IT Industrialisation as Enabler of Global Delivery

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Abstract—This paper presents a concept to utilise different delivery types for the maintenance and evolution of legacy software systems. Based on a so called delivery model cube, three different dimensions are explained that have to be considered for legacy systems in terms of global delivery. The different delivery types come with different preconditions that have to be met before the respective delivery model can be deployed successfully. The prerequisites are classified according to basic concepts within the area of industrialization. We show how the classification can be used to determine appropriate measures for legacy systems when considering global delivery. This is done by localising the envisioned delivery setup within the delivery model cube and automatically identifying necessary preconditions from the corresponding industrialization maturity.

Keywords – outsourcing; delivery models; organisational maturity; IT industrialisation

I. INTRODUCTION

As Smith lined out as early as 1776 in his famous An Inquiry into the Nature and Causes of the Wealth of Nations [1], progress and a qualitative increase in productivity in society lie in specialisation and industrialism essentially represented by the concept of division of labour. In Smith’s work, the different approaches to manufacture pins were investigated and compared, but the same principles apply to IT industry today and reflect the evolution seen over the past decades.

As IT industry has evolved over time, fundamental changes to the businesses and their supporting IT organisation have occurred. Recent years have seen the transition from integrated full-service units towards specialisation of departments and companies along the various functions required to run businesses and their supporting IT. Additionally, cost efficiency considerations put high pressure on executives who try to focus on their core competencies and hand over non-core tasks to specialised providers.

Consequently, the overall change leads to specialisation (i.e., organisations focus on their core competencies), division of labour (i.e., outsourcing in different variations) and (cross-country/cross-cultural) supply chains (i.e., global delivery).

This type of specialisation can be applied straight away when developing a new IT product: The project owner has to define the overall process chain and the respective acting parties for each step. The interfaces have to be defined (e.g. by a typed communication plan) and an overall quality management has to be established to guarantee not only the quality of the different intermediate steps and results but to ensure the end-to-end delivery in time, budget, and quality.

But how to apply industrialization concepts for already running IT projects and systems? For systems being developed and maintained for 20 years and more, having experienced a large amount of changes resulting in manifold maintenance activities? For organisations having heavily established structures and conventions? Is there any way to utilise global delivery for this kind of projects as well?

This paper presents a roadmap to utilise the concept of industrialisation for legacy IT systems as well. After giving an overview about the core concepts of industrialisation in Section II, different types of global delivery are presented in Section III. Using a Delivery Model Cube these different types will be contrasted with specific industrialization maturity levels: Section IV will show how global delivery can be applied to legacy systems having reached a minimum level of industrialisation maturity. In Section V, the application of the delivery model cube is elaborated. We conclude with a short summary in Section VI.

II. INDUSTRIALISATION

In this section we describe the different steps on the road to an industrialized IT setup (cf. [2]). The steps comprise modularization, standardization, automation, specialisation and benchmarking. Later on, some of these steps will be used as preconditions within the delivery model cube.

According to the BITKOM study on IT professionalisation (cf. [2]), the concept of industrialisation is comprised of five sub-concepts. It starts out with modularisation and continues in standardisation. Further concepts to be followed are automation, specialisation and benchmarking.

A. Modularisation

The overall business process chain must be refined to a level where a detailed process landscape can be created. The process landscape defines activities, responsibilities, dependencies and results of the processes. Today, a lot of techniques for modularisation are available, however they are still not applied consistently in industry. Typical techniques for modularisation are architecture management (cf. TOGAF, Zachman, SAGA etc. in [3]), RACI-matrices, data flow diagrams, process modelling tools and service oriented architecture modelling.

A typical anti-pattern for legacy systems requiring further modularisation would be an overall process chain consisting of three processes “collecting change requests”, “apply
change requests” “test change requests” only and no further refinement available.

B. Standardisation

Based on modularisation and using it as precondition, the process landscape as well as the interfaces must utilise standards to the best possible extent or they should at least refer to standards wherever possible. Applying those standards guarantees a specific level of quality as well as an easier establishment due to a lot existing literature and knowledge. Internal standards are valuable to harmonise and facilitate internal information exchange, but adaptation of industry standards is preferred as they enable interchangeability across organisations.

Today, numerous industry standards and quasi-standards are available and ready-to-use. Examples are CMMI for development activities, TMMI for testing activities, ITIL for operational aspects of an IT organisation, WSDL for defining technical interfaces between services, or UML for giving corresponding notation standards to describe a software system.

A typical anti-pattern for legacy systems requiring further standardisation would be an incomplete maintenance process not giving any advice when to test which artefacts after a minor modification. Further, missing descriptions for interfaces between subsystems or components indicate non-standardisation of the organisation.

C. Automation

When processes are known and considered as an asset for business, one can start identifying the repetitive parts of the work to optimise for efficiency. Therefore, for each activity within each process step or even for complete process steps the possible level of automation has to be determined. There will be activities requiring a lot of human interaction, others might be automated completely. Automation can expand from individual activities to the automated execution of entire process chains without any interaction of humans.

A typical anti-pattern for legacy systems at this step can be manual copy-and-paste activities from one tool into another tool, or repeated labour-intensive quality checks on application data executed for the sheer purpose of handing on information that has been available in different form in the systems already.

D. Specialisation

When processes are automated (or least the potential for automation is understood) and optimised of efficiency, business may start identifying and focusing on core competencies. On this level it can be decided what processes or parts of the processes are considered as core business and what parts are not. Strengthen the core business is understood as specialisation. The fundamental decision if it makes sense to utilise partners to deliver processes or parts of processes can be taken if and only if management has a conscious view on what the core competencies of the business are. This decision can only be taken for identified tasks (modularisation) using standards (e.g. ISTQB) and automation (not necessarily applied but considered from an conceptual point of view; if this is not the case it might be possible that a task is outsourced to a third party that could be fully automated easily). A typical anti-pattern for an organisation is the not-invented-here-syndrome on various standard services outside the business itself (e.g., a trading company having internal facility management services; a laundry running a garage to maintain its delivery trucks). In legacy systems, this anti-pattern corresponds to the unconscious utilisation of proprietary implementations of standard components, such as spread sheet applications, GUI frameworks, etc. instead of using ready-to-use components from the market.

E. Benchmarking

After passing the previous steps each process is well defined, standardised (or at least refers to standards), has identified potentials for automation and is assessed and evaluated with regards to core competency, the prerequisites allow the first time for a benchmark, i.e. comparing efficiency and effectiveness of this step with similar steps in other projects or competitors.

Benchmarking is always difficult since there is a high risk to compare apples and oranges. On this level apples might be benchmarked with peers as well, but the parameters of difference (e.g. smell) are clear and can be considered systematically when thinking about benchmarking. Without having this consensus about involved parameters benchmarking stays error-prone and fuzzy (cf. [4]).

The industrialisation consisting of these 5 steps including their dependencies (and some overlaps) is depicted in the following Figure:

![Industrialisation Roadmap](image)

Figure 1. Industrialisation Roadmap

It is important to point out that companies do not have to reach the maximum industrialisation level (e.g. a three person company doesn’t need a standardisation step) in order to realise benefits. A lot of benefits from earlier steps in industrialisation can already be leveraged on lower maturity levels. In addition, each of these steps can be implemented partially, i.e., the industrialisation can be in place for the IT development without being applied for facility management.

III. GLOBAL DELIVERY & THE DELIVERY MODEL CUBE

Many technical innovations in IT industry affect more and more the way of how a service or product is built, delivered, and consumed. The new way IT understands itself is often called industrialisation and is strongly related to the car-industry and its history: Like other production focused sectors they have already undergone significant changes from craftsmanship into an industrialised approach character-
ized by specialisation and division of labour across enterprises, IT is taking the first steps on this road right now.

An important aspect related to industrialisation is global delivery: Gartner defines it as “[…] the incorporation of globally dispersed creation and consumption of IT-enabled services, including applications, infrastructure and business processes.” [5], p. 38.

This definition spans three dimensions that can be used for a refinement of global delivery and address the following questions:

- Where are the resources located working on the "globally dispersed" creation?
- What type of engagement type is linked with the provided and consumed service?
- How to pay for the provided and consumed service?

Each of these dimensions is further refined in the following for the subsequent integration of the industrialisation concept.

A. Geographical locations

With the entire globe transforming by means of internet technologies into a “global village” the location where a service or a product is delivered technically becomes less and less important. However, in reality technology does not always bridge all abysses: Different laws and regulations, different types of communication, different cultures, different price levels and many more parameters still determine the constraints for selecting the geographical location utilised for a service/product delivery.

From a very local perspective to a global perspective the following classification can be identified:

- Onsite: The service/product is delivered within the premises of the customer company, i.e. within the company buildings or directly neighbouring locations.
- Onshore: The service/product is delivered within the borders of the same country, i.e. within the same legal area [6].
- Nearshore: The locations providing the service/product are dispersed over different locations but still cohesive in terms of cultural behaviour. The EU is a typical nearshore community. A more quantitative definition of nearshore is given in [7]: “nearshore […] refers to outsourcing to a country location that has a time differential of not more than three hours from the […] main business locations”.
- Offshore: The locations providing the service/product are in low-cost countries like India, Malaysia or China. The most obvious characteristic of those countries is a much lower salary level. At the same time, cultural differences are eminent, e.g., high staff fluctuation and incompatible working styles.

In all variations of the geographical solution, customers and providers face different risks in the context of cultural and language issues. As a rule of thumb, the more borders (not only the physical ones) are crossed, the higher the risk. Language still is a main source of misunderstanding if customer’s and service providers first language are not the common business language (e.g., German, Chinese, English). Culture here not only refers to the culture of different nationalities but can already be a source of surprises when only considering different company cultures in the same national arena.

B. Engagement styles

Engagement styles in IT industry vary and evolve similarly to the way the production industry has transformed: Starting from one man shops where universal geniuses invented numerous ingredients and assembled everything in a very personal style going through a transformation into modern industrialised production schemes with a large number of third parties building parts for the overall product. For IT, this development is reflected by the following engagement styles (cf. [8] and [5]):

- DIY (do it yourself): The style requiring the least mature organisation in terms of division of labour is simply making use of internal resources performing all necessary activities. This way of production even works when communication is informal, processes are non-existent or in their first stages. Effectiveness and efficiency are difficult to predict and measure and depend largely on individuals. Scalability is limited, work is done at the customer’s premises and at the customer’s risk.
- Body Leasing: To overcome limited scalability (i.e., ramping up and down resources according to the staffing profile of a project), external resources are brought into the organisation by contracting free lancers or utilising body leasing companies providing skilled and experienced individuals. On this level the CV of a candidate is the prime decision making instrument and predictability of the outcome is limited. Delivery risk is still mostly with the customer.
- Outtasking: As soon as an organisation is mature enough to identify repetitive tasks not being part of their core competencies outtasking can be applied. Partner companies are asked to complete specific tasks autonomously on behalf of the customer, typically onsite with close interaction with the customer’s employees. On this level the CVs of the resources are less important than the tasks they have to complete in order to achieve required results. Depending on the nature of the task the delivery utilises the customer’s infrastructure to a large extent. Delivery risk is shared between customer and partner company but remains in the customer’s ownership mostly.
- Infrastructure Outsourcing: At a higher level of maturity, companies strive to reduce their own risk and outsource more and more complex services. Processes need to be defined and followed, interfaces between processes need to be clear and documented and the task distribution in the customer’s organisation needs to be transparent. To this end, services can be identified and the customer’s management can consciously decide what service is part of the
core business (and therefore needs to be retained) and what services can be outsourced. The first candidates to outsource are infrastructure services: the final delivery of the service itself is still retained in-house but the supporting infrastructure is provided through a third party in its own responsibility. Typical examples are provision of desktop and server hardware, databases, webservers or file storages.

- Application Outsourcing: On the next level not only the infrastructure but additionally the applications used to perform the business processes are outsourced. Typical examples are ERP hosting, office application providers (e.g., Google Docs, or Office365.com), or well-known CRM providers like salesforce.com.

- Business Process Outsourcing: In some cases, whole business processes can be run by a partner company (e.g., HR processes can be implemented with the support of external providers and can be even operated by third parties). Typically, the interfaces between customer and provider are well defined and relatively limited. Services are delivered to the customer according to a formal contract (usually in service level agreements, SLAs) with specified service level objectives within quantified boundaries. The delivery risk (along with resource risks) is entirely with the service provider as is the management of the necessary applications and infrastructure. From the customer’s point of view the outsourced business service becomes a black box, i.e. he is not a specialist on this business field anymore.

In the above engagement models a shift in risk ownership takes place. On one hand, some risks with the delivery (of the service or task) are handed over to the service provider. In particular, risks affecting the quality of service are in the responsibility of the provider (who promises to manage these risks in improved ways compared to the service consumer). On the other hand, risks that arise from immaturity in organisations (primarily the consumer’s organisation) and service / supplier management related risks come into play.

C. Compensation models

For internal resources, no sophisticated payment model is needed and the deployment of resources and their assignment is more a question of enterprise resource planning. As soon as external resources are brought aboard, customers need to think about how to pay for them. The more experience is available with a service or product (e.g., expected response times, quantities and qualities) the more likely a compensation model based on service or product output can be applied. If there is only limited experience with the service or product the compensation model will focus on structures outlining what resources are required to deliver results.

Evolving from a white-box task view towards a black-box service view the following stages can be identified (cf. [8]):

- Time & Material: All hours and all material utilised to deliver a service/product are accounted for. The compensation model focuses on endeavour instead of achieved output, so even if the output is not adequate the time & material model obliges complete payment unless negligence comes into play. The value delivered may be perceived differently from within the customer and delivery assurance of the desired results is strongly limited.

- Cost plus: This model needs a rough overview about a desired result and a cost estimation to achieve it (cf. [8]). In best case the created result fulfils the requirements and could be created within the estimated effort threshold. If additional effort is needed this plus is usually paid for if it can be justified why the originally planned effort is exceeded.

- Fixed price. For more output oriented tasks organisations can pay for specified results of the delivery rather than the effort to produce the results (black-box view). If the deliverable can be fully understood and specified a priori, customers and providers simply agree on a fixed price. Payment is due when delivered, usually supported by product or service quality criteria to some extent.

- Transaction based: If the elements of delivery are clear but the quantity is variable customers and providers can agree on transaction based (output based) pricing. Payment is closely linked to quantity delivered at specified quality and scheduled on a regular basis (e.g., monthly).

- Business value based: On this level the customer does even not pay for the direct product or service but for the business value that can be achieved by using the product or service. A typical scenario is outsourcing the complete invoicing for a company, i.e. it even does not matter which tool is used, how many resources are necessary etc. but payment is based on a fraction of the invoicing volume.

In general, to achieve a fair price the challenges of management of the how-to of the delivery are traded in for challenges in specifying the quantities and qualities of the deliverables in a proper way.

Each specific global delivery can be characterised by their specificity within these three dimensions and can be depicted as a delivery model cube (see Figure 2).

![Figure 2. Delivery Model Cube with its dimensions](Image)
IV. MATURITY AND INDUSTRIALISATION

Depending on how far a customer organisation has progressed on the way to industrialisation, suitable coordinates within the delivery model cube are predetermined. For example, if a company has not achieved modularisation it will be difficult and risky to use outtasking or more advanced engagement styles because it is not clear how the task to be outsourced is defined. Regarding the geographical locations, all resources must be onsite preferably because ad-hoc communication usually is fundamental for any progress. Further, the best suited compensation model will be time and material because even a cost plus model needs a clear understanding about the result that have to be achieved.

In the following, each industrialisation maturity level determines boundaries within the delivery model cube. The spaces spanned within the boundaries in the cube give valuable guidance for the successful selection of delivery models in terms of geographical locations, engagement styles, and compensation models. Each combination of industrialisation maturity and the spaces not covered within the delivery model cube impose significant risks for the success of such an endeavour.

A. Before modularisation

- Geographical location (onsite): Success depends heavily on ad-hoc and continuous communication. Feedback-loops are – if any are done at all – depending on ad-hoc meetings.
- Engagement style (DIY and body leasing): Since there is no clear process landscape delegating working items is continuously done ad-hoc and on a strongly communicated based manner.
- Compensation model (time and material): The only compensation model for pre-modular organisations that can be used successfully.

B. Modularisation achieved (but before standardisation)

- Geographical location (+onsite): As soon as modularisation has been achieved resources can be deployed more flexibly and the modules can be staffed on the basis of skill profiles.
- Engagement style (+outtasking): Some identified modules can be subject to outtasking.
- Compensation model (+cost plus): Further models cannot be applied as their prerequisites are not properly defined.

C. Standardisation achieved

- Geographical location (+nearshore): As soon as standardisation has been achieved and information can be exchanged in more formal ways between collaborating partners in the work chain, the delivery can also be shifted to nearshore locations.
- Engagement style (+infrastructure outsourcing): The engagement styles typically successful are infrastructure outsourcing, and depending on the details of the tasks, sometimes even application outsourcing.

- Compensation model (+fixed price): Preferred compensation models after standardisation has been achieved are fixed price models.

D. Automation achieved

- Geographical location (+offshore): It becomes increasingly simpler to make use of offshore locations since the level of automation, which is independent from any cultural differences, has become clear.
- Engagement style (+application outsourcing): With automation in place, engagement styles up to application outsourcing can be used.
- Compensation model (+transaction based): Since automation focuses on repeating activities the transaction based compensation model gets important on this level.

E. Specialisation achieved

- Geographical location (+/-): Specialisation brings further shifts into near- and offshore locations for non-core activities.
- Engagement style (+business process outsourcing): When organisation start to thoroughly consider their core competencies and consciously decide what business processes to run themselves and what processes to purchase as a service, engagement styles up to BPO can be applied.
- Compensation model (+business value): Since this level supports talking about business processes this compensation model is the preferred one.

F. Benchmarking achieved

- Geographical location (+/-): On this level no additional geographical location is added; moreover the geographical location plays only a minor role here.
- Engagement style (+/-): On this level no additional engagement style is added.
- Compensation model (+/-): On this level no additional compensation model is added.

An overview about the relations between industrialisation steps and engagement models, geographical locations and compensation models is visualised in Section VIII.

V. APPLICATION

The application of the global delivery cube and its dependencies to the industrialisation steps for strategic decisions in terms of global delivery is straightforward: If there is a need for a more flexible usage of different scenarios within the global delivery cube the industrialisation steps suggest a systematic roadmap. This roadmap aims at a higher degree of freedom within the cube; this freedom can be used to move from a starting point to an end point. However, it can also be used just to know that there would be an opportunity to move. In many cases this is done in the context of risk management.

In real world different drivers for this initiative exists:

- Missing resources: If the business is growing it might be difficult to utilise additional resources.
Maybe it’s difficult to identify some additional colleagues, maybe it’s difficult to educate them (because there is no explicit training material). In both cases more freedom within the global delivery cube would be necessary, i.e. to utilise offshore resources or to abstract from resources to a task-level. This scenario is especially important when talking about legacy systems because there the resources that are available for maintaining are often a bottleneck.

- Cost pressure: If a service or product does not have any obvious unique selling points (e.g. by a unique feature) it comes under cost pressure, i.e. the delivery of the service/product has to be cheaper. More freedom within the global delivery cube would enable additional possibilities to decrease cost, e.g. by utilising low-budget resources from offshore or to identify supporting processes and delegate these completely to an outsourcing company.

- Re-organising: If an organisation becomes too complex or desires to focus resources to its core competency (e.g., to foster innovation), it can think about a re-organisation: The global delivery cube helps to localise the current status and a higher degree of freedom within the cube enables additional opportunities.

The global delivery cube’s application based on these use cases follows an easy sequence to derive measures for the maintenance and evolution of legacy systems:

- Analyse current status in terms of industrialisation, i.e., for a given product/service determine the level of modularisation, standardisation, automation, specialisation and benchmarking.

- Based on the industrialisation level determine the possible alternatives in terms of geographical location, engagement model and compensation model as explained in Section IV.

- Compare determined alternatives within the global delivery cube with the current situation in the company in terms of geographical location, engagement model and compensation model. In cases where the current status is not within the boundaries of the spanned industrialisation level, a high risk is identified. Typically, a mitigation plan containing measures for maturity improvements based on the industrialisation roadmap can be derived and executed.

The respective industrialisation assessments (first step) can be easily conducted by means of the QRM framework.

VI. SUMMARY

Today, many IT innovations are based on IT industrialisation as can be observed with current trends such as cloud computing, deployment of offshore resources or managed services. IT industrialisation follows five steps: modularisation, standardisation, automation, specialisation and benchmarking. Industries other than IT have already undergone a series of changes towards industrialisation and IT will follow the same path.

One of the steps is usually referred to as IT global delivery, i.e. the incorporation of globally dispersed provision and consumption of IT-enabled services, including applications, infrastructure and business processes. In this paper, the global delivery cube, a tool for classifying the different flavours of IT global delivery in terms of geographical locations, engagement styles and compensation models is described.

Within the global delivery cube industrialisation efforts follow a general roadmap along the industrialisation steps of increasing maturity. If there is no industrialisation maturity at all the global delivery cube collapses and only leaves room for small IT manufacturers, i.e., organisations with everybody doing everything onsite, based on time & material. Following the road of industrialisation enlarges the set of alternatives within the global delivery cube and thus gives management more flexibility in implementing the business.

It is noteworthy that the flexibility to move between the variants of running a business within the global delivery cube has is limited by risks imposed by industrialisation. A company on a low industrialisation maturity level applying the “wrong” global delivery parameters creates high risks to the delivery of the business.

VII. ACKNOWLEDGMENT

Parts of this work have been supported by EU project TIMBUS: “Digital Preservation for Timeless Business Processes and Services”, Grant Agreement Number 269940.

References
The relation between industrialisation steps and engagement models is visualised in the following Figure 3.

<table>
<thead>
<tr>
<th>Industrialisation Step</th>
<th>DIY</th>
<th>Body Leasing</th>
<th>Outtasking</th>
<th>Infrastructure Outsourcing</th>
<th>Application Outsourcing</th>
<th>Business Process Outsourcing</th>
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Figure 3. Relation between industrialisation steps and engagement model

The relation between industrialisation steps and geographical locations is visualised in the following Figure 4.

<table>
<thead>
<tr>
<th>Industrialisation Step</th>
<th>Geographical Location</th>
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Figure 4. Relation between industrialisation steps and geographical location

The relation between industrialisation steps and compensation models is visualised in the following Figure 5.

<table>
<thead>
<tr>
<th>Industrialisation Step</th>
<th>Time &amp; Material</th>
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Figure 5. Relation between industrialisation steps and compensation model