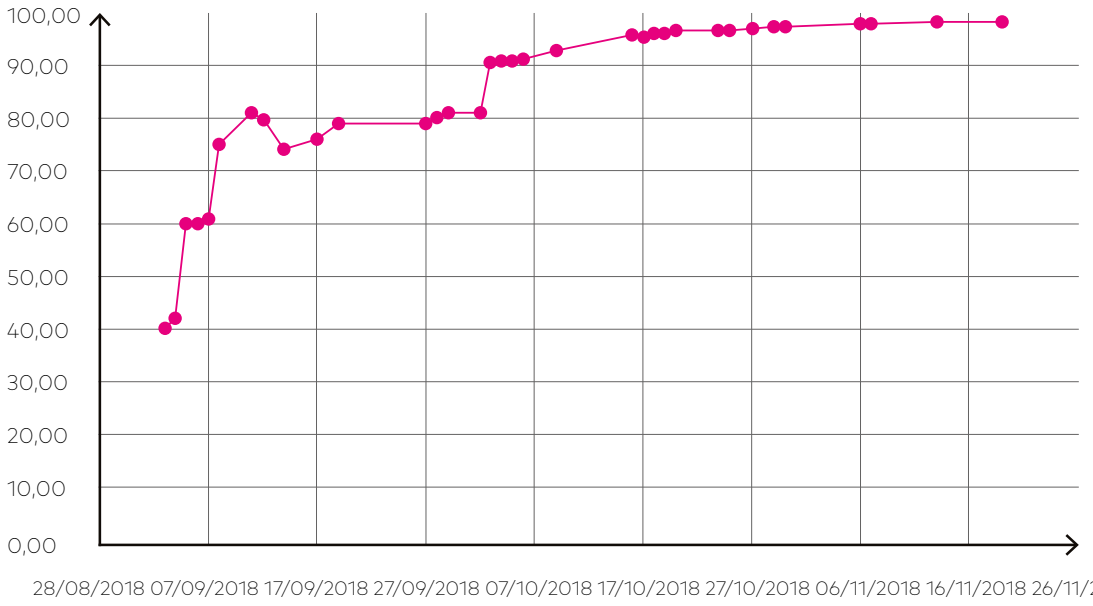
6.2.2 Timeline

The Factory Certification (FC) phase was completed in approximately 10 weeks, starting from the beginning of September to mid-November.

6.2.3 Transformation Progress

The first CodeTurn transformation runs for the COBOL code were started at the beginning of September, running until the end of October to reach 97.34%. Taking the first weeks of November to reach the 98.21% upper limit introduced by the customer specific data access.

Percentage successful transformation

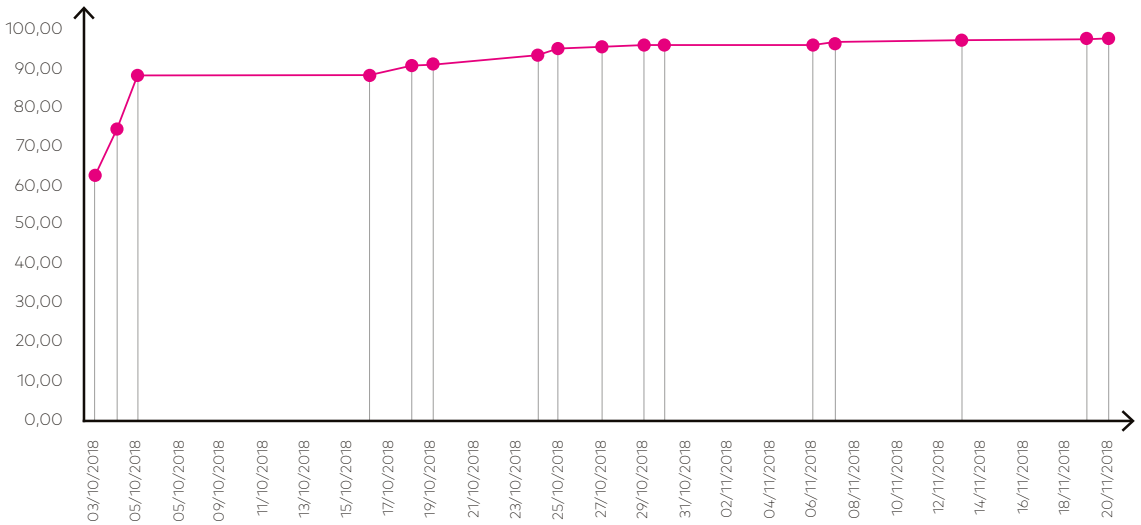


Some remarks on the resulting graph:

- The usage of tools to automate the process is evidenced by major increases in correct transformations in the project. For example, on September 8th there was an increase of 14%, and on October 3rd there was another increase of 9% due to various CodeTurn improvements.
- Around mid-September, there was a drop in the correct transformation as a result of an extra customer source code delivery.

At various points in time, feedback was provided to the customer leading to incremental changes in the COBOL code to be transformed. In total, 3 complete snapshots (all source code and data structures) were delivered to us by the customer. Furthermore, the final snapshot delivery received additional patches in the form of individual source code deliveries. These were needed to resolve software delivery issues at the customer side, such as the wrong version of some COBOL copybooks being delivered to Astadia.

Percentage successful compilation of transformed Java programs



6.2.4 Compilation Progress

As of the start of October, the compilation of the generated Java code was started. The progress of this compilation can be found in the below overview:

6.2.5 Case Study Conclusions

This case illustrates that for large migration projects

- By using mature tools to automate the transformation, the progress of correct transformation and compilation is quick, with typically:
  - A handful of updates are responsible for big jumps in the trendline.
  - At the end of FC, the progress in the trendline slows down, caused by edge cases that need to be handled by CodeTurn.
- Customer support is needed for clean-up and validation of their own source code. This is limited to 5-10 days of effort, during the FC phase.

6.3 Factory Exit Case Study

6.3.1 Scope Overview

Over 1 million lines of COBOL code and 900,000 lines of ADS code, including 356 maps were transformed. Accompanied with 66,000 lines of JCL code.

The migration project targeted a Microsoft product stack, built around .NET, SQL Server and PowerShell.

To test the migrated application, dedicated tests were performed in the staging area:

- For the online application 16 separate TestMatch scenarios were recorded – each starting from a new initial database state and filesystem.
- For the batch application 92 jobs were executed, spread over 4 different days.

The Astadia team executed these tests on our Factory environment.

6.3.2 Timeline

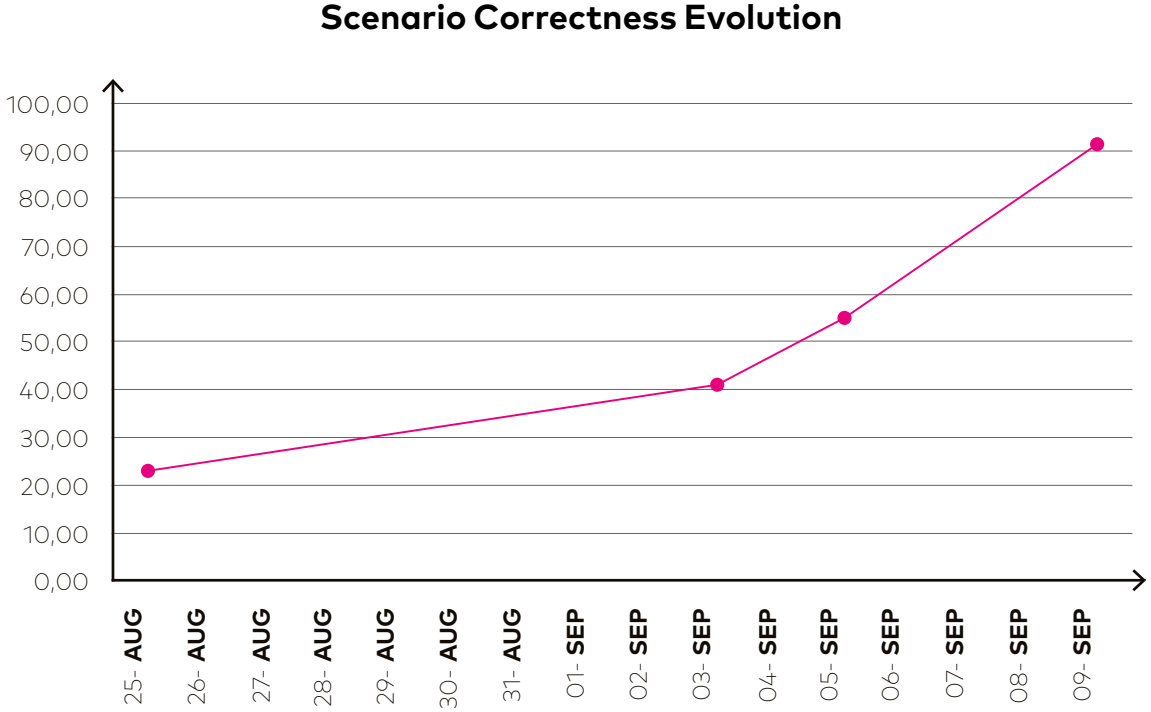
The Factory Exit phase took a total of 14 weeks to complete.

6.3.3 Evolution of Online Test Case

The overview below represents the testing evolution of one of the 16 provided test cases. This particular case contains 73 different Dialogs that are invoked, with the scenario containing 246 different transactions that are invoked.

The test status reported by TestMatch after each executed test, evolved as in the below graph. The fourth and final executed test showed a correctness of 91%. The remaining differences were analyzed together with the customer, after which the final acceptance of the correctness of the test scenario was achieved.

As these 16 online scenarios were delivered to Astadia in a time span of 18 calendar days, the time to execute the Factory Exit Testing for all the 16 online scenarios was 8 weeks.



6.3.4 Evolution of the Batch Test Cases

The vital measure of batch correctness was comparing the output files the different batch jobs created. In total, all the jobs combined, produced 174 different output files that had to be compared.

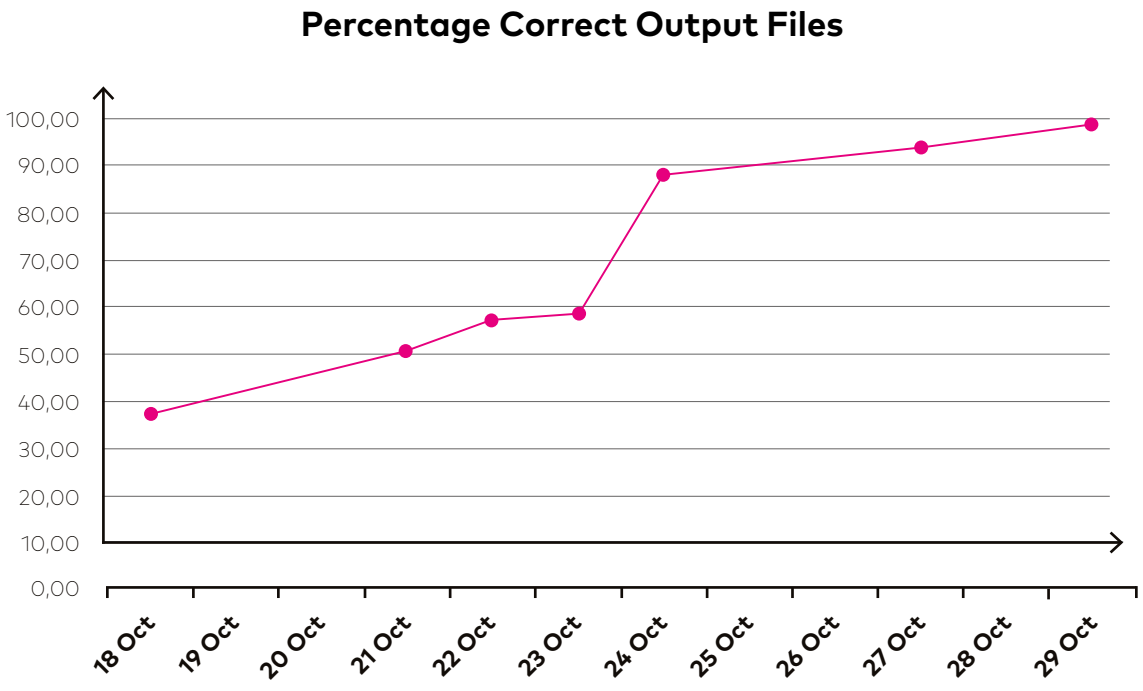
The below graph plots the progress of these comparison results, listing the percentage of correctly produced files.

6.3.5 Case Study Conclusions

A well-prepared Factory Exit phase can be completed in 2-4 months. Some key characteristics of such a Factory Exit:

- Usage of mature tools such as CodeTurn and DataTurn for the code transformation and data conversion
- Usage of tools such as TestMatch and DataMatch to automate the testing
- A representative test data set that is provided to the Factory that is limited in size in order to optimize its handling (e.g. speeding up the database restore before the execution of a test run)
- Using dedicated test recordings with many different programs allows for fast progress in the testing phase.

For more information, reach out to cloud@amdocs.com



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