ADVANCE Annual Report (1 October 2010-end September 2011)

http://www.advance-logistics.eu/

Short project description

In the logistics industry, the advantages of networks with small local partners are widely recognised, as these bear the potential of offering flexible services at affordable costs. Small participants serving a wider network are locally more flexible, react faster to changes or region-specific challenges, and offer higher variety—however, not entirely without drawbacks. In the age of track-and-trace solutions and specialised, small consignments, the amount and variety of data accompanying logistics processes often presents major challenges, especially when it comes to transparent or coordinated action: it is difficult to filter the onslaught of data and make its appropriate portions available at the right time and place to support correct decisions, make better forecasts and issue timely warnings. The three-year FP7 project ADVANCE aims to tackle this problem by investigating and advancing the related scientific backgrounds as optimisation and machine learning, and offer a modelling and decision support framework which companies and networks can use to build solutions covering their own specific needs.

Summary of Activities

Having started in October 2010, the project has already achieved significant results, both in exploring the de-facto challenges and potential theoretical background, as well as in building up an IT environment that will support practical experiments and will serve as a runtime framework for solutions deployed in the industry.

In-depth insight in the application field

The first months of the project, as well as the time of preparation before official kick-off, were spent conducting studies and interviews in close collaboration with the main industrial partner of the project. Findings were substantial for the success of the project, and refined our initial assumptions to be more in keeping with the reality of industrial practice:

- The analysis of interviews and properties of business models helped us identify the exact class of application scenarios and the challenges that can be addressed. As solution algorithms often have to be exactly tailored to the given problem, such deep knowledge is essential for meeting a proper choice.

- On-site interviews have revealed the specifics of daily operation—these were especially valuable in selecting the problems that can be efficiently tackled by introducing advanced IT. We have examined and identified points where fast decisions are met by long-term routine, and the overhead of "smart" support would obstruct the process. Keeping clear of such interference will not merely

bring an efficiency advantage—it will forego the serious pitfalls some other experiments did not avoid.

- The detailed analysis of business models and corporate behaviour has already yielded notable results, and more lies still ahead—sorting out limitations and typical business behaviour will enable us to set correct strategic goals not even the industry could identify so far.
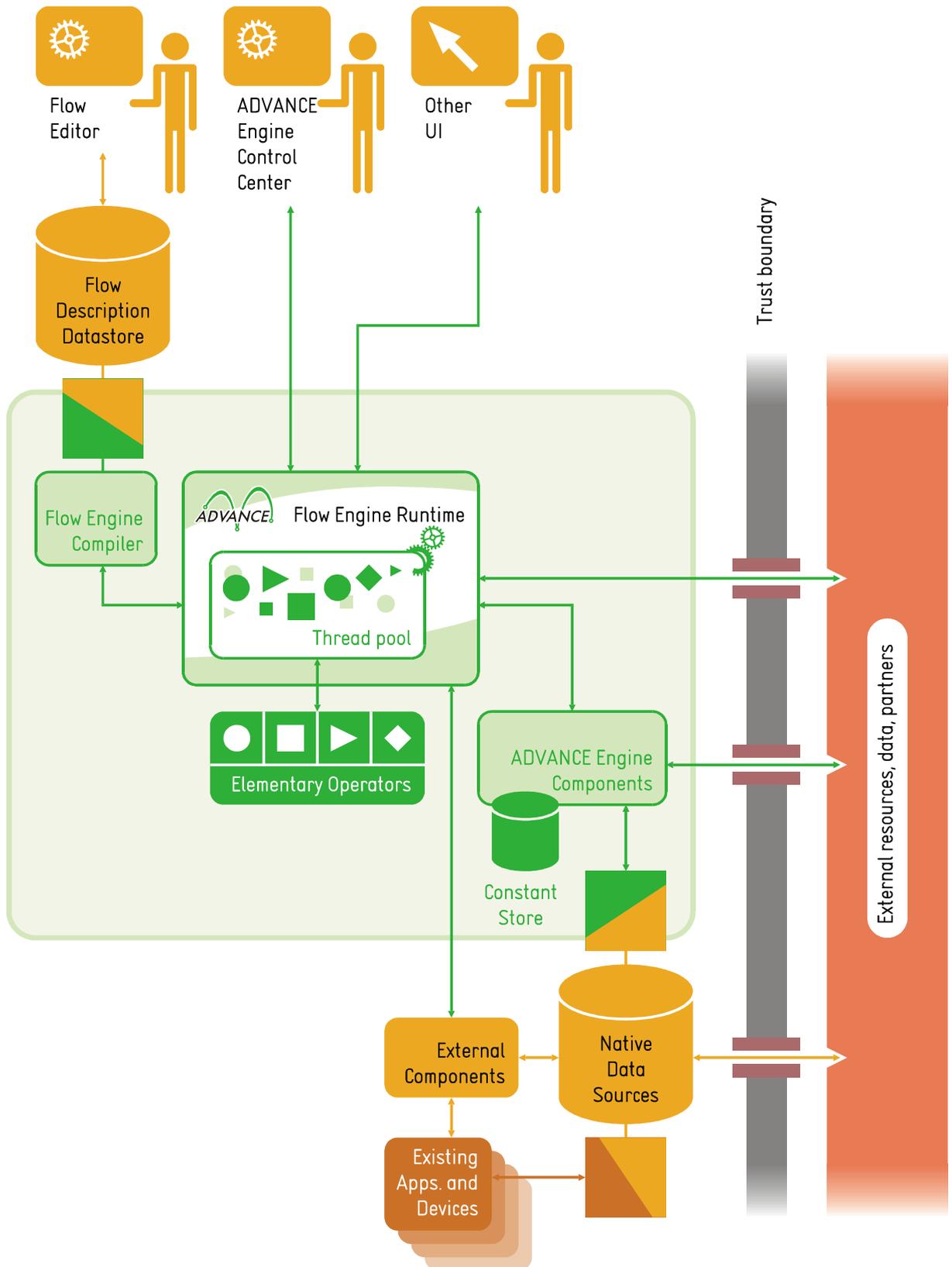
Building the fundaments—test bed and solution framework in one

Much of the efforts in year 1 were exerted to build a fundamental framework that will serve two purposes: *i)* it will provide a test bed for experiments and field tests of putting theoretical results at practical work, and *ii)* by the end of the project, it will be refined to a solution framework other users can build their own solutions on.

This fundamental framework, the ADVANCE engine, is in essence an environment where the solutions of our targeted application domain can be built and run. Assembling a specific solution would mean a large assortment of technical details to care about: we would have to sort out and properly match data models of the information handled, we would have to ensure proper timing of operations or sequences, etc. Many of these chores pose no technical challenge in the individual case, but require lots of almost automatic development work—the purpose of the ADVANCE engine and the associated development environment is to take this unnecessary burden off the shoulders of developers and researchers, shorten development time and reduce the risk of errors where this can be done automatically.

Progress in the design and development of the ADVANCE engine was considerable during the first project year, with reactive support of runtime behaviour and type inference mechanisms in data model negotiation being in the focus. These results alone are less in the field of attention of prospective users than the graphical interface of the environment will be. Their importance, nevertheless, is shown by the fact that "by-products" of our development efforts are already highly appreciated and used in other developer communities—as it turned out, others were already "lining up" waiting for an open-source solution to appear for problems that have been around for years.

Also contributing to the creation of re-usable structures was the elaboration of data models that can be used throughout the targeted sector of the logistics domain, and adapted to concrete business cases with minimal additional work. In addition to identifying the best choices between specific and general, much care was taken in elaborating the best means of formalising the description of data flows.

Flow Editor

ADVANCE Engine Control Center

Other UI

Trust boundary

External resources, data, partners

Flow Description Datastore

Flow Engine Compiler

ADVANCE Flow Engine Runtime

Thread pool

Elementary Operators

ADVANCE Engine Components

Constant Store

External Components

Native Data Sources

Existing Apps. and Devices

Serving initially as a test bed, the ADVANCE engine will also fit into real-life applications as a configurable framework for advanced modelling and prediction services.

Exploring the scientific backgrounds

Several areas of optimisation and artificial intelligence must be relied on to solve the information handling problems targeted in the project, and considerable efforts are planned to be spent on selecting and harmonising solution components from all these areas into a practicable and industry-ripe solution. In the first months of the project, the modelling and global optimisation of logistics networks—primarily the so-called hub-and-spoke type characterising the project's key application scenario—were surveyed. It was revealed that the required methods are highly specialised for each case, conveying two implications:

- the solution framework should be able to host a wide spectrum of algorithms in order to guarantee the targeted versatility, and
- researchers, developers and users should be made aware of the high degree of required specialisation to prevent pitfalls at less experienced companies.

The perceived degree of specialisation proved to be a valuable guide for our focal research efforts which were, in the first year, directed towards the following areas:

- pre-processing of large data sets for analysis,
- use of incomplete data appearing in collaborative networks,
- machine learning and generic optimisation algorithms.

Research in these areas will continue throughout the next year.

Getting involved and being aware—interaction with industry, science and the public

The outstanding commitment of the main industrial consortium member, Palletways, gives the consortium the opportunity of gaining a realistic picture of the application area, revealing aspects of importance and keeping research and development in the project always close to the reality of everyday industrial operation. The constant collaboration ensures a co-evolution of views and insight on both the industrial and the academic side which is to the benefit of all participants involved. This mutual matching of attitudes is also expected to be of advantage while approaching the targeted users, once the solution framework reaches adequate ripeness. Close contact also has the advantage that realistic data and implicit knowledge, often omitted even by domain experts, is always at hand and can be consulted at critical points.

Already the first project year yielded notable steps in promoting the project and raising awareness of our solutions taking shape. Several scientific publications, among them refereed journal articles, have been presented, published, or are in preparation. Coverage of the project by news reports informed the general public as well as the industrial community about the project's goals and advances. In numbers, in the first year 8 press releases, 2 conference papers, 2 journal papers, 1 book chapter, 1 leaflet, 7 web sites, 7 partner (coord., resp. technical) meetings, 3 major user workshops, and 1 project presentation at EU event have been elaborated/held.

The road ahead—what's next in 2012

In 2012, the first fully operable version of the underlying solution framework will be completed and will allow theoretical results, by then delivered to a considerable part by research activities, to be tested in running simulation and on data from real-life processes. Also important is the role of human operators and their behaviour—running prototypes will also offer opportunities of hands-on experience and will deliver valuable feedback to be matched against current expectations and assumptions.

Close contact with the industry will remain an important fundament of work within the project, guiding our activities to remain in keeping with the reality of everyday practice. In the second year, this will still act as a safeguard of co-evolution; large-scale field tests are to follow in later stages of the project.

Further Information

The official project web site (http://www.advance-logistics.eu) provides further information about the goals and results of the project, and keeps visitors informed about related recent news.

More information can also be obtained from project coordinator Elisabeth Ilie-Zudor at the e-mail address ilie@sztaki.hu.