The Applied Polymathical/Holistic Mathematical Model for Enterprise Transformation Projects (AHMM4PROJECT)

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Abstract

<<CCCC ABSTRACT>>

In this work the focus is on Enterprise's transformation projects (simply Project) and the Applied Polymathical/Holistic Mathematical Model for Projects (AHMM4Project); where it can be also presented as AHMM(Project). The AHMM4Project is the Project's structure and supports its Meta-Model. The AHMM4Project is a set of interrelated Mathematical Models (MM), transformed artefacts, critical success factors (or calibration-factors), and adapted Enterprise Architecture (EA) Models (EAM). MMs, artefacts and EAMs use a standardized and holistic set of names-conventions, mapping concepts, unbundled-services, relations, to model the transformation and validity-checking of any part of the Enterprise, Project, Data-storage(s), or the Information Communication System (ICS). EAMs, pool(s) of unbundled services, relationships, and other can be exported to MMs via eXtensible Markup Language (XML) format. Exported MMs are combined to generate the AHMM4Project that can be used for Project's integrity-checking, gap-analysis, financial analysis, risk-management, and many other types of strategic enterprise operations. MMs are based on DataSets (DS) that are interrelated and use a mixed-research method(s) that are supported by qualitative and quantitative research module. This module is the central reasoning engine based on the qualitative Heuristics Decision-Tree (HDT). And this article's main objective is to support Projects.

Keywords

Mathematical models, Polymathics, Enterprise transformation projects, Enterprise architecture, Artificial intelligence, Qualitative and quantitative research, Critical success factors/areas, Performance Indicators, Software (re)engineering and Strategic Vision.

Introduction

This article presents the AHMM4Project that is used in the contexts of a Project. Where a Project is also supported by an In-House Implement (IHI) Polymathic Transformation Framework (IHIPTF), critical success factors (and areas), standard methodologies, MM's nomenclature... In complex Projects the AHMM4ENE can predict various types of problems and propose solutions. AHMM4Project's main objectives and features are:

- To drive Unbundling for Modelling Process(es) (U4MP) and its embodied Refinement Processes (RP) (simply Disassembling). Disassembling transforms legacy source-code to deliver unbundled-services.
- To support and offer integrity-checking for Projects by matching existing MMs that are persisted in DSs.
- Is a coherent set of interrelated MMs, transformed artefacts in the forms of conventional blocks, Critical Success Factors (CSF, used for calibration purposes), and adapted EAMs that use an IHI methodology.
- The IHI methodology or the Methodology, Domain, and Technology Common Artefacts Standard (MDTCAS), uses various parts of existing methodologies and IHI artefacts.
- MDTCAS uses MMs, artefacts, EAMs, naming-conventions, mapping-concepts, unbundled-services, relations…

- MDTCAS is used to model Projects and for validity-checking of any part of the Enterprise, Project, Data-storage(s), or the ICS. Where an ICS can be a Cloud (Cld).
- EAMs, pool(s) of unbundled-services, relationships, and other can be exported to MMs via XML format based DSs.
- As shown in Figure 1, exported MMs are combined and synthesized to generate the Project's AHMM4Project that can be used for Project's integrity-checking, GAP-Analysis (GAPA), financial-analysis, risk-management, and many other types of strategic enterprise operations.
- As mentioned, MMs are based on DSs that are interrelated and they use a mixed-research method(s) that is supported by qualitative and quantitative research module. This module is the central reasoning engine based on the qualitative HDT.
- The main goal is to reduce XHFRs and local their main sources, complexities…Supports the Research and Development Project's (RDP) evaluation and execution, which is the first CSA.

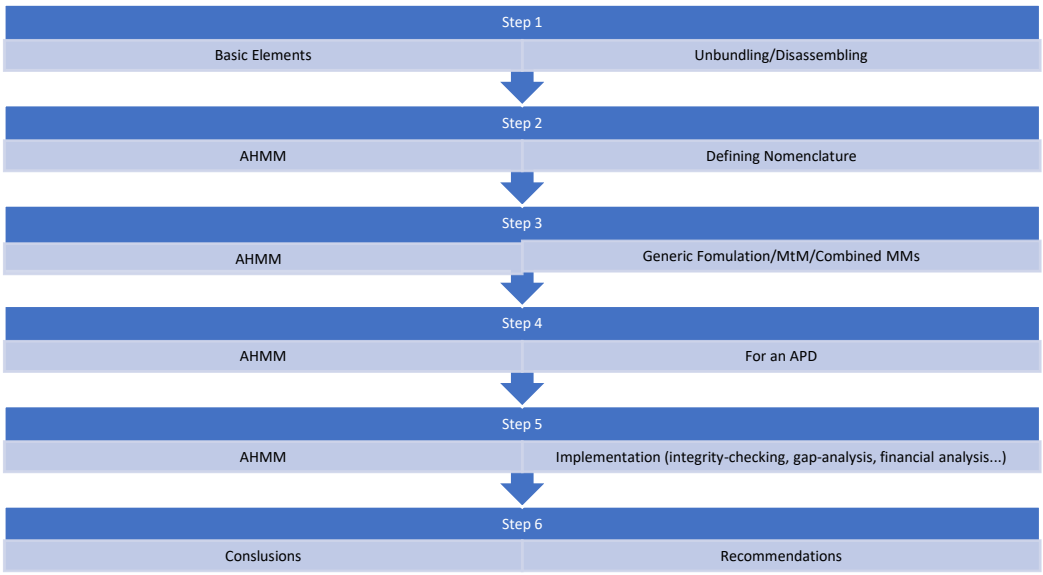

Figure 1. The AHMM steps or Phases.

The valuable reader can refer to the glossary files and related works file for more information on abbreviations, definitions, and constructs.

The Research and Development Project

<<CCCC RDP>>

The Research Question

This article's Research Question (RQ) is: "Which AHMM4Project characteristics and structure are needed to support Projects and Entity's evolution?" The Polymathic Resources and Literature Review (PRLR) is mainly based on IHIPTF's knowledge and articles repository, and authors' related works and projects, like:

- Applied Holistic Mathematical Models for Dynamic Systems (AHMM4DS) (Trad, 2021).
- The Business Transformation and Enterprise Architecture Framework-The Applied Holistic Mathematical Model's Persistence Concept (AHMMPC) (Trad, 2019).
- An Applied Mathematical Model for Business Transformation and Enterprise Architecture-The Holistic Mathematical Model Integration (HMMI) (Trad, & Kalpić, 2020a).
- Using Applied Mathematical Models for Business Transformation (Trad, & Kalpić, 2020a).
- The Transformation and Enterprise Architecture Framework: The Applied Holistic Mathematical Model for Geopolitical Analysis (AHMM4GA) (Trad, 2021a).

- Organizational and Digital Transformation Projects: A Mathematical Model for a Dynamic Enterprise-Ecosystem Model (DEM) (Trad, 2021b).
- The Polymathic approach for Projects that use a MtM (Trad, 2024a).
- The Business Transformation Project's Holistic Agile Management (Trad, & Kalpić, 2022a).
- Organizational and Digital Transformation Projects-A Mathematical Model for Building Blocks based Organizational Unbundling Process (Trad, 2023a).
- Trad, A. (2023c). Enterprise Transformation Projects-A Mathematical Models' based Enterprise Refinement Concept (ETP-ERC) (Trad, 2023c).
- Enterprise Transformation Projects-The use of the Polymathic Rating and Weighting Concept (PRWC) (Trad, 2024d).
- The Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis (Trad, & Kalpić, 2023a).
- Business, Economic, and Common Transformation Projects-The Integration of Six Sigma (ISS) (Trad, & Kalpić, 2024a).
- The Selection and Training Framework for Managers in Business Innovation and Transformation Projects, An applied mathematics hyper-heuristics model (Trad, & Kalpić, 2014).
- The Business Transformation An applied mathematical model for business transformation-Introduction and basics (Trad, & Kalpić, 2018a).
- An applied mathematical model for business transformation-The Holistic Critical Success Factors Management System (HCSFMS) (Trad, & Kalpić, 2018b).
- Business Transformation Projects An Enterprise Architecture Applied Mathematical Model's Proof of Concept (Trad, & Kalpić, 2018c).
- The Business Transformation An applied mathematical model for business transformation-The Research Development Projects Concept (RDPC) (Trad, & Kalpić, 2018d).
- Applied Mathematical Model for Business Transformation Projects: The Intelligent Strategic Decision-Making System (iSDMS) (Trad, 2020a).
- The business transformation framework and enterprise architecture framework for managers in business innovation: An applied holistic mathematical model (Trad, 2021d).
- An Applied Mathematical Model for Business Transformation and Enterprise Architecture: The Holistic Organizational Intelligence and Knowledge Management Pattern's Integration … (Trad, 2021e).
- An Applied Mathematical Model for Business Transformation and Enterprise Architecture: The Business Engineering and Risk Management Pattern (BE&RMP) (Trad, 2021f)
- … and others.

A hypothesis (or an assumption) corresponds to a Projects Critical Success Areas (CSA) and the article's main subject/topic corresponds to a *central* CSA and the RQ. RQ's feasibility and RDP's credibility are related to on a set of hypotheses (and assumptions). And RQ's main hypothesis (or assumptions) are that the following transformational activities and phases were finalized successfully finalized:

- Project's start, vision and roadmap development.
- Project's budget was developed and accepted; and there is a sufficient level of political support.
- The Entity has a robust, evolutive, and longterm RDP.
- Disassembling and automated choreography strategies were verified and established.
- All Disassembling processes terminated successfully.
- The Project has integrated/implemented the MDTCAS, PRWC, HDT, and IHIPTF.
- Adopted the DB Centric Concept (DBCC) or DB first, and DB Centric Implementations (DBCI).
- The Project's Manager and team have advanced Modelling skills
- The Project has a Factors Management System (FMS)
- The Project and Entity have defined MM's fundaments/basics, Symbols/Notations, and AHMM's artefacts and sets
-
- ….

A hypothesis (or assumption) corresponds to a CSA, and the article's main topic corresponds to a CSA and the RQ.

The PRLR

This RDP found a research-gap that is based on the facts: 1) There isn't an identical Polymathic-concept for Projects, MMs aggregations, AHMM4Project, and IHIPTF; 2) XHFRs' localisations; 2) There isn't an identical Quantitative-Qualitative Research Mixed Model (QQRMM) mixed-method; 3) A Project manages intangible CSFs; 4) A concrete PRWC/FMS and Factors that are related to Projects, GAPA, MMs, ICS' components, IHIPTF, and APplication Domains (APD); and 5) The application of CSA Decision-Tables (CSA_DT) to qualify-verify Project's main CSA/topics. GAPA exists for all CSAs, but only RDP's GAPA is presented.

[MMMM_Symbols]

MM's Fundaments, Basics, Symbols, and Notations

The author, AHMM/AHMM4Project, and hence the IHIPTF, are the first to propose a Mathematical Notation (MN) for Polymathic Transformation Initiatives/Projects (MN4PTI). The IHIPTF and MM main symbols are (Cuemath, 2024; MathVault, 2024):

+	Add or unit operator used in GAPA's context.
-	Difference or GAPA operator.
∑	The Sum on IHIPTF's resources' instances.
U	The Union of.
$\underline{U}$	A set of.
Δ	The difference symbol that is specific to IHIPTF and used for a TDM Itr and is a Project diff (or) can be evaluated
∫	Accumulation
[]	Argument, element of an array, search-item…
()	function operator.
||	OR operator.
&&	AND operator.
!	NOT operator.
→	Conditional.
a	for atomic, for the atomization of an element.
b	based or inheritance.
BP	Business Process or any other type of choreography.
E	an Entity.
Enum	an Enumerator.
i	instance of operator
Itr	An iteration, mainly a Project's iteration.

Cls	a class or structure type.
m	mapping operator.
mc	micro-operator, which means single.
MM(Arg)	Mathematical Model for Arg.
Obj	an object type.
OU	Organizational Unit.
P(Arg)	A pattern for Arg.
Prb	A problem.
sec(Arg)	securization or secured function for Arg.
Qlt(Arg)	Qualitative function for Arg.
Qnt(Arg)	Quantitative function for Arg.
Sol	A solution.
T	Transformation initiative or Project.
Teval	T's evaluation.
x	Product or Problem processing operator.
Wgt	Weighting.
V(Arg)	Viewpoint for Arg.

AHMM's Main Artefacts and Sets

The AHMM's main resources, artefacts, and items are (Cuemath, 2024; MathVault, 2024):

A	⋃ of Actions/***Fs.***
Arg	⋃ of Arguments***.***
C	⋃ of Constraints.
D	⋃ of Diagrams.
E	⋃ of OUs.
H(Arg)	HDT/Heuristics function for Arg.
F	⋃ of Features or **∑** ***mcR***
F(Arg)	Function, which can be an optimization and/or quantitative method-call for Arg.
V	Valuate function, ⋃ of ***H.***
P	⋃ of Prb-types.
S	⋃ of Sol-types.

R	⋃ of Requirements.
Re	⋃ of Relations.
Rl	⋃ of Rules.
Srv	⋃ of Services.
S	⋃ of Solutions.
St	⋃ of Project (transformation) States.
T	⋃ of **St**s; transformation steps and states.
Tsk	⋃ of **A**; actions in the form of services.
Prj	⋃ of **Ts**.
PrjSt	Project status, a binary value 0 for Failure and 1 for success.

AHMM's MMs

The AHMM() can include one or more of the following MMs:

- MM for U4MP (MM4UP) which supports unbundling.
- MM for Object Orientes (OO) (MM4OO) which structures on the base of OO paradigm.
- MM for Factors (MM4FC) which structure and checks Factors.
- MM for GAPA (MM4GP) which supports GAPA's estimations.
- MM for PRWC (MM4PR) which supports PRWC's estimations.
- MM for Expectations and Constraints (PEC) (MM4PE) which structures PEC.
- MM for Complexities Management (MM4CM) which tries to contain complexities.
- MM for MetaModels (MtM) (MM4MM) which is base for MtM.
- MM for Polymathic Enterprise MtM (PEMtM) (MM4PM) which is base for PEMtM.
- MM for BP (MM4BP) which supports and checks BP, BPMs, and choreographies.
- MM for Methodologies and ICS (MM4MD) which supports and checks OOM/UM, Archimate, and other.
- MM for MDTCAS (MM4MT) which supports and checks MDTCAS.
- MM for APDs (MM4AD) which supports and checks APDs and its problem-types.
- MM for Agile Project Management (APM) (MM4AP) which supports and checks APM, and PM.
- MM for Intelligence (MM4IN) which supports and checks AI and decision-making.
- MM for AHMM() (MM4AH) which constructs the for a specific topic .

AHMM's Methodology Types

The Cls can used for Factors and CSAs, and other as shown in Figure 1.

```
class CSA
{
        GID             gid,
        TEXT            description,
        TEXT            name,
        ....


};
```

Figure 1.

The AHMM's methodology types are:

- Needs a type for unbundling-refinement processes, which are the Entity Common Standard Elements (ECSE) which comes.
- They are common elements to all existing standards that are adapted locally, like classes (Cls), Objects (Obj), and Enumerator (Em).
- Elements can be extended to suit the Project.

Factors define Project's initial nodes that are defined as vital for its success and targets to be reached. AHMM()'s s basic element are used in AHMM() and is IHIPTF's specific model. The AHMM() uses:

- The symbol $\sum$ indicates summation of AHMM()'s s actions, denoting the relative importance of the set members selected as relevant. Ratings and weightings as integers ranging in ascending importance from 1 to 10.
- The symbol $\bigcup$ indicates sets union.
- The AHMM() defines the Project and the set of relevant MMs.

The Factors and FMS

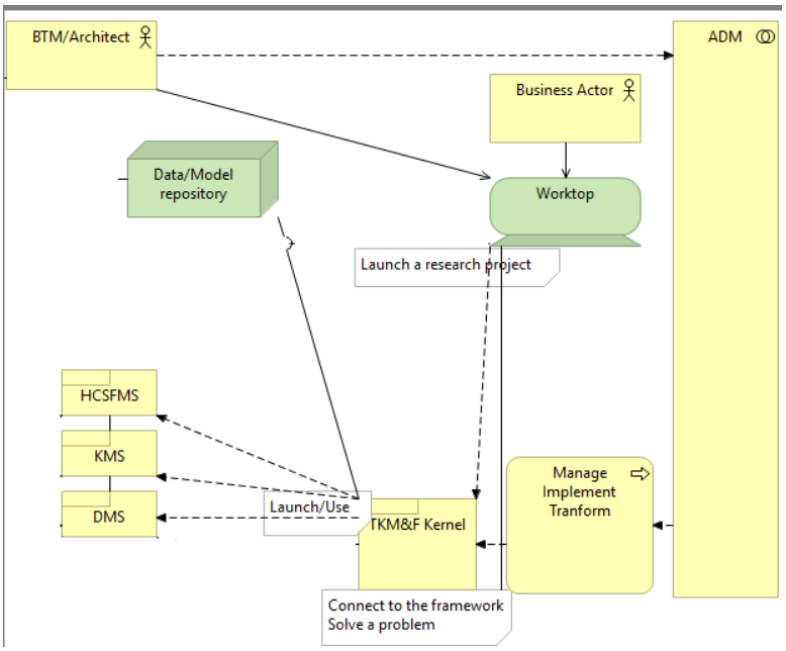

Figure 2. The TDM's and Factors interactions.

The FMS and Factors main features are (Myers, Pane, & Ko, 2004; Trad, Kalpić, 2020a; Lankhorst, 2009; Peterson, 2011; Putri, & Yusof, 2009):

- They are used in various levels of Project, Natural Programming Languages (NLP) scripts, and for risks' management
- The FMS manages CSAs, CSFs, Key Performance Indicators (KPI), and concrete ICS VARiables (Var), or Factors.
- A CSA links/maps to a set of CSFs (and Project's resources), and a CSF is a set of KPIs.
- The Project Team selects and tune he initial-sets of Factors.
- A KPI links/maps to a "unique" Project requirement (and problem-type).
- CSFs are used for mapping Project's (and IHIPTF) problem-types, Decision Making System (DMS)/Knowledge Management System (KMS) (simply Intelligence) elements/artifacts, and predefined-constraints.

- Factors' main roles are: 1) A CSA maps to an Entity APD (or common functional-domain, like health…; 2) A CSF maps to a set of requirements (and directly linked problems, like type of health-problem…; and 3) A KPI maps to a unique ICS' item that is directly-linked to a Var.
- Factors, ICS' libraries, VARs, and resources are managed/synchronized by the TDM, as shown in Figure 2.
- IHIPTF's repository contains the relations/mapping between Factors and Project's resources, like services, EA/MDTCAS-models, APD-requirements, and other.
- Factors related to Project's goals/objectives, APD-requirements, ICS-VARs, Entity's organisational structure, as shown in Figure 3.
- Factors and problem-types link to Action Research (AR) based Learning-Processes (LP). An Entity LP (ELP) manages all stored LPs.

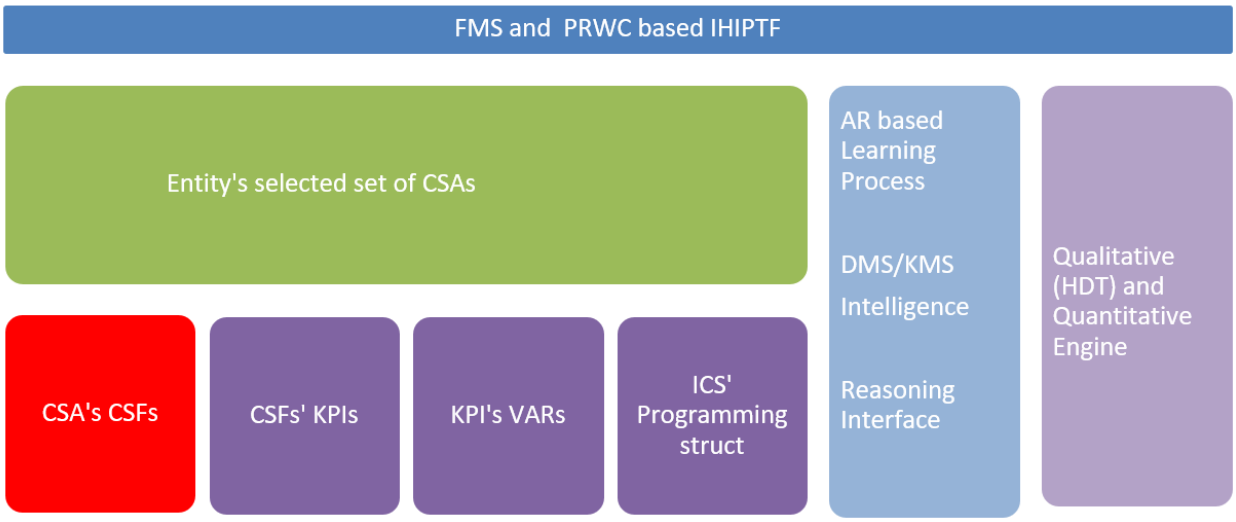

Figure 3. The Evaluations of Projects and IHIPTF.

[MMMM_Factors]

The AHMM4Project for Factors (or the MM for Factors, or MM4FC) defines, establishes, and relates initial-sets of Factors which is a somehow random and complex process which uses the following criteria:

- The used ∑ symbol is not to the definition of the classical ***sumof()***..
- The ∑ symbol relates to the processing of a series of Project of transformational steps equations.
- Defines the transformation of an Organizational Unit (OU).
- It is applied for GAPA and hence risks' management (simply GAPA).
- Uses a Weitling and Rating concept (Wgt) and CSA_DT, as shown in Figure 4.
- A Wgt € {1 … 10} (FC1).
- Evaluations/Analysis = ∑ Factors, which abstracts GAPA on Project's level (FC2).
- Factors = ∑ CSAs, which abstracts GAPA on subsystem's/APD's level (FC3).
- CSA (OU or Sector) = ∑ CSFs, which abstracts GAPA on APD's component/topic level (FC4).
- CSF (OU_Element) = ∑ KPIs, which abstracts GAPA on blocks or service-bundles level (FC5).
- KPI = ∑ VARs, which abstracts GAPA on ICS' attributes/service(s) level (FC6).
- GAPA(Itr) = ∑ KPI (FC7).
- ….
- BP = $\bigcup$ MA + $\bigcup$ Re + $\bigcup$ Ressources (FC10).
- OU_Element = OU[n or element], € {1 … k} (FC11).
- OU (or Sector) = $\bigcup$ APD[n] +$\bigcup$ BP + $\bigcup$ Re + $\bigcup$ Ressources (FC12).
- mcE = $\bigcup$ OU (FC13).

- E = $\bigcup$ mcE (FC14).
- …
- F(Arg) = Wgt x Qnt(Arg) v/& Wgt x Qlt(Arg) (FC20).
- Teval = F (Var/Arg) (FC21).
- …

MM4FC (that includes FC1 to FC6), CSFs, and KPIs are the constraints-elements needed for Project's basic evaluations, management, and planning; and are also the basis of MetaModels (MtM) and their aggregations in the Polymathic Enterprise MtM (PEMtM).

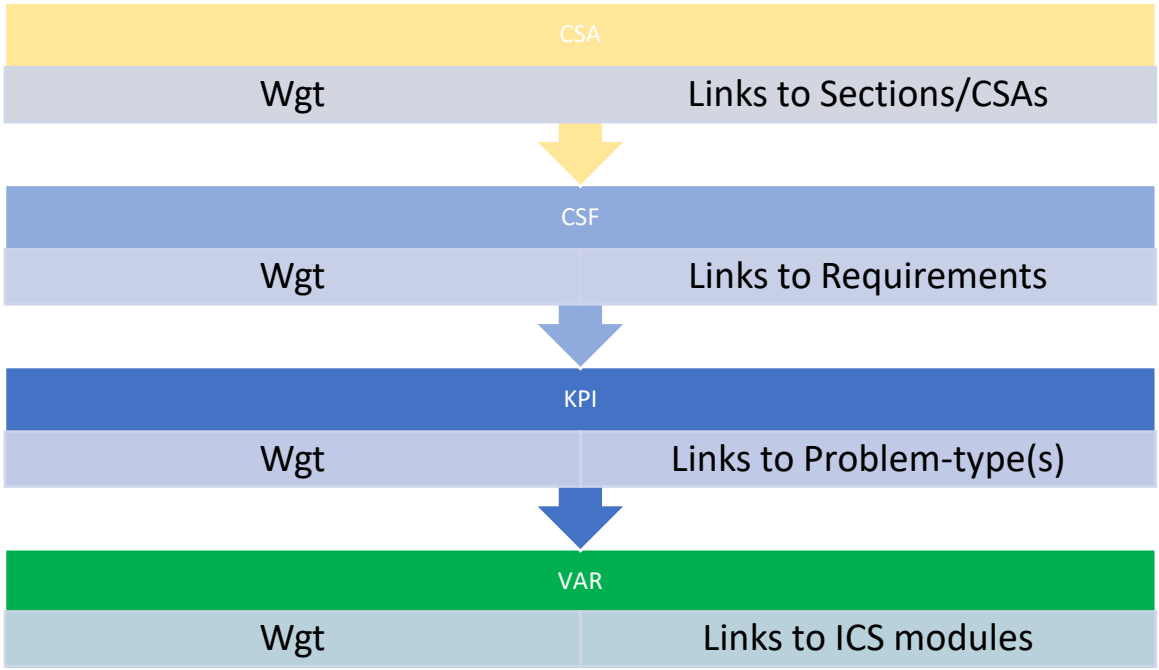

Figure 4. The Evaluations IHIPTF (for EME) that processes CSA_DTs.

The Role of PEMtM and its bindings to AHMM4Project, IHIPTF, GAPA, and PRWC

PEMtM which is a generic MtM has the following characteristics:

- Is IHIPTF, FMS, and PRWC, basic structure and their integrity-checker. Which ensure that Factors are measurable and mapped to a ratings and weighting (simply Wgt).
- Extends the MM4FC and has a static and dynamic form.
- The AHMM4Project for MtM (MM for MtM, or MM4PM) is PEMtM's structure and integrity-checker.
- It uses Rules, Constraints, HDT, Intelligence, and other basic structures and their integrity-checkers.
- It aligns Factors and Project's Unit of Work (UoW) that needs the needed level of granularity and responsibility.
- Therefore, it supports the "1:1" mapping, implementation, and classification concept.
- The ADM based TDM synchronizes PEMtM's implementation and evolution.
- It supports Project's GAPA and control.

The MM4PM includes the following criteria and equations:

- Includes the MM4FC and its equations (PM1).
- Prj = ∑ CSAs and all APDs' levels (PM2).
- TDM = ∑ ITeRation (Itr) on Project's level (PM3).
- Prj(Itr) = CSA(1)*Wgt(1)+CSA(2)* Wgt (2)+… (PM4).

- PEMtM = ∑ E's Resources/relations + ∑ Prj's Resources/relations (PM5).
- Prj = ∑ PEMtM and all Entity's levels (PM6).

Evaluating GAPA for one or All Project's CSAs

GAPA is used to evaluate Project's and its modules performances; and GAPA and control are done by Intelligence that uses AR based HDT to tune and improve Project's gap(s) or evolution. GAPAs can executed on the various Project's and IHIPTF's parts and components like the: MMs, AHMM4Project, PRWC, FMS-Factors, Pool of Building Blocks (BB), PEMtM, MDTCAS, TDM, APDs' integration… The PEMtM supports GAPA's execution and results; and that in various Project's and TDM's levels, and phases. GAPA is coordinated with TDM's phases, which shows improvements, regressions, or an eminent XHFR. Shortly written, GAPA evaluates Project's (and its phases) performances; and are used for each Entity's CSA/APD, where used CSFs can be: 1) Project resources like requirements or objectives; 2) Mapping levels of Disassembling and related BBs (simply Block); 3) PRWC's results; 4) GAPAs persistence and diffs-comparison; 5) TDM's phases' coordination; and 6) Intelligence's processing. KPIs hard-link to VARs that are Blocks' attributes, therefore, Intelligence enabled evaluation-processes can be automated to deliver CSAs, and CSFs values. Project's important decisions are based on GAPA(s) evaluations which support the implementation of Project's strategy, roadmap, and statuses, which in turn are based on the analysis of (the external and internal) defined CSAs and hence CSFs and KPIs (and VARs). GAPAs can help Managers estimated XHFRs. GAPA which is a generic Gap mechanism has the following characteristics:

- Extends the MM4FC and MM4PM.
- The AHMM4Project for GAPA (MM for GAPA, or MM4GP) is GAPA's structure and integrity-checker.
- For a TDM Itr a Prj diff (or Δ) can be evaluated (GP1).
- Prjt(Itr)=CSA(1)*Wgt(1)+CSA(2)* Wgt(2)+… (GP2).
- A Δ for the Prj is done on all selected CSAs (GAPA4Project) (GP3).
- GAP(Itr) = ∑ KPI (GP4)
- GAPA(Itr) or Δ =Prj(Itr)-Prj(Itr-1) (GP5)
- Risk=∑ GAPA(Itr) (GP6).
- Δ =∑ XML diffs (GP7).

Selected APDs' Evaluations and CSA_DT

The APD is a set of non-technical topics related to the Project and Entity's functional-objectives which deliver values; where values can be either tangible or intangible. The CSA_DT contains the evaluation of an CSA, where a specific CSA corresponds to a concrete Project topic or research area. RDP's resultant or final Phase's 1 evaluations are the synthesis of all CSA_DT's or the Project's (PRJ) DT (PRJ_DT). Some CSA_DTs have practically the same values, as some are mature and have been made robust, as shown in Figure 4. APDs' evaluations are related to Project's main sections and CSAs. These evaluations use Factors to assist Intelligence to avoid regressions. GAPA which is a generic MM for APDs' (MM4AD) evaluations have the following generic characteristics:

- Extends the MM4FC, MM4PM, and MM4GP.
- The AHMM4Project for APD (MM for APD, or MM4AD) is APDs' structures and integrity-checker.
- For a TDM Itr a APD's diff (or Δ) can be evaluated (AD1).
- Δ [APD (Itr)]=CSF(1)*Wgt(1)+CSF(2)* Wgt(2)+… (AD2).
- GAPA(APD)= GAPA(Itr)- GAPA(Itr-1) (AD3).
- Selected ACSs (SCSA)= ∑CSA (AD4).
- APD_DT=AVG(∑ SCSA_DT) (AD5).

An RDP has to setup the AHMM4Project, Wgts, and PRWC Enumerators (PRWCE), which for this article has the following values:

- Proven (that is equal to 10) (EN1).

- Possible (that is equal to 8 or 9) (EN2).
- Feasible (that is equal to 7 or 6) (EN3).
- Complex (that is equal to 5) (EN4).
- Very_Risky (that is equal to 3 or 4) (EN5).
- Very_Complex (that is equal to 1 or 2) (EN6).
- Failure (that is equal to 0) (EN7).

Enumerators are to be used in all article's CSA/CSA_DT and PRJ_DT processing and resulting-findings. As mentioned IHIPTF's and Project's main objectives are to reduce XHFRs and their origins, or complexities… All IHIPTF and Project activities need an PRWC.

The Use of the PRWC

The PRWC main features, constraints and relations are (Trad, 2024e):

- Can use standard methodologies like the Decision Making Notation (DMN).
- Includes the findings from the author's previous research articles (and works); which created the PWRC.
- The AHMM4Project and MM for PRWC (MM4PR) are supported by the PEMtM, where in turn the PEMtM needs the PRWC to be tuned and used in Projects.
- The PRWC is used to evaluate Project's and its components status(es) and integrity.
- The combination of PEMtM, FMS/Factors, and PRWC are used in various APDs like organizational and business engineering, complex transformation initiatives, EA modelling, Intelligence.,
- The PRWC uses the FMS that includes: Factors like VARs, which are used to interface ICS' components and Intelligence.
- The PRWC kernel is founded on interlinking and evaluation-mechanisms of sets of CSAs, CSFs, KPIs, and VARs (simply Factors).
- Most of Projects fail and have XHFRs that is due the lack of a Holistic or Polymathic concepts; and the lack of a Project integrity-checker that needs a PEMtM and MMs.
- LPs manage Entity's and Project's Knowledge Items (EPKI) that are related-linked to Entity's/Project's resources, Factors, and modules like Intelligence.
- Intelligence manages and uses EPKIs that are in-turn interlinked with Factors.
- Intelligence based PRWC checks Project's enhancements and uses interfaces to tune and evaluate Factors.
- Intelligence based PRWC identifies the needed Factors and control evaluation processes; and in the same time estimates XHFR's possibilities.
- The PRWC interfaces the FMS that links Factors (like a CSA or CSF) to one (or more) EPKI(s) that in turn maps to NLP scenario(s).
- NLP scenarios manage Intelligence's and PRWC's requests and control various IHIPTF activities-actions.
- The PRWC enables FMS' interfaces to modify Intelligence, which delivers solutions (in the form of information-answers, or EPKIs) and the corresponding sets of actions and services.
- The IHIPTF offers IHI evaluation-mechanisms to support the PRWC, but the Project can use exiting standards or commercial products/solutions like the Object Management Group's (OMG) DMN (OMG, 2022).
- The DMN can be used for CSA_DTs' evaluations, Intelligence's activities; and HDT's processing.
- Another possibility is Weighted Criteria Matrix can be used for Intelligence to support Project, using evaluation-criteria (that applies ratings).

The PRWC uses the following MM4PR generic characteristics:

- Extends the MM4FC, MM4PM, MM4GP, and MM4AD.
- The MM4PR is PRWC's structure and integrity-checker.
- For a TDM Itr a PRWC's diff (or Δ) can be evaluated (PR1).
- Prj(Itr)= ∑ Prj_Modules (PR2).
- Δ [PRWC of Prj(Itr)]=CSF(1)*Wgt(1)+CSF(2)* Wgt(2)+… (PR3).
- GAPA(PRWC)= GAPA(Itr)- GAPA(Itr-1) (PR4).

The PRWC can also be applied to evaluate the levels of Polymathics and complexities.

Polymathics, Complexities, and XHFRs

XHFRs, and complexities facts, and consequences are (Bryce, 2015; Heywood, Hillar, & Turnbull, 2010; Buch-Madsen, 2011):

- Project's complexities, Polymathical approaches/concepts, and too quick ICS' domains evolutions, are the main reasons for XHFRs. So, Projects are challenging because they encompass various-categories of complexities.
- The most critical category of complexities is related to Disassembling processes, which unbundle/transform Legacy ICS' Components and Resources (LICSCR) to provide pool(s) of unbundled-services, initial MDTCAS-models, and initial Business-Processes (BP) Models (BPM).
- Complexities and uncertainty management need advanced Polymathical-skills and Project's team must have such skills.
- advanced Polymathical-skills are needed for: 1) Implementing numerous modules/tasks; 2) Interrelating/mapping features, requirements and modules/components; and 3) Abstraction, EA/MDTCAS modelling predispositions.
- Enterprises, and organizations (simply Entity) can have exponential-evolutions (or regression) which need to be well-managed. Entity's structure depends on transformational-technics and the path to optimal-evolution.
- Implement mechanisms to detect major-defects (and blocking their propagation).
- To apply automated control, accountability, audit, by the means of an IHI Complexities Management Strategies (CMS), which traces and controls the progress of complexities. Some Project domains like the ICS can be a real challenge.
- The CMS includes the following constraints: 1) It is mandatory sub-system and the team has to accommodate; 2) Reduces resistances and stress; 3) Enables upskilling; 4) Predicts possible pitfalls; 5) Improves cognitive-capacities, critical-thinking, leadership-capacities, pragmatism… 6) Confront realities by simplifying and reactive behavior; 7) Promote Polymathism; and 8) Respect deadlines, budget…
- Polymathism depends on the team members educational background (Trad, 2024b, 2024c).

The CMS uses the following MM for Complexities Management (MM4CM) generic characteristics:

- Extends the MM4FC, MM4PM, MM4GP, MM4PR, MM4CM, and MM4AD.
- The MM4CM is CMS' structure and integrity-checker.
- For a TDM Itr a CMS diff (or Δ) can be evaluated (CM1).
- Polymathism = $\bigcup$ Team-members Skills (CM2).
- Complexities = $\bigcup$ Interlinking domain-topic (CM3).
- CMS(Itr)= Eval($\sum$ Complexities + $\sum$ Polymathism) (CM4).
- Δ [PRWC of CMS(Itr)]=CSF(1)*Wgt(1)+CSF(2)* Wgt(2)+… (CM5).
- GAPA(PRWC)= GAPA(Itr) - GAPA(Itr-1) (CM6).

The IHIPTF

The IHIPTF, supports various types of methodologies and formalisms, as shown Figure 5; and the IHIPTF is complex and archaic Project formalisms are hard to manage. Because there are uncoherent objectives and Factors that influence the Project, like: 1) Requirements (or R) that link to services/microartefacts; 2) Defining the optimal granularity of resources and services/microartefacts; 3) Management of IHIPTF's processes and modules; 4) Mapping mechanisms coherence; and 5) Implementation phases' complexities.

A systemic and global system-approach for IHIPTF's usage is needed for *Projects*. The IHIPTF can be applied to any type of Project, APD, and other general transformational-activities. As shown in Figure 5, the IHIPTF uses the PRWC to evaluate: 1) GAPAs (or Project's statuses); 2) To define and optimal MDTCAS and PEMtM to abstract the usage of EA (and other methodologies); and 3) Offer Entity Transformation Mathematical Model (ETMM). Because of various limitations the IHIPTF (including MDTCAS, PEMtM, and ETMM) will be presented in the cases of DS, Object Oriented Methodology (OOM), BPM… Which have central roles.

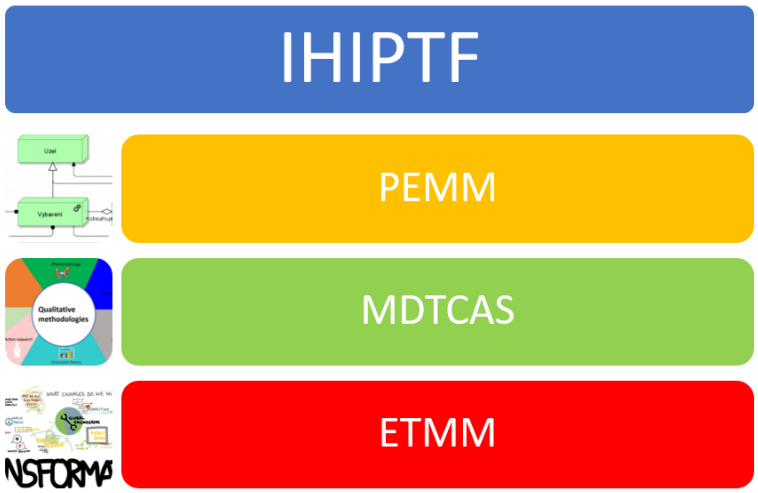

Figure 5. The IHIPTF's relations with other blocks.

The DataSets, OOM, and BPM

<<CCCC DataSets>>

Using DataSets

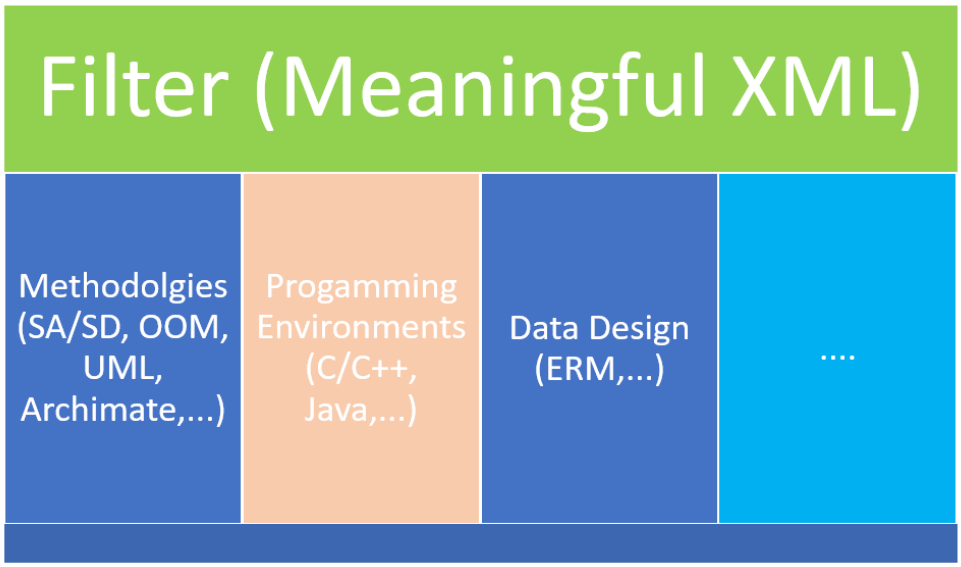

Figure 6. Delivering meaningful XMLs.

In all ICS related domains, DSs are heavily and can be considered as a common media, like (Holistics, 2024; Sheldon, 2024; Siman, 2024):

- DSs can be: 1) Structured or organized in specific structures; 2) Unstructured which don't have well-defined schema; and 3) Hybrid which include structured and unstructured data.

- DSs standardize data-formats and can be used for all APDs like analytics, business-intelligence, AI (model training) and other.
- DSs can be conceptualized as columns and rows (like in Entity Relationship Diagrams-ERM tables and spreadsheets), where a column represents a variable that presents data, and a row represents a record that contains a related set of variable values. A value within a data set is sometimes referred to as datum or data point.
- DSs are can use various formats like, Comma Separated Values (CSV), JavaScript Object Notation (JSON), Resource Description Framework (RDF, and XML, which provide standard-structures.
- DS' types are: 1) Numerical that contains only numerical values; 2) Bivariate which contains 2 variables which express the relationship between data; 3) Multivariate which contains 3 (or more) variables that are related; 4) Categorical, divides data into distinct groups based on criteria; 5) Correlation, in which variables are related and are inter-dependent.
- DSs support: 1) Correctness of results; 2) Performances improvements; 3) Usability of data-structures.
- DSs are used in statistics and Machine Learning (ML) for models: Training, Validation, and Testing.
- DS transcends all ICT and business domains and can be used as a common buffer-artefact, where anything can be exported to DSs. Programming languages/Compilers, ERM/ERD/DBs, AI, Frameworks, in fact all use DSs. Therefore, the common IHI MDTCAS can be used a methodology which uses an IHI Common DS (IHICDS).
- IHICDSs can be interrelated to mimic relationships (or R) and use GUIDs for unique identifications. Hence such IHICDs can form an IHIPTF and Project's In-Memory DB (IMBD) and apply validity and integrity-checking rules like the Relational DB's (RDB) Codd's rules.
- IHICDSs can be exported to XML medias, as shown in Figure 6; such XML-files can be used for various MDTCAS, "Δ", GAPA, related activities.
- DSs based MMs can be interrelated to support an AHMM variant like the AHMM4Project; which in-turn uses the QQRMM or the HDT.
- EAMs, OOMs, (and other models), pool(s) of unbundled-services, relationships, and other can be exported to format based DSs; and MMs can access (or import) such XML-files. So, MMs and XML-files interactions can be automated.

DS and XML's usage with MM and AHMM4Project, will be presented for a limited set of methodologies and technologies, like the OOM, BPM, and MDTCAS.

The OOM

<<CCCC OOM>>

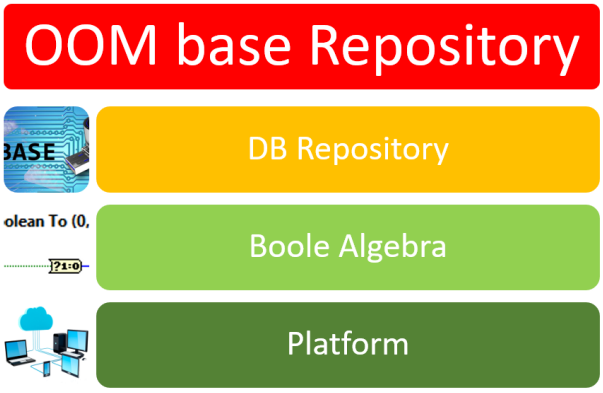

Figure 7. OMM's relation with the IMDB repository and existing MMs.

The OOM can use DS and hence the XML format that offer the following (Trad, & Kalpić, 2001; SAP, 2010; Bird, Goodchild, & Halpin, 2000):

- XML based OOM systems as the fundament for the transformed ICS.
- Reverse engineering by the use of XML-files into OOMs, where the XML Document Type Definition (DTD) provides an overall structure and XML Schema Definition (XSD).
- The reversed OOMs can be persisted in the following formats: Binary (BIN), and XML-DTD.
- An MtM for a future PEMtM, like the OOM shown in Figure 8, which contains two classes and an association.

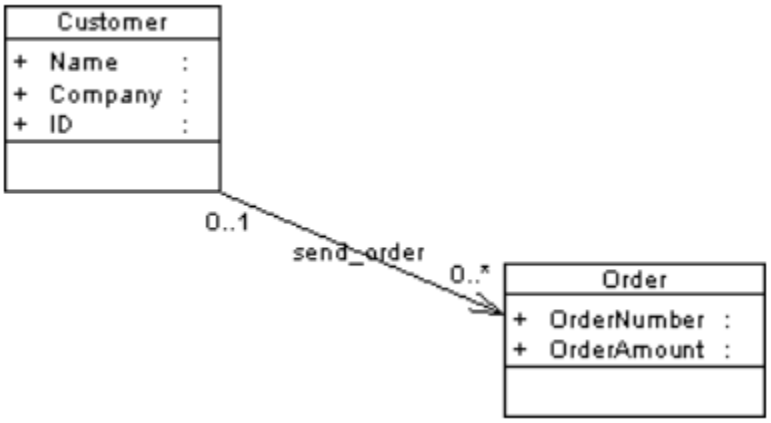

Figure 8. An example of an OOM and XML mapping.

- Migrating and modifying relationships in a class diagram (Dia) and the creation of attributes before generation permits data-types to be modified.

OOM	CDM	PDM	XSM
Domain	Domain	Domain	Simple Type
Class (Persistent and Generate check boxes selected).	Entity	Table (The cardinality of a class becomes the number of records of a table.)	Element
Abstract class	Entity	Table	Complex type
Attribute (Persistent check box selected)	Attribute	Column	Attribute or element (see generation options)
Identifier	Identifier	Identifier	Key
Composition	-	-	New level in the element hierarchy
Operation with <<storedProcedure>> stereotype (parent class generated as a table)	-	Stored procedure attached to the table, with the operation body as a body in the procedure definition.	-
Operation with <<storedFunction>> stereotype (parent class generated as a table)	-	Stored function attached to the table, with the operation body as a body in the function definition.	-
Association	Relationship or association	Table (if many-to-many multiplicity) or reference. Role names become migrated foreign keys.	KeyRef constraints
Association class	Entity/relationship notation: entity with two associations. Merise notation: association, and two association links	A table and two associations between the end points of the association class	-

Figure 9. Mapping and inter-generation between various model-types.

- Reverse engineering of OO source-files into an OOM, by extracting data and/or source and building (or updating) an OOM, which can a new model, or an existing one. Where source-files can be Java, IDL, EAM

case-tools, C/C++, C#, and other. The reverse-engineering encoding format, can be Unicode or MBCS (Multi-Byte Character Set).

- Reverse-engineering into existing OOMs and objects can be added; and an OOM can be generated, like the models shown in Figure 9.
- Importing and/or exporting an OOM in XML Metadata Interchange (XMI) can imported to a higher-level methodology like Unified Modelling Language (UML). XMI can be used to exchange OOM, UML or other between different case-tools.
- XMI supports the transfer of objects, and assigns default-symbols to imported objects and assigns them to default Dias.
- OOM can map to Object Relational Mapping to synchronize with ERM and hence RDBs; and also a mean for designing/implementing XML-Schemas. which reduces data-redundancy.

Knowing that an ERM maps completely to OOM and UML Cls-Dia.

The OOM uses the following MM for OO (MM4OO) generic characteristics:

- Extends the MM4FC, MM4PM, MM4GP, MM4PR, MM4CM, and MM4AD.
- The MM4OO is OOM's structure and integrity-checker.
- For a TDM Itr an OOM diff (or Δ) can be evaluated (OO1).
- Clses (Itr)= ∑ Cls (OO2).
- Objs (Itr)= ∑ Obj (OO3).
- Cls-Dias(Itr)= ∑ Cls- Dia + ∑ Re (OO4).
- Obj-Dias(Itr)= ∑ Obj-Dia + ∑ Re (OO5).
- Other-Dias(Itr)= ∑ Other-Dia + ∑ Re (OO6).
- Δ [PRWC All-Dias(Itr)]=CSF(1)*Wgt(1)+CSF(2)* Wgt(2)+… (OO7).
- GAPA(PRWC)= GAPA(Itr)- GAPA(Itr-1) (OO8).

The BPM as a MM in AHMM4Project's Context

<<CCCC BPM>>

Model Element in BPMN	Model Element in UML
A pool	A class with ≪service≫ with the same name. (whitespace characters are removed.)
A task	A method with the same name (whitespace characters are removed and the first character is decaptalized.)
A message flow	A class with ≪connector≫ with the name of *flownameConn* A class with ≪messageExchange≫ with the name of *flownameEx* A class with ≪message≫ with the name of *flowname* (where *flowname* refers the name of a message flow)
An outgoing message flow from a pool	An association role 'source' against a message exchange
An incoming message flow to a pool	An association role 'sink' against a message exchange

Figure 10. OOM/UML mapping (Wada, Suzuki, & Oba, 2011).

The BPM can use DS, OOM/UML, and hence the XML format that offer the following (Wada, Suzuki, & Oba, 2011):

- Transformed ICS use BPs, BPMs, and services. Services can be based on Service Oriented Architecture (SOA), that are consumed by BPs. BPs and services are reusable, and are separated from their functional properties.

- BP based transactions use: 1) Reflection (automated extractions) of APD's and common services, artifacts, where a BP can map to UML's Activity (Act) Dia.
- A transaction has three characteristics: Interaction, Function, and Self-description.
- Extraction of choreographies are based on Disassembling processes.
- BP Integration (BPI) supports the usage of unbundled BPs in transactions.
- BPs facilitate APD's transformation/integration and ICS' inter-operability, and offers the following characteristics: 1) Integrates unbundled scenarios; 2) APD's inter-operability is supported by the XMI; 3) Mapping between BPs (and related services) and functional-domains.
- Mapping between DS and OOM; and OOM/UML with BPM Notation (BPMN), as shown in Figure 10.

Any ICS artefact or EA/BP models can be converted to MMs that are based on Petri-Net's (PN) 4-tuple C=(P,T,I,O) approach, where as shown in Figure 11 (Osuszek, 2012; van der Aalst, 2003):

- P = { p1 , p2 , ... , pn } is a finite set of places/positions.
- T = { t1 , t2 , ... , tm } is a finite set of transitions.
- I : T → P* is the input function.
- O : T → P* is the output function.
- The sets of places and transitions are disjoint: P ∩ T = Φ.
- The value of the I (tj) function is the collection of input places of the tj transition.
- The # (pi , I (tj)) notation means the number of occurrences of the pi place in the I (tj) collection.
- The value of the O (tj) function is the collection of output places of the tj transition.
- The # (pi , O (tj)) notation means the number of occurrences of the pi place in the O (tj) collection.
- The nodes of the graph are linked with directed-arcs so that no two places and no two transitions are connected directly.
- A PN is a Work Flow (WF or BPM) if: 1) There is one source place i ∈ P such that •i = ∅; 2) There is one sink place o ∈ P such that o• = ∅; and 3) Each node x ∈ P ∪ T is on a path from i to o.

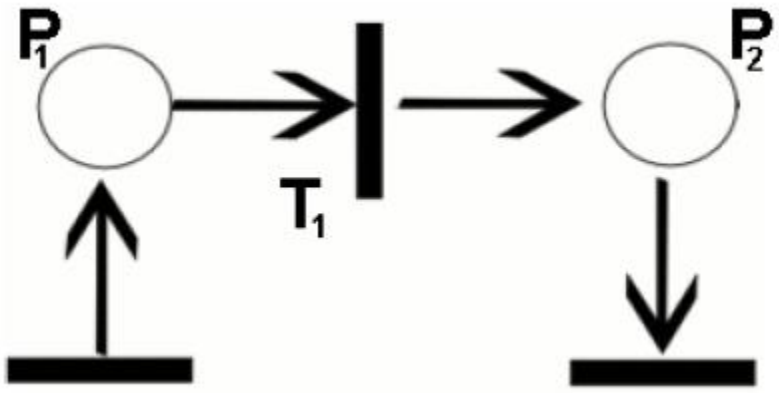

Figure 11. A Petri Net Dia (Osuszek, 2012).

BPM Language (BPML) can be used to "express" BPs, in the forms of high-level block-Dia and/or an XML standard-code. BPML is a specialization of BP and it supports the definition and description of tasks assigned to participants, and Intelligence's activities. BPM symbols are: Task, Sub-process, Transaction, Call, event, Message, Timer, Escalation, Conditional, Link, Error, Cancel, Compensation, and other. The OOM uses the following MM for BP (MM4BP) generic characteristics:

- Extends the MM4FC, MM4PM, MM4GP, MM4PR, MM4CM, MM4AD, and MM4OO.
- The MM4BP is BPM/BML's structure and integrity-checker.
- For a TDM Itr an (BPM) diff (or Δ) can be evaluated (BP1).
- Tsk (Itr)= ∑ Tsk (BP2).

- Sub-BPs (Itr)= ∑ Tsk (Itr) (BP3).
- Transactions (Itr)= ∑ Sub-BPs (Itr) (BP4).
- Call (Itr)= ∑ Transactions (Itr) (BP5).
- …..
- BPMs(Itr)= ∑ BPM + ∑ Events (BP10).
- Activity-Dias(Itr)= ∑ activity-Dia + ∑ Re (BP11).
- Δ [PRWC BPMs(Itr)]=CSF(1)*Wgt(1)+CSF(2)* Wgt(2)+… (BP12).
- GAPA(PRWC)= GAPA(Itr)- GAPA(Itr-1) (BP13).
- ….

OOM/UML, BPM/BPMLT are MDTCAS main parts and uses DSs and XML format for import, export, and persistence purposes.

The MDTCAS

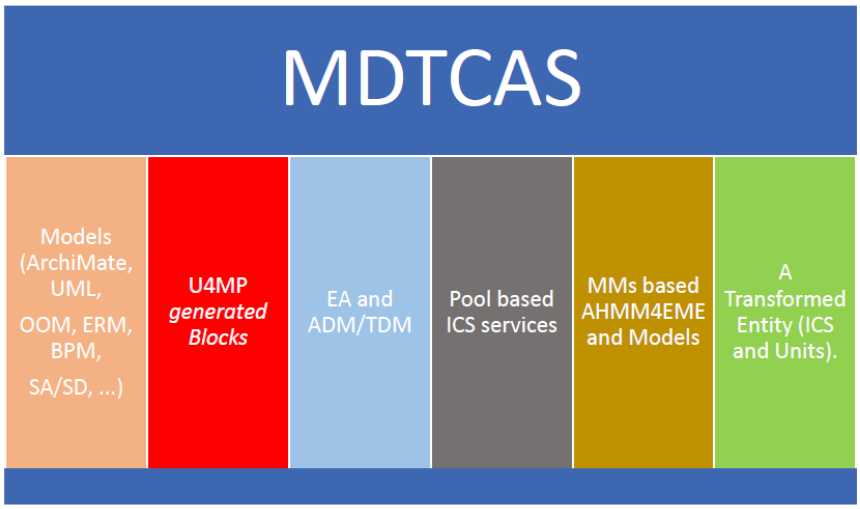

Figure 12. The IHI MDTCAS and the AHMM4Project.

The MDTCAS is based on the following features, constraints, and pre-conditions (Trad, 2024a; The Open Group 2011a; Trad, 2023d):

- Is a combination of existing methodologies, that includes Legacy methodologies, like the Structure Analysis and Structured Design (SA/SD).
- The Entity Relationship Modelling (ERM) for data usage and management.
- Enables a Polymathic approach for Projects by implementing a business and common MtM or PEMtM that: 1) Executes various types of Project's integrity-checks; 2) Aligns the U4MP and its embedded RPs; and 3) Serves as the pattern for all existing methodologies.
- U4MP and the related RPs, unbundle Entity's and ICS' legacy interfaces, modules and resources into Blocks. Unbundling activities need to define the optimal-levels of granularity, synchronize with IHIPTF/TDM operations, and comply with Artefacts Mapping Concepts (AMC) (Trad 2023a).
- The IHIPTF supports Projects, TDM's synchronization, PEMtM's usage, and MDTCAS' acceptance and application.
- The TDM synchronizes all Project's transformational-operations and evolution, where the PEMtM and AHMM4Project support APDs' operations.
- The AHMM4Project supports U4MP/RPs by using MDTCAS and TDM to interface and integrate existing methodologies, concepts, and standards.
- The TDM uses The Open Group's Architecture Framework (TOGAF) and its ADM.
- Integrates common artefacts, Blocks, relationships, events…
- Integrates structured legacy methodologies (like the Structure Analysis and Structured Design-SA/SD),

- Integrates ERMs, BPM(N)s, XML-models, OOM/UML-models, Real-Time Object-Oriented Modeling (ROOM), Archimate-models, DMN-models, Process/collaboration Models (UPM), and others.
- For all mentioned the methodologies and concepts, OOM and BPM can the fundament for the MDTCAS and Blocks' design, as is shown in Figure 12.

As shown in Figure 12, MMs supports all Project's EA models and AHMM4Project to achieve complex transformational activities, like the generation of EA and other types of Dias, artefacts, catalogues, and matrixes. Factors and FMS based PRWC synchronizes and controls the ADM based TDM, which in-turn supports implementation activities. The OOM uses the following MM for MDTCAS (MM4MT) generic characteristics:

- Extends the MM4FC, MM4PM, MM4GP, MM4PR, MM4CM, MM4AD, MM4OO, MM4BP, and MM4MT.
- The MM4MT is MDTCAS' structure and integrity-checker.
- For a TDM Itr an MDTCAS diff (or Δ) can be evaluated (MT1).
- Objs (Itr)= ∑ Obj (MT2).
- Clses (Itr)= ∑ Cls (MT3).
- Tsks (Itr)= ∑ Tsk (MT4).
- Res (Itr)= ∑ Re (MT5).
- …..
- OOMs(Itr)= ∑ OOM + ∑ Re (MT10).
- UMLs(Itr)= ∑ UML + ∑ Re (MT11).
- BPMs(Itr)= ∑ BPM + ∑ Events (MT12).
- Act-Dias(Itr)= ∑ Act-Dia + ∑ Re (MT13).
- …..
-
- MDTCAS(Itr)= ∑ OOM + ∑ UML + ∑ BPM + … + ∑ Re (MT20).
- Δ [PRWC MDTCAS(Itr)]=CSF(1)*Wgt(1)+CSF(2)* Wgt(2)+… / (MT21).
- GAPA(PRWC)= GAPA(Itr)- GAPA(Itr-1) (MT22);

Project's Management, Context, Constraints and Preconditions

<<CCCC Project>>

Structure and Viewpoints

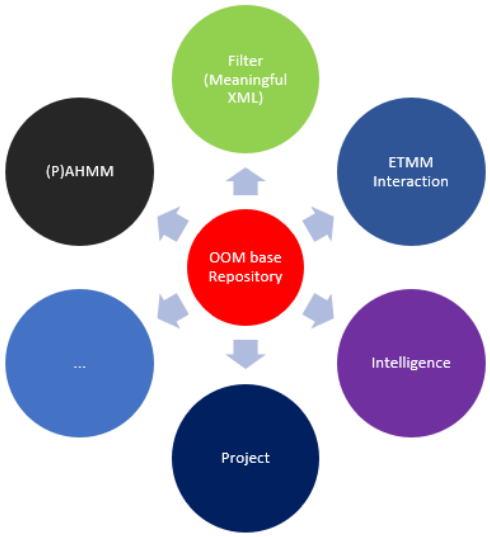

Figure 13. The OOM and the AHMM4Project.

Project's need Polymathic capabilities because traditional ICS siloed components need the integration of IHIPTF, TDM, and Agile Project Management (APM), as shown in Figure 13. As already mentioned, an important hypothesis, is that the U4MP transforms the legacy ICS and enables the use of Blocks in the Project (Trad, 2023c), but the Project has various goals and Viewpoints. As shown in Figure 14, the Project depends on Entity's capacities, political-will to implement MMs in various APDs and the enforcement of required Viewpoints. The Project has various types of Viewpoints, like: "O" for Organizational, "S" for Security, "F" for Financial, "I" for Integrity checking, "C" for EA's Cartography, and "M" for MMs. The Project is primarily Viewpoint "M"; "I" as the second objective.

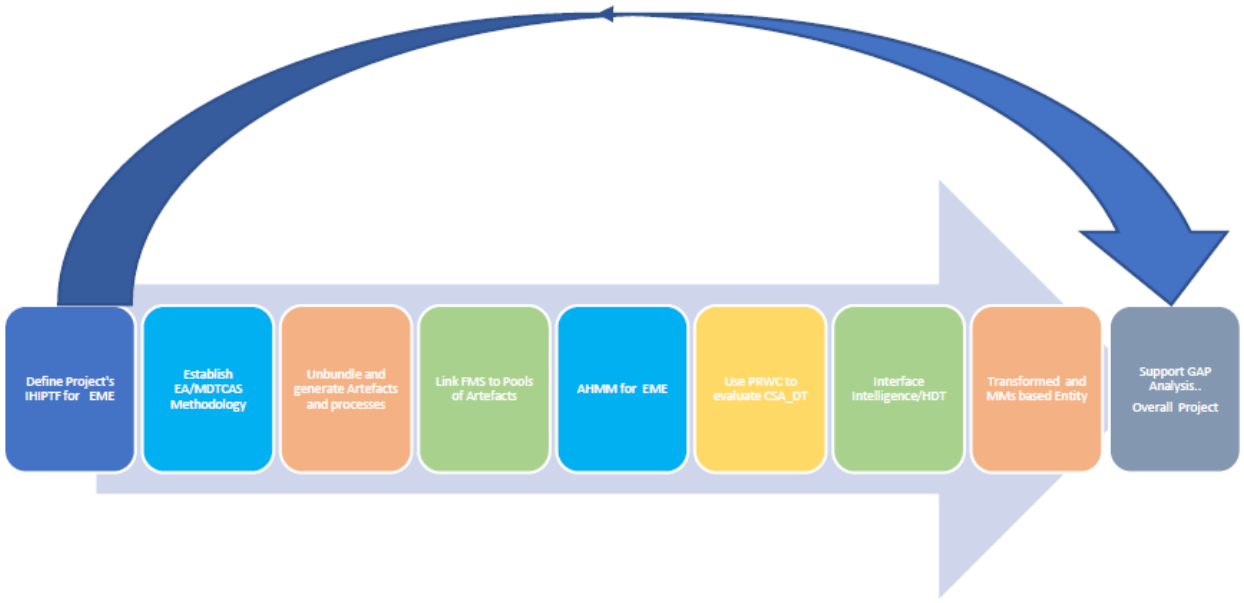

Figure 14. Project's Phases.

The Project needs IHI approaches/concepts, Viewpoints, and solutions which can be implemented without the need of colossal investments and commercial products. An MM corresponds or maps to a Viewpoint and the AHMM4Project (and its related MMs) tries to present an approach for Projects and its Expectations and Constraints (PEC).

The PEC

This section presents the Project's constraints and preconditions that must be fulfilled before starting the project. A Project that uses the IHIPTF, PRWC/FMS, and AHMM4Project must have well-defined Goals, Expected-Results, Constraints, and Objectives (simply Expectations). These expectations can have the form of a Factor (like a CSF) or a constraint be of the following nature or origin:

- Project's feasibility, XHFRs and complexities. Which are assisted by Intelligence and GAPA.
- Financials, which establishes and is related to the Project.
- Quality assurance and APM.
- Automated artefacts, Dias, and plans generation.
- Other.

The PEC can be applied on all or on a selected number of CSAs, as shown in Figure 15. The PEC uses IHIPTF's modules and integrates various methodologies, like:

- IHIPTF's GAPA is applied to each CSA.

- PEC focuses on intangible values, and expectations that are selected to improve all-over performances, conditions, upskilling processes, and ethics…
- Figure 15, presents IHIPTF's phases in which Project's sets of Factors to be analysed by the PRWC and FMS.

A PEC and other IHIPTF modules can be applied for an APD (or its SubDomain) as becomes on argument:

- APD = ∑ APD_SubDomain (PE1).
- SubDomain = ∑ Blocks + ∑ Components/libraries + ∑ Actors + … (PE2).
- ….
- For a Prj(APD) = ∑ Prj(APD_SubDomain) (PE11).
- For a GAPA(APD) = ∑ GAPA(APD_SubDomain) (PE12).
- For a AHMM(APD) = ∑ AHMM(APD_SubDomain) (PE13).
- For IHIPTF(APD) = ∑ IHIPTF(APD_SubDomain) (PE14).
- For PEMtM/FMS/PRWC(APD) = ∑ PEMtM/FMS/PRWC(APD_SubDomain) (PE15).
- …

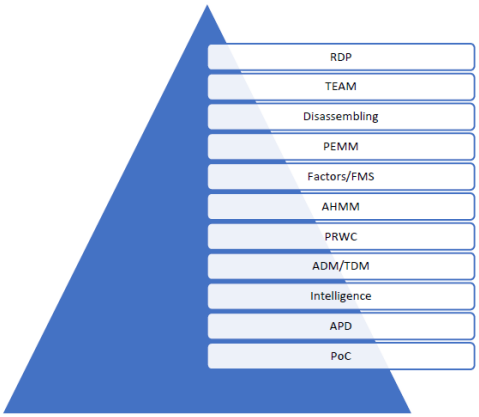

Figure 15. All applied CSAs.

The OOM uses the following MM for PEC (MM4PE) generic characteristics:

- Extends the MM4FC, MM4PM, MM4GP, MM4PR, MM4CM, MM4AD, MM4OO, MM4BP, MM4MT, and MM4PE.
- The MM4PEC is PEC's and GAPA's structure and integrity-checker.
- For a TDM Itr an PEC/GAPA diff (or Δ) can be evaluated (PE21).
- PEC/GAPA for an Item = PEC/GAPA(Item), or simply GAPA(Item) (PE22).
- ….
- GAPA(OOMs(Itr))= GAPA(∑ OOM) + GAPA(∑ Relation (PE30).
- GAPA(UMLs(Itr))= GAPA(∑ UML) + GAPA(∑ Relation) (PE31).
- GAPA(BPMs(Itr))= GAPA(∑ BPM) + GAPA(∑ Events) (PE32).
- GAPA(MDTCASs(Itr))= GAPA(∑ MDTCAS) + GAPA(∑ Relation) (PE33).
- …..
- GAPA(MDTCAS)= GAPA(MDTCAS(Itr))- GAPA(MDTCAS(Itr-1)) (PE40).
- ….
- Δ [GAPA Prj(Itr)]=CSF(1)*Wgt(1)+CSF(2)* Wgt(2)+… (PE50).
- Δ [PRWC of Prj(Itr)]=CSF(1)*Wgt(1)+CSF(2)* Wgt(2)+… (PE51).

The GAPA for RDP (GAPA4RDP):

- For a TDM Iteration (Itr) (PE60)

- RDPValue (Itr)=CSF(1)*RAT(1)+CSF(2)*RAT(2)+… (PE61)
- GAPA4RDP(Itr)=RDPValue(Itr)-RDPValue (Itr-1) (PE62)
- Risk=∑ GAPA4RDP(Itr) (PE63)

Hypothesis (and assumptions) in AHMM4Project are soft constraints and can be formulated as follows:

- Ph(x) is the phase x, where x=1,2,3… (PE70).
- Disassembling Function is Df(ph(x)) (PE71).
- Project unbundling = ∑ Df(…) = TRUE (1) / Successful (PE72).
- All unbundling = ⋃ Df(…) (PE73)
- …
- PRJ_DT=AVG(∑ CSA_DT) (PE80).
- ….

The U4MP as Project's Go or NoGo

The U4MP from the Project's and hence AHMM4Project perspective (or Viewpoints) need (Trad, 2021a, 2023a):

- The U4MP includes and manages successive RPs to refine OU's structures, and related components and resources.
- The MMs based AHMM4Project checks Project's or APD's integrity at each Itr.
- In-turn OUs can be retransformed ((re)assembled+checked+interrelated) by the IHIPTF and AHMM4Project, to offer an efficient Entity.
- Primarily that the U4MP was successfully terminated and the viable pool or repository of Blocks can be used.
- The repository must an Entity Wide Transformation Blocks/Artifacts Repository (EWTBR, simply Repository).
- A well-defined Holistic Naming Conventions, Granularity and Mapping (simply Mapping).
- Mapping implements a "1:1" interlinking, implementation and classification concepts.
- Mapping and Repository aligns Project's Blocks, Factors, Units of Work (UoW), and other resources. That needs the definition of level(s) of granularity and responsibility.
- The MDTCAS interfaces of U4MP's resultants Blocks which can be: BBs, Composite BBs (CBB), Organizational BBs (OBB), EA or modelling BBs (ABB), Micro-Artifacts (MA), or other.

The OOM uses the following MM for UP (MM4UP) generic characteristics are:

- Extends the MM4FC, MM4PM, MM4GP, MM4PR, MM4CM, MM4AD, MM4OO, MM4BP, MM4MT, MM4PE, and MM4UP.
- The MM4PUP is U4MP's structure and integrity-checker.
- ….
- Entity = ∑ OU + ∑ Prj (UP01).
- OU = Repository[Blocks] + ∑ Prj/U4MP (UP02).
- U4MP = ∑ RPs + ∑ GAPAs (UP03).
- Repository = ∑ Blocks + ∑ Relations (UP04).
- ….
- For a TDM Itr an U4MP diff (or Δ) can be evaluated (UP10).
- ….
- ***mcR*** = ***m*** KPI (UP20)
- ***mc m*** MA/mcR = MA + ***m mcR*** (UP21)
- ***F*** = ***mcR*** (UP22)
- ***P*** = ***m R*** (UP23)
- ***R*** = ***m*** CSF = ⋃ ***mcR*** (UP24)
- R = ⋃ ***F*** + ⋃ ***Rl*** + ⋃ ***C*** + ⋃ ***D*** + ⋃ ***Re*** (UP25)
- …..
- U4MP(Itr)= U4MP(Itr)- U4MP(Itr-1) (UP30).

- ….
- GAPA(U4MPs(Itr))= GAPA(∑ RP) + GAPA(∑ Blocks) (UP40).
- Δ [GAPA Prj(Itr)]=CSF(1)*Wgt(1)+CSF(2)* Wgt(2)+… (UP41).

The U4MP which is Viewpoint "U" and influences ET and Projects generic characteristics are:

- Implementing Unit Process Structures (UPS).
- Implementing ReFinement Actions (RFA).
- Implementing Automated RFA (ARF).
- Implementing the Model View Control (MVC).
- Implementing the atomic MVC (aMVC).
- Executing OU Transformation (OUT).
- Executing RP for OUP (RP4OUP).
- Executing Entity Transformation (ET).
- ARF actions=support ARF and DevOps operations.
- ….
- RFA = U Tsk (UP50)
- ARF = U RFA (UP51)
- UPS = U ARF + DevOps activities, and finalizing BPs (UP51)
- PRJ = ∑ UPS (for the ICS, components, and its networks) (UP52)
- OUT = U Prj's components/parts (UP53).
- ET = ∑ OUT (UP54).
- ….

The U4MP can have the Viewpoint "O" and influences ET and Organizational elements are:

- MA = ∑ aBB + ∑ sBB + ∑ aMVC (C1)
- BB = ∑ ARP/UP + ∑ MA + ∑ OPM (C2)
- CBB = ∑ BB + ∑ ABB + ∑ SBB (C3)
- OBB = ∑ CBB (C4)
- SDC = ∑ OBB (C5)
- OU = ∑ SDC (C6)
- RP = ∑ ARP/UP (C7)
- DOM = ∑ RP (C8)
- RP4OUP = ∑ DOM (C9)
- OU = ∑ RP4OUP (C10)
- E(O) = ∑ OU (C11)

```
Class CBB4ET_Viewpoint_C
{
    // Microartefacts
    //-------------------------------------------------------------------------------------------------------------
    //

    // Building Blocks
    //-------------------------------------------------------------------------------------------------------------
    //

    // Building Blocks
    //-------------------------------------------------------------------------------------------------------------
    //
```

```
    // Organizational Building Blocks
    //-------------------------------------------------------------------------------------------------------------
    //

    // Organizational Unit
    //-------------------------------------------------------------------------------------------------------------
    //

    // Viewpoint: “O” or Organizational
    //-------------------------------------------------------------------------------------------------------------
    //


    // Viewpoint: “S” or Security
    //-------------------------------------------------------------------------------------------------------------
    //


    // Viewpoint: “M” or Models
    //-------------------------------------------------------------------------------------------------------------
    //

    // Viewpoint: “T” or Team
    //-------------------------------------------------------------------------------------------------------------
    //

    // Viewpoint: “F” or Finance
    //-------------------------------------------------------------------------------------------------------------
    //


};
```

Figure 16. CBBs for Transformation Viewpoint (C).

The PEMtM

The PEMtM from the Project’s and hence AHMM4Project perspective (or Viewpoints) need (Trad, 2021a, 2024a):

- A PEMtM can be a statical or classical one as shown in Figure 16, or a dynamical and refined (auto-generated PEMtM as shown in Figure 17.
- There are various ways to implement a PEMtM, and in this article the PEMtM is related to the mentioned MMs.
- PEMtM is the Project’s stub and it can take long-time to be implemented and has to be regenerated.
- MMs ensure that the Entity avoids a locked-in situation in regards to ICS, infrastructure, and AI products and services.

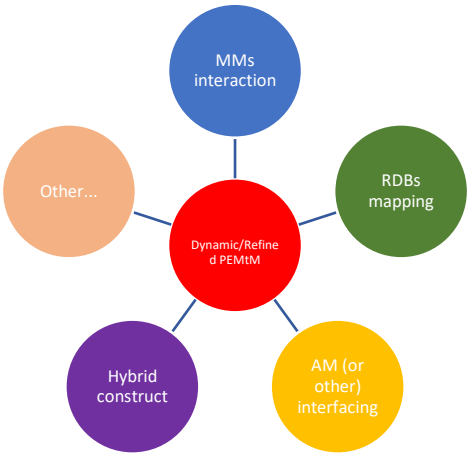

Figure 17. A refined (auto-generated).

- An optimal manner to implement PEMtM can be based on: 1) RDB characteristics, because RDBs are used in all ICS' activities and components. RDBs also include Entity's data and their structures, integrity-checking capacities; 2) An MMs based PEMtM which is a correlation of MtMs; 3) Specific purchased products like the ones related to Asset Management (AM), which include valuable data for PEMtM, which can include (Trad and Kalpić 2020b): 1) Business resources; 2) Financial data; c) DBs, and ICS information; and 4) A hybrid solution that combines the previous points 1, 2 and 3.
- Option 4 is an optimal and realistic one, but it has to be refined (auto-generated), which is optimal for Projects and more specifically Digital Transformations (DT).

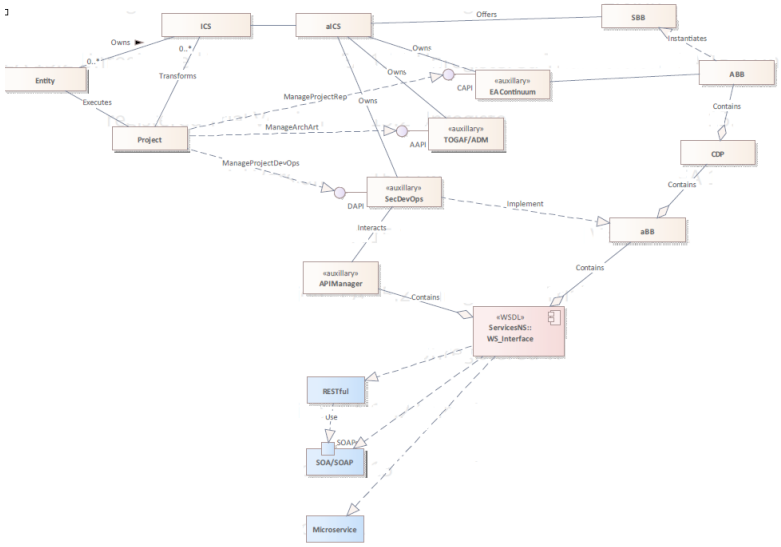

Figure 18. A statical and classical PEMtM.

The PEMtM supports DTs which offers a basic common platform for Projects; this platform includes Blocks, BP(M)s and other resources (and artefacts) that enable agile Project's activities. A DT (or digitization) success is a strategic objective because Projects are too complex and have XHFRs (Eira, 2022). A DT begins with the Disassembly of legacy ICS subsystems and that enables the automation of TDM, MDTCAS, and EA digitized-models to be used. A feasible DT is the base of many important IHIPTF's parts like EA and methodologies (Eira, 2022).

The OOM uses the following MM for PEMtM (MM4MM) generic characteristics are:

- Extends the MM4FC, MM4PM, MM4GP, MM4PR, MM4CM, MM4AD, MM4OO, MM4BP, MM4MT, MM4PE, MM4UP, and MM4MM.
- The MM4PAHMM is PEMtM's structure and integrity-checker.
- ….
- Implementing or extracting DB (or RDB) MtM (DB_MtM).
- Implementing or extracting MMs MtM (MM_MtM).
- Implementing or extracting PRoducts MtM (PR_MtM).
- Implementing HYbrid MtM (HY_MtM), which uses the DB_MtM, MM_MtM, PR_MtM, and other.
- ….
- MtM = ∑OOM || ∑Re || ∑UML || ∑Re || ∑BPM + ∑ Events || … (MM01).
- MtM = ∑ Cls (MT3).
- MtM = ∑ Tsk (MT4).
-
- ….
- HY_MtM = ∑ DB_MtM + ∑ MM_MtM + ∑ PR_MtM… (MM01).
- PEMtM = HY_MtM || ∑ DB_MtM || ∑ MM_MtM || ∑ PR_MtM (MM02).
- PEMtM → MDTCAS (MM03).
- PEMtM → E (MM03).
- PEMtM → T (MM04).
- PEMtM → DT (MM05).
- PEMtM → Prj (MM06).
- PEMtM → U4MP (MM07).
- ….
- For a TDM Itr an PEMtM diff (or Δ) can be evaluated (MM10).
- ….
- PEMtM(Itr)= PEMtM(Itr)- PEMtM(Itr-1) (MM20).
- GAPA(PEMtMs(Itr))= GAPA(∑ RP) + GAPA(∑ Blocks) (MM21).
- Δ [GAPA Prj(Itr)]=CSF(1)*Wgt(1)+CSF(2)* Wgt(2)+… (MM22).

The APM

The APM from the Project's and hence AHMM4Project perspective (or Viewpoints) need (Trad, 2023e):

- Projects need dynamic Development and Operations (DevOps) approach.
- DevOps offer mechanisms, tooling, and development environments to support APM.
- DevOps is still archaic which can generate APM problems.
- Tests are developed in text/prose form and can be understood by business users.
- DevOps' prose scenarios contain information to automate the linkage of the needed Blocks.
- DevOps' enables a fully-automated unit, integration and acceptance tests.

The OOM uses the following MM for APM (MM4AP) generic characteristics are:

- Extends the MM4FC, MM4PM, MM4GP, MM4PR, MM4CM, MM4AD, MM4OO, MM4BP, MM4MT, MM4PE, MM4UP, MM4MM, and MM4AP.
- The MM4AP is APM's structure and integrity-checker.
- ….
- Synchronizing ADM Phases (Phs).
- Selecting Enterprise TeaM (TEM).
- ….
- APM → MDTCAS (AP01).
- APM → Prj (AP!02).
- ….
- Phs = ∑ Tsk (AP10)

- Cyc = ∑ Phs (AP11)
- ADM = ∑ Cyc (AP12)
- TDM = ∑ ADM + ∑ TEM (AP13)
-
- ….
- For a TDM Itr an APM diff (or Δ) can be evaluated (AP20).
- ….
- GAPA(Itr)= APM(Itr)- APM(Itr-1) (AP30).
- GAPA(APMs(Itr))= GAPA(∑ RP) + GAPA(∑ Blocks) (AP31).
- Δ [GAPA APM (Itr)]=CSF(1)*Wgt(1)+CSF(2)* Wgt(2)+… (AP32).
- ….
- Prj = ∑ TDM (ADM based) (AP40)

EA, ICS, and Methodologies

<<CCCC EA, ICS, Methodologies>>

Refine and Extract

Refinement for Projects, needs MMs based Dynamic Entity Model (DEM). Projects are of strategic importance and it is crucial to define a Polymathic concept for Refinement. Entity's RPs are sets of extraction/conversion actions, and an Entity is a set of OUs where an OU owns 1 or "n" OU Platform(s) (OUP). On OU's level, RP refines OUP(s) BPs, resources, and services. DEM reorganizes Entity's APDs' and Ous functions. Entity's functions are refined into Blocks (or BBs) which can be reused to reused to (re) engineer OUs and OUPs. OUs are then (re) assembled in ENTs (Trad, 2021b). Many Projects and IHIPTF's parts have to quickly adapt to changes and that needs the automatic generation of models, Dias, and other. Such automatic generation activities include (Burke 2020):

- The IHIPTF is applied to automate the generation and extraction of EA (and other types of) models and related Entity's cartographies from ICS different levels which represent components/parts, Blocks, and Interfaces.
- Such interfaces combine different domains like, EA, Entity's (re)organization, Traditional project management, Changes' management, Finance, AI, MMs, and other. Models and cartographies can include: 1) Networks; 2) DBs and data-sources; 3) Applications' components and libraries; 4) Methodologies (OOM/UML, Archimate…); 5) Interfaces, Application Programming Interfaces (API)…; 6) Processes, Transactions…; 7) Security, Governance/Audit…; 8) Actors/delimiters…; 9) Intelligence; 10) Control/Monitoring…; 11) Services; and 12) Requirements.
- Support an Adapted Long-term ROI (ALROI) concept that protects critical intangible values.
- Is of strategic importance that guarantees the Entity's long-term sustainability but there is a lack of adequate skills.
- PEMtM synchronizes the U4MP to automate the extraction and enhancement of Blocks, BPs, and EA-models.
- Intangible values, ensure sustainability which is an important Factor for Entity's future.
- Supports a cross-functional analysis and design, roadmap building skills/capabilities.
- Refine and extract ends with the delivery of an optimal MDTCAS as a central methodology for the Entity and Project(s).

Selecting a Methodology-MDTCAS

Project's EA modelling is done by the MDTCAS and ADM based TDM which deliver Entity restructuring and transformational models and controls, which depend the applied Viewpoint(s). The TDM synchronizes Project's modelling activities and phases as shown in Figure 19 (Markides, 2011). TDM can uses existing frameworks like TOGAF/ADM, UML… The TDM supports the MDTCAS in implementing: 1) Vision(s)/Viewpoint(s); 2) Principles; 3) FMS/Factors and PRWC; 4) Standards/Frameworks; 5) AHMM4Project and MMs; 6) PEMtM; 7) GAPA/Intelligence; and 8) Blocks and BPs. The IHIPTF integrates

the MDTCAS and TDM to manage Blocks which are used in APD's modelling activities and support. MDTCAS supports also Disassembling to facilitate the integration of standard methodologies and concepts, like TOGAF's ADM. The Project, IHIPTF, and AHMM are agnostic to APD's type(s) and applied methodology/ICS. Generated EA-models and TDM map to Entity's, ICS', and Project's cartography of applications and other.

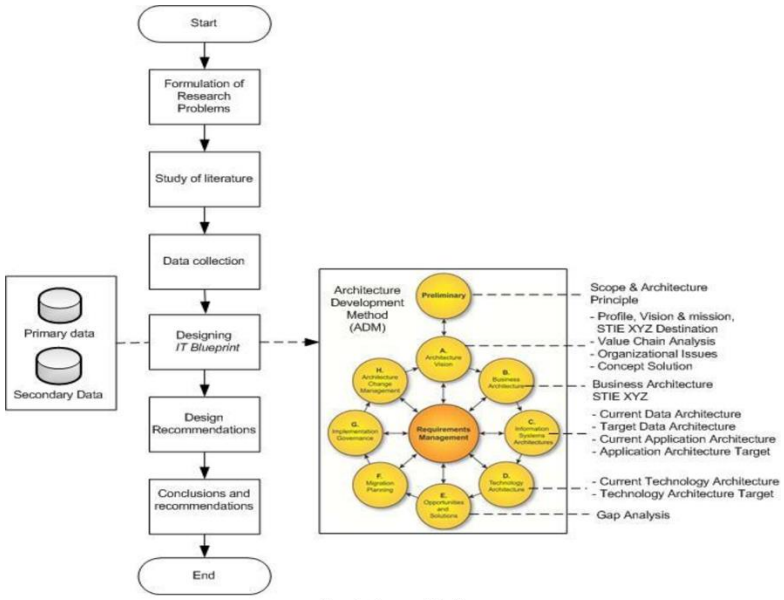

Figure 1: Conceptual Model

Figure 19. ADM's phases (The Open Group, 2011a, 2011b; Holilah, Girsang, & Saragih, 2019).

Entity applications are classified by: 1) EA-models capacities; 2) Interfaces that are linked to applications; 3) Dias represent applications' cartographies; 4) Combining mixed applications; 5) Application components are structured according to their nature; 6) Components are related by services; 7) Applications' cartography depends on TDM's usage; 8) A central repository can generate Project's application's cartography; and 9) As shown in Figure 20, the EA/TOGAF is layered, and the interaction component layer is on top, process-based components in the middle, and entity components on the bottom. The EA concept has the following layers: Business Architecture; Data Architecture; Application Architecture; and 4) Technology Architecture (The Open Group 2011a; Trad 2023a).

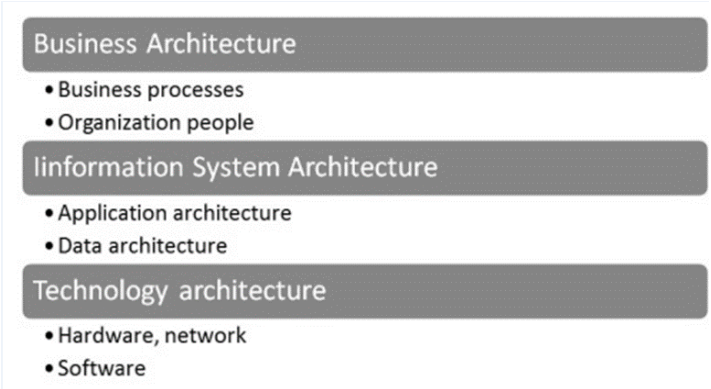

Figure 20. The Used EA and IBMM Concepts are Layered.

The OOM uses the following MM for Methodologies and ICS (MM4MD) or Viewpoint "I", generic characteristics are:

- Extends the MM4FC, MM4PM, MM4GP, MM4PR, MM4CM, MM4AD, MM4OO, MM4BP, MM4MT, MM4PE, MM4UP, MM4MM, and MM4MD.

- The MM4PMD is MDTCAS's structure and integrity-checker.
- ….
- Implementing or extracting Services (simply Srv).
- Implementing or extracting atomic BBs and Blocks (simply aBB).
- Implementing or extracting atomic solution BBs and Blocks (simply sBB).
- Implementing or extracting Scenarios, which can be BPMs (simply Scr).
- Implementing or extracting Architecture BBs and Blocks (simply ABB).
- Implementing or extracting Organizational BBs and Blocks (simply OBB).
- Implementing or extracting Solution BBs and Blocks (simply SBB).
- Implementing or extracting Applications (simply App).
- Implementing or extracting Components (simply Cmp).
- Implementing or extracting Data tables (simply Dtb).
- ….
- E → Cld (MD01).
- Art = ∑ ***m*** Srv || ∑ ***m*** Dtb || ∑ MA || ∑Re || ∑BPM + ∑ Events || … (MD02).
- MtM = ∑ Cls (MD03).
- MtM = ∑ Obj (MD04).
- ….
- *Srv* = ⋃ MA (MD10)
- *Cls* = ⋃ F() ***or*** Srv + ⋃ Var + ⋃ Re (MD11)
- *Obj* = ***i*** Cls (MD12)
- *Cls-Dia* = ⋃ Cls + ⋃ Re (MD13)
- *Obj-Dia* = ⋃ Obj + ⋃ Rel (MD14)
- *aMVC* = ⋃ Dia + ⋃ Re (MD15)
- *MVC* = ⋃ MVC + ⋃ Re (MD16)
- *aBB* = ⋃ Srv + ⋃ Re (MD17)
- *sBB* = ⋃ ***i*** Srv + ***i*** ⋃ Re (MDI8)
- *BB or Block* = ⋃ Dia (MDI9)
- *Scr* = ⋃ ***i*** Dia + ⋃ ***i*** Srv + ***i*** ⋃ Re (MDI8)
- *ABB* = ⋃ Dia (MDI9)
- *SBB* = ***i*** Scr (MD20)
- *App* = ⋃ Scr (MD21)
- Cmp = ⋃ App ***or*** IEL ***or*** Dst (MD22)
- ICS = ⋃ Cmp (MD23)
- Cld = ⋃ ICS (MD24)
- E = ⋃ Cld (MD25)
- ….
- For a TDM Itr an MDTCAS diff (or Δ) can be evaluated (MD30).
- ….
- MDTCAS(Itr)= MDTCASITR)-MDTCAS(Itr-1) (MD40).
- GAPA(MDTCASs(Itr))= GAPA(∑ RP) + GAPA(∑ Blocks) (MD41).
- Δ [GAPA Prj(Itr)]=CSF(1)*Wgt(1)+CSF(2)* Wgt(2)+… (MD42).

The MM4MD has also a Data Viewpoint "D", generic characteristics are:

- *Dtb* = ***m*** Cls (MD51)
- *Var* = ***m*** Cls.Atr (MD52)
- *Dtb* = ⋃ Var (MD53)
- *Dbs* = ⋃ Dtb (MD54)

- *Dst* = ⋃ Dbs (MD55)

The MM4MD has also a basic/pure ICS and Security Viewpoints “I” and “S”, generic characteristics are:

- *sec(Art)* = ***m*** Dtb (MD70)
- *sec(Art)* = ***m*** MA (MD71)
- sec(MA) = sec(∑ aBB + ∑ sBB + ∑ aMVC) (MD72)
- sec(BB) = ∑ sec(ARP/UP) + ∑ sec(MA) + ∑ sec(OPM) (MD73)
- sec(CBB) = ∑ sec(BB) + ∑ sec(ABB) + ∑ sec(SBB) (MD74)
- sec(OBB) = ∑ sec(CBB) (MD75)
- sec(SDC) = ∑ sec(OBB) (MD76)
- sec(OU) = ∑ sec(SDC) (MD77)
- sec(RP) = ∑ sec(ARP/UP) (MD78)
- sec(DOM) = ∑ sec(RP) (MD79)
- sec(RP4OUP*)* = ∑ sec(DOM) (MD80)
- sec(OU) = ∑ sec(RP4OUP*)* (MD81)
- E(S) = ∑ OU(S) or sec(OU) (MD82)

The MM4MD has also a Models Viewpoints “M”, generic characteristics are:

- RP4OU = ∑ ARP/UP + ∑ RP (MD100)
- MA = ∑ aBB + ∑ sBB + ∑ aMVC (MD102)
- BB = ∑ ARP/UP + ∑ MA + ∑ OPM (MD103)
- CBB = ∑ BB + ∑ ABB + ∑ SBB (MD104)
- OBB = ∑ CBB (MD105)
- DEOM = ∑ OBB (MD106)
- SDC = ∑ DEOM (MD107)
- OU = ∑ RPOU + ∑ SDC + ∑ OUP (MD108)
- DEM = ∑ OU(M) (MD109)
- E(M) = ∑ DEM (MD110)

The MM4MD has also a Models Viewpoints “M”, generic characteristics are:

- Selecting TeaM Members (TMM).
- Selecting Enterprise TeaM (TEM).
- ….
- TMM = **i** TMP (MD120)
- TMM = ⋃ SKL (MD122)
- TEM = ⋃ TMM (MD123)

The MM4MD has also a Finance Viewpoints “F”, generic characteristics are:

- Develop a Budget (Bud).
- Estiamte Costs (Cst).
- Selecting Enterprise TeaM (TEM).
- ….
- Bud = ⋃ Cst (MD130)
- Fin = ∑ Bud (MD131)

Intelligence

<<CCCC Intelligence>>

Basics-A Polymathic Approach

Projects and AHMM4Project need a Polymathic approach and perspective (or Viewpoints) (Clark, Fletcher, Hanson, Irani, Waterhouse & Thelin, 2013; Trad, 2024f):

- Projects need dynamic and generic Polymathic Intelligence learning processes.
- Changes generate vast sets of actions and create solutions, which in turn can generate many problems.
- Intelligence combined with HDT, PRWC, and FMS offers major advantages in integrating automated decision-making processes and services.
- FMS and PRWC based Intelligence, offers the possibility to selects and tunes Factors, which are used for orchestration in NLP scripts.
- Intelligence is used in all Project's phases, processes, and components, and are related to sets of Factors that are mapped to Blocks (sets of NLP-based actions/services).
- The HDT uses: 1) Neural Networks (NN) used to connect tree-nodes or Artificial Neurons (AN); 2) ELPs based reasoning; 3) Set of AHMM and MMs instances; 4) PRWC; 5) AR is as a set of continuous beam-search heuristics processing steps; and 6) Interfaces the QQRMM for problem solving and synchronizes a set of algorithms.

The OOM uses the following MM for Intelligence (MM4IN) or Viewpoint "N", generic characteristics are:

- Extends the MM4FC, MM4PM, MM4GP, MM4PR, MM4CM, MM4AD, MM4OO, MM4BP, MM4MT, MM4PE, MM4UP, MM4MM, MM4MD, and MM4IN.
- The MM4IN is MDTCAS's structure and integrity-checker.
- ….
- Implementing or extracting LPs as Intelligence Knowledge Items (IKI).
- Implementing or extracting the HDT.
- Implementing or extracting the ELP subsystem.
- Interfacing the QQRMM.
- ….
- E → Intelligence (IN01).
- ….
- NN **b** MA = $\bigcup$ NN (IN20)
- HDT = $\sum$ NOD + $\sum$ QLT + $\sum$ QNT + $\sum$ F() (IN21)
- MA **b** Scr = $\bigcup$ action->data + $\bigcup$ MA + HDT() (IN22)
- IKI = $\bigcup$ Scr (IN23)
- ELP = $\bigcup$ IKI (IN24)
- Sol = $\sum$ HDT(Prb) (IN25)
- KMS = $\sum$ ELP and Sol(s) + $\sum$ Facts (IN26)
- DMS = $\sum$ HDT() + $\sum$ KMS (IN27)
- AI (for Decision Making) = $\bigcup$ DMS + $\bigcup$ KMS (IN28)
- ….
- // Reschedule Prj with the found solution
- RPrj = $\bigcup$ AI + $\bigcup$ Sol (IN30)
- ….
- **mc** E = $\bigcup$ RPrj (IN40)
- E = **mc** E (IN41)
- ….
- For a TDM Itr an Intelligence diff (or Δ) can be evaluated (IN50).
- ….
- Intelligence(Itr)= Intelligence(Itr)- Intelligence(Itr-1) (IN60).
- GAPA(Intelligences(Itr))= GAPA($\sum$ RP) + GAPA($\sum$ Blocks) (IN61).
- Δ [GAPA Prj(Itr)]=CSF(1)*Wgt(1)+CSF(2)* Wgt(2)+… (IN62).

The AHMM4Project

<<CCCC AHMM>>

Introduction and Basics

The AHMM() or AHMM4Projects has a composite structure that includes the following (Hine, 2013):

- The AHMM uses the Basic Mathematical Model's (BMM) Nomenclature (BMMN).
- A statical view, which presents definitions, MA, Blocks, Dias, and Res.
- A behavioral view, which is an instance of the statical view.
- Is the skeleton of the IHIPTF and its modules like the FMS and PRWC.
- Defines generic patterns and interfaces to external frameworks.
- Includes specific definitions for APDs.
- Defines its specific QQRMM and the initial set of Project problem-types and their related Factors, which initialized in TDM's preliminary phase.
- The HDT inputs various sets like: Constraints, Rules, Data-sets, Configurations, and other, which are stored in IHIPTF's repository.
- The use of simplistic quantitative analysis, is very limited and there is the need for a qualitative method that enriches the ELP.
- The QQRMM based HDT evaluates Project' problem types and to proactively detects violations to the defined constraints and applied rules.
- The ARbLP based ELP is suitable for complex Projects, because AR is helpful in education and can be defined as the process of learning and improves the quality of transformational and implementation processes.
- AR provides the Team with valuable experiences and knowledge improve the ELP and supports the resolving Project problems and AHMM() tuning processes.
- AR uses a systematic process and offers solutions for the problems types, where solutions can include bridging/interfacing the gap between Projects' and IHIPTF related theory, recommendations, and practices.
- The QQRMM based HDT and related ARbLP based ELP enhance the Project's and AHMM() transformational model and structure.

The Project's and AHMM() Transformational Model and Structure

The Project's and AHMM() (or AHMM4Projects) transformational model includes (Morawski, 2013; Easterbrook, Singer, Storey, & Damian, 2008; Polderman, & Willems, 1998; Hinkelmann, 2016; Sankaralingam, Ferris, Nowatzki, Estan, Wood, & Vaish, 2013; Syynimaa, 2015; Giachetti, 2012):

- The Project's adopts holistic, cross-functional, and Polymathic transformational model and structure, which is supported by the AHMM() and variants, which needs uses multi-level Disassembling processes.
- The FMS/PRWC identify and assess strategic Factors and hence support risks' management to support and guaranty Entity's operations', business coherencies, and integrity. Integrity is supported by using the AHMM(), which constitutes its basic structure.
- For a given Project, and AHMM() requirement (or problem type), AHMM() based Intelligence identifies the initial sets of Factors and related sets of actions, to be used by the ARbLP based HDT/ELP.
- There is an immense lack of a Polymathic-holistic approach to Projects, AHMM(), and the PRLR, therefore this chapter proposes the AHMM() that uses and interfaces the following IHIPTF's resources: 1) Articles and resources related to Projects, Projects' and IHIPTF, FMS/PRWC, Factors' evaluations, ICS (re)engineering, AI/HDT, Humanoids' integration…; 2) The author's RDP/PRLR works, and IHIPTF; 3) Project's and AHMM()'s feasibility concept; 4) Initial sets of Factors; and 5) RDP's use of the Empirical Engineering Research Model (EERM).
- A Polymathic-AHMM (PAHMM) is a subset of real-world system's behaviours, capabilities, and possibilities, where the PAHMM is a description of a limited, modelled, integral, and precisely defined reality, which can be abstracted to support a Project and AHMM().
- A PAHMM provides abstractions of a real-world of a physical system or module.
- Modelling is a descriptive EA/design process, which validates PAHMM principles.
- The usage of EA, TDM, MDTCAS, AI, and HDT can be used by an PAHMM.

- The gap between the PAHMM based Project's adoption and its usage is still immense today.
- An PAHMM that optimizes Projects by using FMS/PRWC, Factors, and AHMM().
- A generic variant of the PAHMM, is the proposed AHMM().
- An applied PAHMM is the description of an Entity, Project, and Projects' and IHIPTF, using MMs, and languages.
- Multi-criteria or a multi-Factors model for Intelligence needs a QQRMM and ARbLP based ELP.
- An PAHMM is optimal for an EERM based RDPs.
- The PAHMM is the base of a Project's basic MtM/PEMtM, and PEMtM.
- An MM specialized for APDs; and the PAHMM is the base structure for Project's, AHMM()'s , and Entity's Viewpoints.

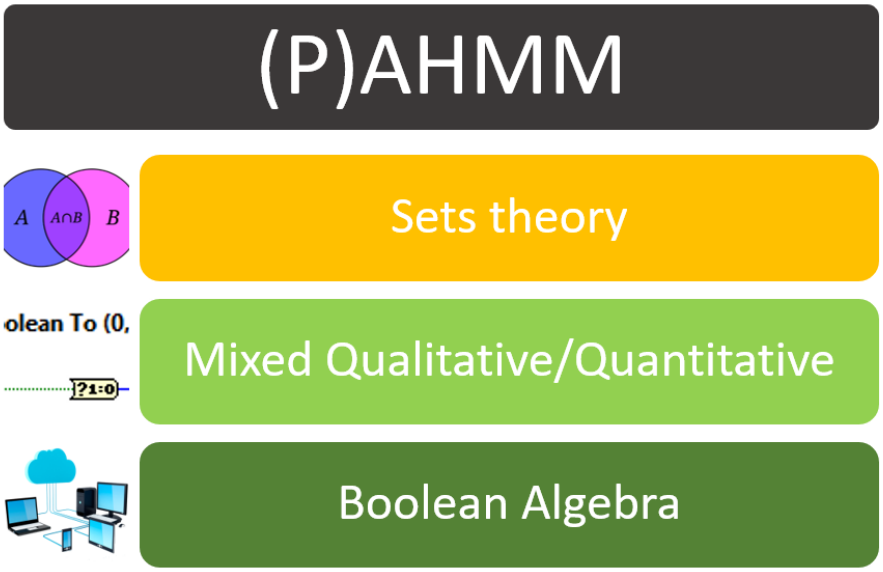

Figure 21.

As shown in Figure 21, the AHMM4Project:

- Extends the MM4FC, MM4PM, MM4GP, MM4PR, MM4CM, MM4AD, MM4OO, MM4BP, MM4MT, MM4PE, MM4UP, MM4MM, MM4MD, and MM4IN.
- Can also integration specific MMs have related to: Prog Lang/compiler MM, Services MM.BPM MM.
- PM MM, OOM/UML MM, DB MM, Archimate MM, DevOps MM, AI MM, MM, and other.
- The Enterprise MM (EMM).
- …

PAHMM based Viewpoints and Evaluations

The OOM uses the following MM for AHMM() (MM4AH) or Requirements Viewpoint "R", generic characteristics are:

- Extends the MM4FC, MM4PM, MM4GP, MM4PR, MM4CM, MM4AD, MM4OO, MM4BP, MM4MT, MM4PE, MM4UP, MM4MM, MM4MD, MM4IN, and MM4AH.
- The MM4AH is PAHAMM's structure and integrity-checker.
- ….
- Implementing or extracting the HDT.
- Implementing or extracting the ELP subsystem.
- Interfacing the QQRMM.

- *Iteration* = An integer variable ***"i"*** that denotes a *Project/ADM iteration*
- ….
- E → PAHMM (AH01).
- E → Intelligence (AH02).
- E → IHIPTF (AH03).
- ….
- **mc** Req = **m** KPI (AH10)
- Ftr = **mc** Req (AH12)
- **mc** Mapping MA/**mc** Req = MA + **m** (**mc** Req) (AH13)
- Req = **m** CSF = ⋃ mc Req (AH14)
- Prb = **m** Req (AH15)
- Req = ⋃ Ftr + ⋃ Rul + ⋃ Cnt + ⋃ Dia + ⋃ Re (AH16)
- ….
- Wgt € {1 … 10} (AH20)
- ∑ Wgt = 1 (or 100 % max) (AH21)
- ∑ CSF = 1 (or 100 % max) (AH22)
- ∑ KPI = 1 (or 100 % max) (AH23)
- ∑ Var = 1 (or 100 % max) (AH24)
- …
- CSA(OU or APD) = ∑ CSF (AH30)
- CSF(OU_Element) = ∑KPI (AH31)
- KPI = ∑Var (AH32)
- CSA(i) = CSF(i)*WGT(i)+ CSF(i+1)*WGT(i+1)+… (AH33)
- CSF(i) = KPI(i)*WGT(i)+KPI(i+1)*WGT(i+1)+… (AH34)
- KPI(i) = Var(i)*WGT(i)+Var(i+1)*WGT(i+1)+… (AH35)
- Var(i) = Call to ICS struct… (AH36)
- BMMN(Itr) as an instance = E(Itr) (AH37).
- ….
- TVR = F (Var/ARG) (AH40)
- F(ARG) = WGTxQNT(ARG) v/& WGTxQLT(ARG) (AH41)
- ….
- MA **b** Scr = ⋃ action->data + ⋃ MA + HDT() + F(ARG) (AH50)
- HDT = ∑ NOD + ∑ QLT + ∑ QNT + ∑ F() (AH51)
- ….
- // Restructure Prj with changes
- MM **b** Prj = ⋃ action->data + HDT() (AH60)
- RPrj = ⋃ HDT + ⋃ Sol (AH61)
- ….
-
- sMA = ∑ aBB + ∑ sBB + ∑ aMVC (AH70)
- sBB = ∑ UP+ ∑ sMA + ∑ sOPM (AH71)
- sCBB = ∑ sBB + ∑ sABB + ∑ SBB (AH72)
- sIBB = ∑ sCBB (AH73)
- Unit = ∑ sIBB (AH74)
- …
- sUnit = ∑ sSUPL (AH75)
- ….
- OU_Element = OU[n or element], € {1 … k} (AH80)
- OU or Sector = APD[n] (AH81)
- **mc** E = ⋃ MA (AH82)
- **mc** E = ⋃ RPrj (AH83)

- E = ⋃ OUs (or Sectors) (AH84)
- E = ∑ **mc** E (AH85)
- ….
- For a TDM Itr an PAHMM diff (or Δ) can be evaluated (AH86).
- ….
- PAHMM(Itr)= PAHMM(Itr)- PAHMM(Itr-1) (AH87).
- GAPA(PAHMMs(Itr))= GAPA(∑ RP) + GAPA(∑ Blocks) (AH88).
- Δ [GAPA Prj(Itr)]=CSF(1)*Wgt(1)+CSF(2)* Wgt(2)+… (AH89).
- ….
- MDTCAS is the glue…
- P2T Project to Transform.
- B2T Blocks or Patterns to Transform.
- B2T = MM
- M2T MMs and/or EAMs to Transform
- ….
- P2T = = ∑ B2T_AI + ∑B2T_DB + ∑B2T_API + … (AH90).
- B2T_DB = DBCC (i) (AH91).
- MM = ∑ Viewpoint(module) + ∑ Pattern + ∑ MDTCAS Blocks (AH92).
- AHMM(Domain) = ⋃ MMs (AH93).
- …

Transformational Series-The Applied Transformation Mathematical Model

A Project or Entity's evolution can be seen as a mathematical transformation serie (Viewpoint "T"), that has the following generic characteristics:

- The AHMM() is composed of: 1) A static view; 2) A dynamic (or behavioural) view; and 3) A pool of reusable ARbLP-based scenarios for specific APD or common use.
- ….
- Extends the MM4FC, MM4PM, MM4GP, MM4PR, MM4CM, MM4AD, MM4OO, MM4BP, MM4MT, MM4PE, MM4UP, MM4MM, MM4MD, MM4IN, and MM4AH.
- ….
- MM4AH(Itr) as an instance = Intelligence(Itr) + other modules (TR01)
- ….
- **The Generic AHMM's Formulation**
- AHMM() = ⋃ ADMs + ⋃ MM4AH(Itr) (TR02)
- ….
- **AHMM's Application and Instantiation for ISS**
- *Domain* = PRWC (TR03)
- PAHMM4(Domain) = ⋃ ADMs + MM4AHs(Domain) (TR04)
- ….
- The AHMM() can be modelled using the ETMM formula that abstracts a Project.
- $Weigthing_1$ and $Weigthing_2$ are delivered by the AHMM().
- AHMM()=$Weigthing_1$*AHMM()_Qualitative+$Weigthing_2$*AHMM()_Quantitative (TR10).
- AHMM() = ∑ AHMM() for a Project iteration (TR11).
- ….
- ETMM = ∑ AHMM() instances (TR20).
- ETMM's OF optimization is done by using constraints and extra variables that need to be tuned (TR21).
- ….
- Prj = ∫ F(ETMM(Itr)) x GAPA(Itr) (TR30).
- **mc** E = ⋃ RPrj (TR31)
- E = ∑ **mc** E (TR32)
- E = ⋃ OUs (or Sectors) (TR33)

- E $= \underline{\bigcup} \text{ Prj} + \sum \text{ICS} + \ldots$ (TR34)
- ….

These variables (for maximization or minimization) can be, for example: specific APD' integration rate, Team's Polymathic capacities, or another Factor. For AHMM()'s PoC the success will be the main and only constraint and success is quantified as a binary 0 or 1, where the OF minimizes ETMM's risks, statuses, and identifies AHMM()'s s efficiency. The ETMM is a combination of used methodologies, PEMtM, and AHMM(). The AHMM() is a part and the skeleton of IHIPTF that uses Blocks based scenarios to support AHMM() requests. The initialization phase generates AHMM() problem types and cross-functional aspects to be analysed by using the FMS/PRWC (Agievich, 2014).

The AHMM() for a specific APD

The AHMM() for specific APD can be used for (Yee, 1996):

- Control and adjustment to alter specific APD performances where the pre-requisite is knowledge of the end-system's behaviour.
- To simulate the end-system and thus to obtain the feasibility Factors. A specific APD real-world physical system has unique characteristics, so they must be modelled and to use experimental practices to check the end-system.
- To link structure, internal sub-domains, and control modules.
- To facilitate monitoring, control of the specific APD mechanisms.
- To describe specific APD specific characteristics.
- Supports the PoC and checks sub-domains behaviours.

Conclusion and Recommendations

<<CCCC CONCLUSIONS>>

In this article that is related to AHMM() based Projects, the author proposes the following set of business, architecture, technical and managerial recommendations:

- A AHMM() strategy and concept is confirmed for its feasibility.
- Project must build a global Intelligence concepts that are parts of the future complex DS based system.
- Enormous efforts must be applied to integrate underlying DS based ICS to support the DMS. Here the main problem is alignment because of siloed software (and other) blocks are silos in general.
- AHMM() should replace traditional obsolete archaic Intelligence.
- Intelligence integration in a future system enables the automation of all its activities.
- The Project must be separated in multiple Project transformation steps, where the first one should attempt to transform the DS based ICS and its EA paradigm.

This RDP is based on a mixed action research model; where CSFs and CSAs are offered to support Project architects to diminish the chances of failure when using AHMM(). This article is part of a series of publications related to applied mathematical models, Projects, Intelligence, and EA patterns. In this article, the focus is on the AHMM() that defines a central model to support the DMS to be used in the future system. The AHMM() is an important factor for the business information system's evolution and maintenance. The most important managerial recommendation that was generated by the previous research phases was that the business transformation manager must be an architect of adaptive business systems. The PoC is based on the CSFs' binding to a specific research resource (or requirements) and the internal reasoning model that represents the relationships between this research's concepts, requirements, microartefacts and CSFs. The final result clearly implies that the proposed AHMM() integration is credible and the article's RQ and that it can be used. To support such complex experiments or PoCs, the author recommend performing the Project implementation operations through multiple independent sub-Projects (or PoCs) to implement separate DSs; where the priority is to transform the ICS,

organizational structure a mathematical model, Intelligence (DMS, KMS) and global EA concept. The AHMM() describes a structured inter-relationship development of various DS characteristics and fields; and the implementation of Project artefacts and mechanisms. The AHMM() component's global EA based implementation is an important factor for the business information system's evolution. The PoC was based on the CSFs' binding to a specific research resources and the reasoning model represents the relationships between this research's requirements, microartefacts and the CSFs. The result implies that an attempt of transformation is feasible. To enforce this scenario, we recommend to perform the Project through multiple independent transformation Projects, where the task of the first ones is to transform the ICS, services and global EA concept.

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