Technology Transformation Projects-The Applied Polymathical Mathematical Model for Enterprise's Performances' Measurement (APMM4EPM)

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Abstract: - Enterprise's Performant Distributed Computing (EPM), needs well-defined structured Mathematical Methods (MM), and modelling technics. And the Applied Polymathical/Holistic Mathematical Model (AHMM) for EPM (APMM4EPM) supports Enterprise's transformation projects (simply Project). The APMM4EPM is a set (and collections) of related Polymathical Mathematical Models (PMM), Enterprise's legacy transformed resources (and artefacts), critical success factors (or Project's tuning-factors), Enterprise performances patterns, Artificial Intelligence (AI) Subdomains (AIS) Models (AISM), complex Enterprise Architecture (EA) Models (EAM); and many other Project's modules, fields and parts. The proposed AHMM and related PMMs were already presented and applied to various domains; and the author's latest work, the AHMM for Enterprise's Business Process Modelling (AHMM4EBPM) is this article's main reference, stub, and logical continuation [1]. PMMs, transformed artefacts, AISMs, and Complex EAMs (CEAM), use standardized and convened sets of names, mapping-concepts, services-architectures, relations, used to model Projects' and to ensure their Validity Checking Processes (VCP). The VCP is used to check and reorient EPM's main areas like Information Communication System (ICS) components, Processing units' concept, Various models' performances, ICS availability, Enterprise security, and other.

Key-Words: - Project's performances, Polymathical mathematical models, Modelling, Business and common transformation projects, Enterprise architecture, Artificial intelligence, Qualitative and quantitative research, and Critical success factors/areas.

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1 Introduction

ICSs and Projects massively use CEAMs, AISMs, PMMs, repositories of transformed (or unbundled) services, artefacts-relationships, and other elements that are implemented and interchanged using various formats like the eXtensible Markup Language (XML) format. Such interchanges need a well-designed EPM on various levels that include:

- EPM_ICS: Classical ICS components' performances like, processors, memories, buses, threading…
- EPM_IDS: The use of In-memory Data Sets (IDS) for performant massive data processing.
- EPM_PRC: Processing units' basic concepts which needs to be reviewed and changed. To replace Bool's logic by IDS based.
- EPM_MOD: Using optimized and performant complex models like Business Processes (BP) Models (BPM), CEAM, AISMs, and other models (simply CModel).
- EPM_VCP: Is applying VPC to check ICS' robustness, availability, and scalability; where VPC needs APMM4EPM and related PMMs.

The APMM4EPM is a set of interrelated PMMs that are used for Project's VCPs (or integrity-checking), Gap-Analysis (GAPA), Project's risk-management, and other enterprise or Project's activities. In-turn a PMM uses interrelated IDSs (or classical DataSets, DS) and adapted Heuristics Qualitative (Ql) and Quantitative (Qn) methods; Ql and Qn are combined to offer a mixed-method, the HDT [1]. The APMM4EPM is used by Projects to transform Enterprises, or organization (simply Entity) and where a Project adopts an In-House Implement (IHI) Polymathic Transformation Framework (IHIPTF) and IHIPTF Methodology (IHIPTFM). The IHIPTF and IHIPTFM enable the use of Critical Success Factors (CSF), to interface standard Project's methodologies, categories of MM's symbols, relations, and nomenclature. The AHMM has a function's interface the AHMM() and EPM is an argument, that forms the APMM4EPM or

AHMM(EPM), which is used also to solve Project's problem-types and to offer solutions. Therefore, the APMM4EPM is a specialization for EPM Critical Succes Areas (CSA) like EPM_ICS, EPM_IDS, EPM_PRC, EPM_MOD, and EPM_VCP. It is recommended to refer and read IHIPTF's and IHIPTFM's works, like:

- The AHMM4PROJECT [2].
- The IHIPTF and IHIPTFM Guides [3].
- The IHIPTF Glossary [4].

APMM4EPM's objectives, characteristics, and advantages are [1], [2], [3], [4]:

- To manage the transformation for CModel(s), the Project uses refinement and unbundling processes (simply Disassembling).
- Disassembling transforms legacy CModels and services to deliver transformed-CModels.
- Establishes modelling-principles and VCPs for CModels by inter-relating and comparing associates PMMs and MMs.
- PMMs and their associated CModels are stored in IDSs.
- The AHMM(EPM) and PMM's symbols/nomenclature, fundaments, basics, and notations originate from the AHMM4PROJECT guide [2].
- The APMM4EPM, and IHIPTFM, are the 1st Project-transformation workbenches that include a Polymathic Mathematical Notation (PMN) for Projects (PMN4PTS) [5], [6].
- Dissembling produce sets of related PMMs, unbundled resources/artefacts in the form of blocks, CSFs (to be used for optimization activities), and generated CModels.
- CModels, PMMs, Blocks, CSFs, and artefacts are IHIPTFM's main elements.
- The IHIPTFM's includes elements from standard- methodologies and artefacts, like EA and BPM Notation (BPMN) elements.
- The APMM4EPM is a set of PMMs that are presented in the AHMM4PROJECT work [1], [2];and in this article the focus is on MM for EPM (MM4 EPM) and its related PMMs.
- The APMM4EPM is used to to predict eXtremely High Failure Rates (XHFR) and analyse their sources, which in most cases is related complexities…
- Uses the IHIPTF's Research and Development Project's (RDP) to support Project's and EPM's integration, analysis, and execution. And it is this article's 1st CSA.

2 RDP for EPM

2.1 The Research Question

The article's (and RDP) Research Question (RQ) is the following: "Which APMM4EPM advantages, characteristics, and structure are needed to support EPM and Project's success?" RQ's Polymathic Scientific Resources and Literature Review (PSRLR) uses IHIPTF's modules, knowledge-base, Conceptual Proof of Concept (CPoC), and works/articles repository, and privileges relevant professional experiences, like:

- The AHMM4EBPM [1] and AHMM4PROJECT(s) [2].
- The Business Transformation and Enterprise AHMM's Persistence Concept (AHMMPC) [7].
- The AHMM basics [15] and AHMM's Integration (HMMI) [8].
- Using AHMMs for Projects [9].
- The AHMM for Geopolitical Analysis (AHMM4GA) [10].
- The Projects that use Meta-Models [11].
- AHMM based Enterprise Unbundelling-refinement (EU) Concept (EUC) [12].
- The use of Polymathic Rating and Weighting Concept (PRWC) [13].
- AHMM for Dynamic Systems (AHMM4DS) [14].
- …

2.2 The Used Set of PMMs

The AHMM() in general and APMM4EPM can include 1 (or more) of following PMMs:

- PMM for Disassembling (PMM4DI) which supports the unbundling of legacy artefacts.
- PMM for Object Orientation (OO) (PMM4OO) which (re)structures legacy modules into OO artefacts.
- PMM for Factors (PMM4FC) which (re)structure and verifies-checks CSFs, CSAs, Key Performance Indicators (KPI), and concrete ICS VARiables (Var) (simply Factor).
- PMM for GAPA (PMM4GP) which supports VCP which enables GAPA's evaluations.
- PMM for PRWC and Factors Management System (FMS) (PMM4PR) which supports FMS and PRWC's estimation-processes.
- PMM for Expectations-Constraints (PEC) (MM4PE) which manages PECs.
- PMM for Complexities' Management (PMM4CM) which enables complexities' modelling.
- PMM for MetaModels (MtM) (PMM4MM) which is the fundament for MtMs.

- PMM for Polymathic Enterprise MtM (PEMtM) (PMM4PM) which is the fundament for PEMtM.
- PMM for BP (PMM4BP) which supports (and checks) BP-BPMs, and various types of choreographies.
- PMM for CModels (PMM4CL) which supports (and checks) various models (CEAMs, AISMs…).
- PMM for Methodologies and ICS models (PMM4MD) which supports and checks OO modelling, Archimate....
- PMM for IHIPTFM (PMM4MT) which supports IHIPTFM.
- PMM for APDs (PMM4AD) which supports (and checks) APDs and its problem-types.
- PMM for Agile Project Management (APM) (MM4AP) which supports, structures, and checks APM, and PMs.
- PMM for Intelligence-AI (PMM4IN) which supports and checks AI ‘and decision-making).
- PMM for AHMM() (PMM4AH) which supports research topics like the EPM .

2.3 RQ’s Related Hypothesis

This RDP and Project use a list of hypotheses (or assumptions) which correspond to CSAs and where the EPM corresponds to the central CSA and RQ. RQ’s feasibility depends on a defined set of hypotheses (and assumptions). Where the main hypotheses (or assumptions) depend on the following Project’s activities (and phases). And these hypotheses are:

- Project’s initiation-start, contracting, roadmap-goals, vision, and team-development are well-established.
- Project’s budget was accepted.
- There is a sufficient level of managers’ political support.
- The Entity has needed experiences, quality, and longterm research roadmap.
- Disassembled artefacts and automated CModels choreographies’ strategies are implemented.
- Disassembling processes were finalized successfully and have generated a repository of CModels, Blocks, services, and other IHIPTFM artefacts.
- The Entity and Project have successfully implemented IHIPTF(M), FMS/PRWC, and HDT.
- The Project uses a DataBase (DB) Centric Concept (DBCC) (or DB first) for IDSs’ operations.
- The Project’s team-members have valid experiences and advanced CModels and services modelling skills.
- The Project and Entity have implemented AHMM() and PMMs’ fundaments, Symbols (or Notations), and AHMM()’s relations-interactions [1], [2].
- A hypothesis maps to a CSA, and the RQ corresponds to a CSA.

2.4 The PSRLR, PRWC, and FMS

This RDP found a research-gap that is due to: 1) There is not an AHMM(), PMMs, and IHIPTF similar approach; 2) XHFRs’ proactive detection; 3) HDT’s originality; 4) A Real-Time (RT) Weightings (Wgt) for PRWC (and FMS) used for GAPA, PMMs, and IHIPTF; and 5) The application of CSA Decision-Tables (CSA_DT) to evaluate CSAs. And as shown in Figure 1. GAPA is applied to all article’s CSAs, but in this article only 1 CSA_DT will be illustrated.

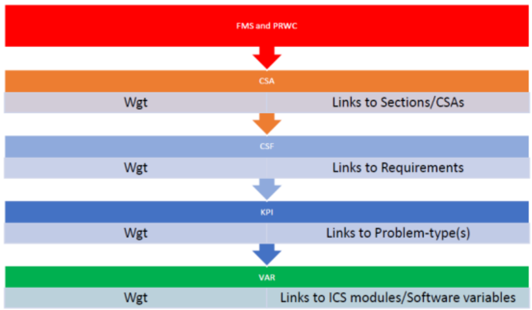

Fig. 1: PRWC’s evaluations for IHIPTF and CSA_DTs

The APMM4EPM is related to the PMM4FC which identifies the Project’s initial-sets of Factors; and includes AHMM equations FC01-FC21 that were implemented in a reference research work [2], in which CSFs, KPIs, rules, and constraints are needed for Project’s basic-evaluations, and eventual (re)scheduling. AHMM() and PMMs have the PEMtM which enables the Entity perform VCPs. VCPs use the PRWC/FMS and Factors to [16], [17], [18], [19], [20]:

- Be by Natural Programming Languages (NLP) processing.
- Incorporate CSAs, CSFs, KPIs, and Vars.
- A CSA maps to set(s) of CSFs (and Project’s services), and a CSF is a set of KPIs.
- Manage Project’s initial-sets of Factors.
- A KPI maps to a unique requirement (or problem-type).

- CSFs are applied for solving problem-types, in AISs, Decision Making System (DMS)/Knowledge Management System (KMS) (simply Intelligence).
- Ensure that: 1) A CSA maps to an APD; 2) A CSF maps to a set of requirements (or problem-types); and 3) A KPI maps to a Var.
- Support VCP and related GAPAs' evaluations processes.

2.5 GAPA's and VCP's Evaluations

VCP is a set of GAPAs, and they both based on the IHI IDSs' (IHIIDS) comparisons. Where IHIIDSs are exported to intermediate formats like XML, as shown in Figure 2.

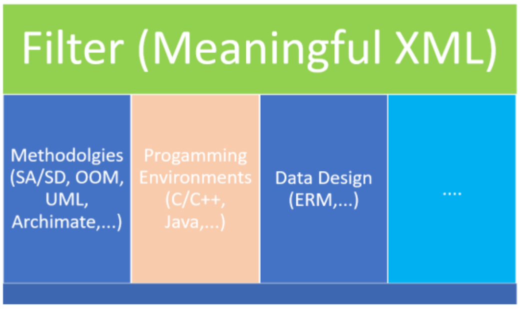

Fig. 2: Exchanging IHIIDSs

Exported files are managed (or imported) by the IHIPTF(M), GAPA, and VCP operations, by applying AHMM variables and formulas 1.1 to 1.8:

- AHMM and Project uses Iterations (Itr)
- Unique IDentifier (UID)
- Entity/ICS component (Cm[UID])
- Cm[UID]'s GAPA (CG)
- Project (PRJ)
- Project(Phase) (PHS)
- Evaluate Project (EVAL)
- PRJ Success Limit (PSL)
- …
- CG(Itr)=GAPA(Itr, Cm[UID]) (1.1)
- CG(Itr-1)=GAPA(Itr-1,Cm[UID]) (1.2)
- Δ=CG(Itr)-CG(Itr-1) (1.3)
- GAPA(PHS)=PRWC(Δ) (1.4)
- VCP(PHS)=∑GAPA(PHS)-∑GAPA(PHS-1) (1.5)
- …
- PRJ(PHS)=∑VCP(PHS)-∑VCP(PHS-1) (1.6)
- EVAL(PRJ(Cm[UID]))=∑PRJ(Cm[UID])(PHS) (1.7)
- IF EVAL(PRJ(Cm[UID])) => PSL (Success) (1.8)
- IF EVAL(PRJ(Cm[UID])) < PSL (Continue or Stop PRJ) (1.9)

EVAL(PRJ(Cm[UID])) evaluates Project's statuses and for a specific its Cm. And can also for all CMs, by using the HDT based Intelligence to estimate VCPs and GAPAs. The use of the PEMtM enables VCP's and GAPA's evaluations in all Project's PHSs which are managed by IHIPTF's Transformation Development Method (TDM). The TDM is built on The Open Group's Architecture Framework's (TOGAF) Architecture Development Method (ADM); which makes it inter-operable.

VCP and GAPA applies Factors like CSFs, KPIs, and VARs, which can be: 1) Project's Cms or fields requirements or problem-types; 2) Disassembling-Mapping resulting artefacts; 3) PRWC's interchange; 4) Intelligence's results; 5) TDM's management; 6) EPM_ICS, EPM_IDS, EPM_PRC, EPM_MOD, and EPM_VCP outcomes; and 7) The application of KPIs and their used VARs to real-world ICS (programming languages) software Cms. Project's evolution and evaluations depend on VCPs and GAPAs, which should be in phase with Project's strategy and XHFRs' predictions. Project's and RDP's CSAs are evaluated by using HDT based CSA_DTs, where an CSA maps/corresponds to a Project domain-topic.

CSA_DTs deliver RDP's final Phase's 1 evaluations which constitute Project's DT (PRJ_DT). And APDs' evaluations depend on Project's CSAs, and these evaluations use Factors, PRWC, and GAPA. The generic PMM4AD supports CSA_DTs and PRJ_DT evaluations which maps to the EVAL(PRJ).

3 From AHMM4EBPM to Apmm4epm-and EPM Fundemants

3.1 The Role of IHIPTF(M)

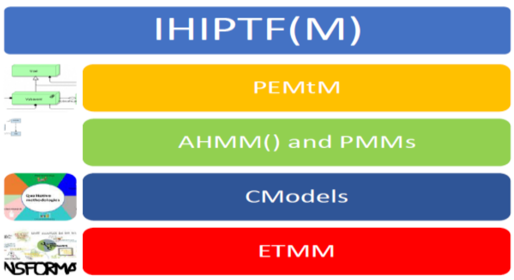

Fig. 3: The IHIPTF(M)'s relations with other modules and Cms

This section wraps-up previous AHMM related works and implementations, to offer a set of fundaments for EPM and Projects. As shown in Figure 3, the IHIPTF(M) offers a PEMtM, AHMM() (and PMMs), CModels, and Entity Transformation Mathematical Model (ETMM). Where IHIPTFM supports existing methodologies to manage: Requirements, Granularity, CModels, Object-Oriented Models (OOM), Mapping-mechanisms; and Complexities. The PRWC is used to estimate: VCPs/GAPAs, and ETMM's tunning. Because of IHIPTF's limitations (and its modules: IHIPTFM, PEMtM, and ETMM).

3.2 IHIIDSs, Artefacts, and CModels

EPMs' common and basic (and all ICS' Cms) is the DS in general and IHIIDS more specifically, and they relate easily to CModels, because they offer the following characteristics [16], [21], [22], [23], [24], [25], [26]:

- EUC offers the extractions of transformed artefacts, like services and resources; and that can be automated.
- The IHIPTF enables the EUC for CModels, related artefacts (and interfaces). Resulting CModels in-turn generate cartographies like: Networks, IHIIDS, Cms, External-interfaces, Application Programming Interfaces (API), Transactions…
- Supports Polymathic analysis and design, and roadmap building.
- Standardizes Project's data-formats.
- Can be used all types of CModels like Entity-Relations (ER) Models (ERM).
- Enables Performances' improvements, VCPs, and (Re)usability.
- Supports AISs and AISMs, are used for various domains like Machine Learning (ML), statistics…
- Is a base of complex collections, Cms' buffers, and algorithms.
- are IHIPTFM's basic elements.
- IHIIDSs can be interrelated to represent relationships and use UIDs for extractions-identifications.
- Supports PMMs for AHMM() variants like the APMM4EPM.
- Supports CEAMs, OOMs.
- Supports interchangeable formats for reverse-engineering, like Metadata Interchange (XMI).
- Offers basic elements for Polymathic and Iterative Learning Processes (PILP).

3.3 IHIPTF(M)'s Integration and PILPs

The IHIPTF(M) and associated PILPs are integrated in the Project and Entity by [27], [28]:

- Using PMMs, sets of services (simply Blocks), PEMtM, CModels…
- Applying CModels, which reflect Project's and Entity's structure, can be validated using VCPs and GAPAs.
- Enabling Entity's CModels' implementations.
- Using the TDM to synchronize Project's phases.
- Implementing a PILP and Models (PILPM), where a PILPM is also a CModel model-type.
- Intelligence and PILPMs use the HDT, FMS, and PRWC, to offer automated intelligence processes and solutions.
- The Action-Research (AR) based HDT constructs are: Tree-nodes, Interfaces to PILPs, and PMMs).
- Using NLP implementation scripts that are called from CModels and HDT.

3.4 IHIPTF(M)'s NLP Capabilities

The IHIPTF(M) has an IHI NLP (IHINLP) Environment (IHINLPE) which offers [29]:

- It is AHMM() based.
- Offers APIs or interfaces to all IHIPTF modules like the EPM_ICS...
- It includes an IHINLPE language suited for Projects and HDT based Intelligence.
- The IHINLPE links CSAs to Cms (or RDP/Project topics) like HDT or EPM_ICS, by implementing the EPM(Cm)2CSA class.
- Each CSA contains the selected CSFs and CSF's KPIs.
- A KPI is linked to a real-world ICS VAR which is a programming-language variable.
- A VAR is a Block's attribute which can is presented as Block.VAR.
- And links (or classes): 1) EPMs to Factors; 2) CSA to CSFs; 3) CSFs to KPIs; and 4) KPIs to VARs.
- Offering a set of EPM interface classes.

3.5 Used EPM Interface Classes

So HDT's evaluation-function (HDT.eval()) evaluated Factors' values. The EPM maps to CSAs by using the EDPCmCSA for a specific Cm class-structure:

```
Class EPMmCSA(Cm[UID])
{
EPM[n]=HDT.eval(Cm[UID][n].CSA[i]);
EPM[m]=HDT.eval(Cm[UID][m].CSA[j]);
```

…
}; where n and m are Project's Itr.

CSAs map to CSFs by using the CSAmCSF for a specific Cm class-structure:

CSAmCSF(Cm[UID])
{
EPM.CSA[n]=HDT.eval(Cm[UID].CSA[n].CSF[i]);
EPM.CSA
[m]=HDT.eval(Cm[UID].CSA[m].CSF[j]);
…
}; where n and m are Project's Itr.

CSF elements map/link to KPI by using the CSF2KPI for a Cm class-structure:

CSF2KPI(Cm[UID])
{
CSA.CSF[n]=HDT.eval(Cm[UID].CSA[n].CSF[i].KPI [k]);
CSA.CSF[m]=HDT.eval(Cm[UID].CSA[n].CSF[i].KPI[m]);
…
}; where n and m are Project's Itr.

KPIs link to IHINLPE scripts and map VAR by using the KPImVAR for a Cm class-structure:

KPImVAR(Cm)
{
CSF.KPI[n]=HDT.eval(…KPI[n].VAR[i]);
CSF.KPI[m]=HDT.eval(…KPI[m].VAR[j]);
…
}; where n and m are Project's Itr.

The used Factors, CSA_DTs, PRJ_DT, and Cms are tuned by the APMM4EPM based PRWC through TDM's phases.

4 The APMM4EPM

4.1 Fundaments

The APMM4EPM uses mainly a Ql approach and enrich PILPs. Relevant PMMs are interrelated to create the APMM4EPM that in-turn supports VCPs, GAPAs, CEAMS, AISMs…

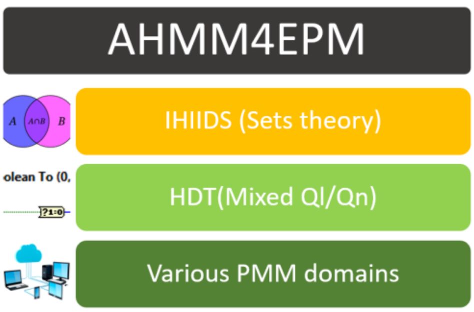

Fig. 4: The APMM4EPM layers

PMMs use IHIIDSs that are interrelated to support the HDT. As shown in Figure 4, the APMM4EPM includes [30], [31], [32]:

- Various views: Static-view; and Behavioural-view.
- Defines CModels' patterns and targeted APDs.
- Integrates the HDT which inputs various sets like constraints, rules, Factors… And evaluates problem-types.
- The FMS and PRWC to assess Project's and EPM's Factors.
- A Project and EPM use PMMs.
- For a requirement (or problem-type(), the APMM4EPM based Intelligence it deliver solutions.
- Mimics the Empirical Engineering Research Model (EERM).
- The APMM4EPM is a subset of real-world system's structures, and behaviours.
- The APMM4EPM offers abstractions (or PMMs) of a real-world physical-system.

A Project is a set of series of AHMM() based transformation that has the following characteristics and constraints:

- Extends PMMs like: PMM4FC, PMM4PM, PMM4GP, PMM4PR, PMM4CM, PMM4AD, PMM4OO, PMM4BP, PMM4MT, PMM4PE, PMM4DI, PMM4MM, PMM4MD, PPMM4CL, PMM4IN, and PMM4AH.
- …
- E represents an Entity.
- Pt represents an AHMM Pattern.
- …
- () represents a function.
- O() represents an Optimization ().
- …
- Qn() represents a quantitative ().
- Qu() represents a qualitative ().
- ….
- PMM(Cm)=∑T(Cm)+∑P+∑IHIPTFM (2.1)
- AHMM(Domain)=U PMMs (2.2)
- PMM4AH(Itr) as an instance = Intelligence(Itr) + other modules (2.3)
- ….
- The Generic AHMM's Formulation
- AHMM()=U TDM+U PMM4AH(Itr) (2.4)
- ….
- AHMM's Application and Instantiation for an APD
- Domain=EPM (2.5)

- PAHMM4(Domain)=U TDMs+ PMM4AHs(Domain) (2.6)
- ….
- The AHMM(Domain) can be designed by using the ETMM() formula that abstracts the EPM or a Project.
- Wgt1 and Wgt2 are delivered by the AHMM().
- ….
- AHMM()=W1*AHMM()_Qn+W2*AHMM()_Qu (2.7).
- AHMM()=∑PMM() for Project(Itr) (2.8).
- ….
- ETMM = ∑ AHMM() instances (2.9).
- …
- ETMM's O() optimization is done by using PRWC's constraints and added VARs that have to be tuned (2.10).
- ….
- Reconsider the formulas from 1.5 to 1.8.
- ….
- Cm[UID]=AHMM() (2.11).
- EVAL(PRJ(Cm[UID]))=∑PRJ(PHS) (2.12).
- IF EVAL(PRJ(Cm[UID])) => PSL (Success) (2.13)
- …
- PRJ=∫ T(ETMM(Itr)) x VCP/GAPA(Itr) (2.14).
- E=U PRJ + ∑ EPM(Cm[UID]) + … (2.15).

5 The EPM Integration

5.1 The EPM_ICS

The EPM_ICS describes an analytical model for ICS' performances evaluation. And the focus is on the utility of such processes, knowing that an ICS is complex due to its heterogeneous and redundant components, where each component is designed to execute a specific job/task. These components can be: Central processor, Memory, Peripherals, Software-packages, Network-nodes… And their combination makes it difficult to predict the overall performance(s) in specific context. As the ICS' complexity grows, the EPM_ICS becomes a very difficult under-taking [33]. The EPM_ICS has the following characteristics and constraints:

- PU represents a Processing Unit.
- MU represents a Memory Unit.
- SU represents a Server Unit.
- NU represents a Network Unit.
- DU represents a Disk Unit.
- SP represents a Software Package.
- ….
- ICS(PHS)=∑PU+∑MU+∑SU+∑NU+∑DU+∑SP… (3.1)
- …
- EVAL(ICS)=∑ICS(PHS) (3.2)
- …
- E1=EVAL(ICS[Itr-1])=∑ICS[Itr-1](PHS) (3.3)
- E2=EVAL(ICS[Itr])=∑ICS[Itr](PHS) (3.4)
- Δ(EPM_ICS(Itr))=E1-E2 (3.5)

```
EPM_ICS_Class
{
Set W= EPM_ICS_Weigting()
        …
        cPU=getPerformances(PU);
        cMU=getPerformances(MU);
        cSU=getPerformances(SU);
        cNU=getPerformances(NU);
        cDU=getPerformances(DU);
        cSP=getPerformances(SP);
        …
        V=cPU+cMU+cSU+cNU+cDU+cSP ;
        …
        V=W*V;
};
```

Fig. 5: The EPM_ICS class

As shown is Figure 5, the weighting W is set and EPM class' variables are (re)evaluated; and then the value V is returned to the caller.

5.2 The EPM_IDS

The IHIIIDS (and a standard DS) is probably the most important ICS and Project's Cm where it is used in concrete operations, like [1], [34], [35]:

- All ICS activities like DB accesses, programming…
- All DB related operations, and can be Considered as the most important.
- All Qn, Ql, and mixed methods… Like the HDT.
- AISs and Intelligence, which includes BigData, ML, Deep Learning (DL)…
- Training, validation, and testing data splitting into three DataSets as follows: Testing IDSs.
- PMMs and AHMMs operations…
- VCPs and GAPAs evaluations.

- AIS activities like Data-labelling used to generate annotated IDSs. That is an important learning and training processes in ML models.
- Data-preparation (and gathering) can reflect CModels' workflows.
- AISMs' assessment by IHIIDSs validations, using metrics like, accuracy, precision…
- Continuous evaluation and enhancements processes.
- Use to for various types of Decision Trees (DT) and DT-classifiers.

The EPM_IDS has the following characteristics and constraints:

- DA represents a DB Access.
- CM represents Concurrency and Multi-threading.
- MP represents Memory Performances.
- HP represents Huge-volumes Performances.
- ….
- $IDS(PHS)=\sum DA+\sum CM+\sum MP+\sum HP…$ (4.1)
- …
- $EVAL(IDS)=\sum IDS(PHS)$ (4.2)
- …
- $E1=EVAL(IDS[Itr-1])=\sum IDS[Itr-1](PHS)$ (4.3)
- $E2=EVAL(IDS[Itr])=\sum IDS[Itr](PHS)$ (4.4)
- $\Delta(EPM\_IDS(Itr))=E1-E2$ (4.5)
- …

```
EPM_IDS_Class
{
Set W= EPM_IDS_Weigting()
        …
        cDA=getPerformances(DA);
        cCM=getPerformances(CM);
        cMP=getPerformances(MP);
        cHP=getPerformances(HP);
        …
        V=cDA+cCM+cMP+cHP ;
        …
        V=W*V;
};
```

Fig. 6: The EPM_ICS class

As shown is Figure 6, this class' W is set and its variables are evaluated; and then the value V is returned.

5.3 The EPM_PRC

Boolean algebra, Boolean Algebra base Architecture (BAA), and the related binary systems has been since the 1950s the standard for ICS architecture and processing. This approach has been adopted and there were many attempts to replace this type of architecture, because mainly all ICS activities and developments have to be converted to binary sets and reconverted back into an original format, which causes major EPM types of problems (like very bad performances, fail-overs…) [36]. Quantum Computer Architecture (QCA) is an ICS subsystem which performs quantum error corrections and where Quantum computation is just a side-effect. It is mainly the ability to interrelate ICS-Subsystems to enable a modular ICS-Architecture based on Quantum-Processors, which simplifies scaling to large ICSs that replaces the actual logic of just making huge and powerful and over-complicated chips. But there are no wide-scale adoptions, because as shown in Figure 7, QCA is very complex [37].

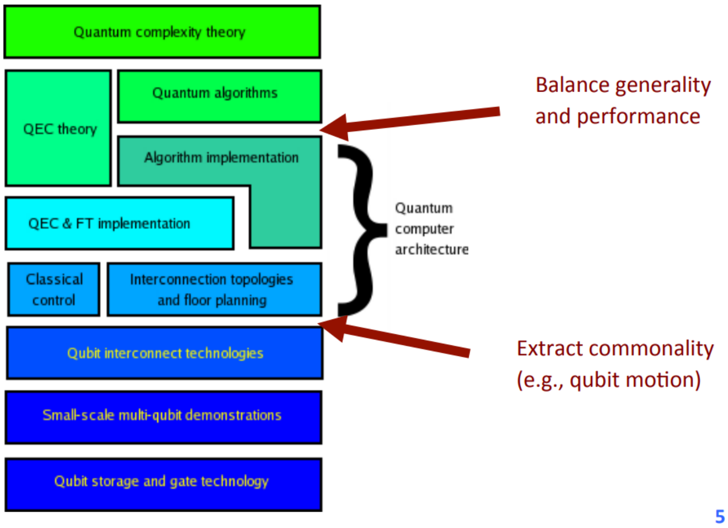

Fig. 7: The QCA

The EPM_PRC proposes and IHIIDS based Architecture (IDSA) which something in between Boolean Algebra base Architecture (BAA) and QCA. IDSA estimates that ICS resources mainly are occupied by processing IDSs and that frequent and unnecessary conversions to BAA are not needed. IDSA improves EDPCs and hence ICS' performances. These major IDSA's characteristics are:

- It replaces BAA and simplifies ICS architectures.
- Improves greatly all ICS' platform operations.
- Facilitates the processing of hard-coded CEAMs, AISs/AISMs, BPMs, and other types of models.
- Improves programming languages performances…

- ….

```
EPM_PRC_Class
{
Set W= EPM_PRC_Weigting()
        …
        cIDA=getPerformances(IDA);
        cDML=getPerformances(DML);
        cICO =getPerformances(ICO);
        cPLA=getPerformances(PLA);
        …
        V=cIDA+cDML+cICO+cPLA ;
        …
        V=W*V;
};
```

Fig. 8: The EPM_PRC class

The EPM_PRC has the following characteristics and constraints:

- IDA represents IDSA's artefacts.
- MDL represents a various types of models.
- ICO represents ICS' operations.
- PLA represents programming Languages Activities.
- ….
- PRC(PHS)=∑IDA+∑DML+∑ICO+∑PLA … (5.1)
- …
- EVAL(PRC)=∑PRC(PHS) (5.2)
- …
- E1=EVAL(PRC[Itr-1])=∑PRC[Itr-1](PHS) (5.3)
- E2=EVAL(PRC[Itr])=∑PRC[Itr](PHS)
- Δ(EPM_PRC(Itr))=E1-E2 (5.4)

As shown is Figure 8, this class' W is set and variables are evaluated; and then the value V is returned.

5.4 The EPM_MOD

The EPM_MOD (or IHIPTFM's performances and robustness) focuses on existing methodologies, has the following characteristics, and complexities [11], [38], [39], [40]:

- Combines of standards and IHIPTFM methodologies that includes ERMs.
- Adapts VCP and GAPA for models.
- Defines a granularity-level and uses The TDM.
- Integrates common artefacts, Blocks, relationships, events…
- IHIPTFM helps BPMNs to interface (other) 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 IHIPTFM and Blocks' design, as is shown in Figure 4; and MMs support EAMs and APMM4EPM to finalize transformational-operations.
- These operations include, automated-generation of CEAMs and other types of Models/Diagrams, Blocks/artefacts, catalogues, and matrixes.
- The TDM synchronizes/controls Project's BPM bases implementation-operations activities.
- The OOM use the PMM for IHIPTFM (PMM4MT).
- Integrates AISMs
- Extraction of CEAMs and AISMs (and related choreographies) depends on Generation and Disassembling processes.
- BPM Language (BPML) used to express BPs, and has the forms of high-level block-Diagram (and/or an XML standard-code).
- Enable Projects, EPMs, and ICS' inter-operability for the: 1) Integration of models-scenarios; 2) APD's business inter-operability; 3) Mapping between CEAMs.
- CEAMs, AISMS, pool(s) of services, relationships… are usually exported to PMMs using XML-format which is costly IDSA avoids this phase which makes the ICS more perfoemant.

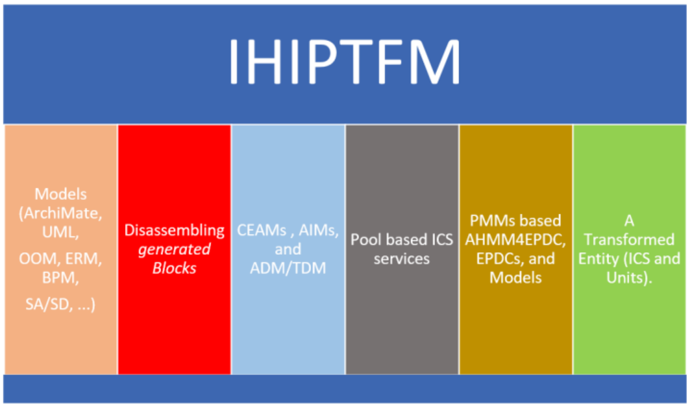

Fig. 9: IHIPTFM, EPMs, and APMM4EPM

The EPM_MOD has the following characteristics and constraints:

- REQ represents Requirements.
- REL represents Relations.
- MDL represents a Model.
- ….
- MOD(PHS)=∑REQ+∑REL+∑MDL+… (6.1)

- …
- E1=EVAL(MOD[Itr-1])=∑MOD[Itr-1](PHS) (6.2)
- E2=EVAL(MOD[Itr])=∑MOD[Itr](PHS) (6.3)
- Δ(EPM_MOD(Itr))=E1-E2 (6.4)

```
EPM_MOD_Class
{
Set W= EPM_MOD_Weigting()
        …
        cREQ=getPerformances(REQ);
        cREL=getPerformances(REL);
        cMDL=getPerformances(MDL);
        …
        V=cREQ+cREL+cMDL… ;
        …
        V=W*V;
};
```

Fig. 10: The EPM_MOD class

As shown is Figure 10, the used W is set and this class' variables are evaluated; and then the value V is returned.

5.5 The EPM_VCP

Main EPM_VCP's characteristics are [1], [16], [17], [18], [19], [20]:

- The VPC is used to validate Project's modules or ICS' statuses, like availability; where VPC uses APMM4EPM, PMM4GP, and associated PMMs.
- Hammers CModels principles and relates PMMs and MtMs.
- Offers initial-sets of Factors and offers mapping-concepts.
- Enables GAPAs by using NLPE, Intelligence, PRWC/FMS and Factors.

The EPM_VCP has the following characteristics and constraints:

- DTI represents DT's Interface.
- INI represents Intelligence Interface.
- SOL represents Sets of Solutions.
- Cms represents the Set of Cm.
- ….
- GAPA(PHS)=∑DTI+∑INI+∑SOL+… (7.1)
- VCP(PHS)=∑GAPA(PHS)-∑GAPA(PHS-1) (7.2)
- E1=EVAL(VCP[Itr-1])=∑VCP[Itr-1](PHS) (7.3)
- E2=EVAL(VCP[Itr])=∑ VCP[Itr](PHS) (7.4)
- …
- Δ(EPM_VCP(Itr))=E1-E2 (7.5).
- …

```
EPM_VCP_Class
{
Set W= EPM_VCP_Weigting()
        …
        c DTI=getPerformances(DTI);
        c INI=getPerformances(INI);
        cSOL=getPerformances(SOL);
        …
        V=cSOL+cINI +cDTI … ;
        …
        V=W*V;
};
```

Fig. 11: The EPM_MOD class

As shown is Figure 11, the EPM_MOD class' W is initiated and related variables are processes and evaluated; and then the value V is returned.

5.6 The EPM_All

The EPM_ALL includes previous EPMs and their classes; it gives the total evaluation for the Project and ICS; and has the following characteristics and constraints:

- GAPA_ALL= ∑GAPA[Cm[UID]](PHS) (8.1)
- …
- VCP(PHS)=∑GAPA(PHS(Cm[UID]))-∑GAPA(PHS-1(Cm[UID])) (8.2)
- E1=EVAL(VCP[Itr-1])=∑VCP[Itr-1](PHS) (8.3)
- E2=EVAL(VCP[Itr])=∑ VCP[Itr](PHS) (8.3)
- …
- Δ(EPM_VCP(Itr))=E1-E2 (8.2).
- PRJ(PHS)=∑VCP(PHS)-∑VCP(PHS-1) (8.3)
- EVAL(PRJ)=∑PRJ(PHS, Cm[UID]) (8.4)
- IF EVAL(PRJ(Cms) => PSL (Success) (8.5)
- IF EVAL(PRJ(Cms)) < PSL (Continue or Stop PRJ) (8.6)
- …

```
EPM_ALL_Class
{
// Set overall Weightings DS (WDS)
//
IHIIDS WDS[1…n]={0.1;…];
```

```
    // EPM_Status defines if the ICS is performant
        // (TRUE)
        // or not (False)
//
        Boolean EPM_Status = False;
        // Defined by Project team
        Real  EPM_Performance_Limit=0.7; //
(70%)

        ….
iICS=EPM_ICS_Instance;
        iIDS=EPM_IDS_Instance;
        iPRC=EPM_PRC_Instance;
        iMOD=EPM_MOD_Instance;
        iVCP=EPM_VCP_Instance;
        …
        cICS=iICS.getData()*WDS[1];
        cIDS=iIDS.getData()*WDS[2];
        cPRC=iPRC.getData()*WDS[3];
        cMOD=iMOD.getData()*WDS[4];
        cVCP=iVCP.getData()*WDS[5];
        …
        V_All=cICS+cIDS+cPRC+cMOD+cVCP ;
        …
        If( V > EPM_Performance_Limit)
        Then EPM_Status=True;
        …
        Return V_All;
};
```

Fig. 11: The EPM_All class

As shown is Figure 11, the WDS is set and all EPM_All_class' variables like cICS are processes and evaluated; and then the value V is returned; and it represents ICS' EPMs statuses.

All the presented MMs are in fact Abstract MMs (AMM) where their instance are concrete MMs. They used to abstract complex transformation initiatives [46], [47].

6 The CPoC

6.1 Setup, Configuration, and Modelling

The CPoC uses IHIPTF(M), APMM4EPM, and sets of selected Factors. These Factors are used by the HDT and CSA_DTs' processing; and are associated to Project's, IHIPTF, and Intelligence resources and mechanisms. The APMM4EPM issues requests to NLPE programs; and maps links between EPM(ALL), ICS, Project-Blocks, UIDs and Factors (especially CSFs). The CPoC initiates IHIPTF's windows-client development interface that is presented in Figure 12. IHIPTF's interface embeds NLPE implementations.

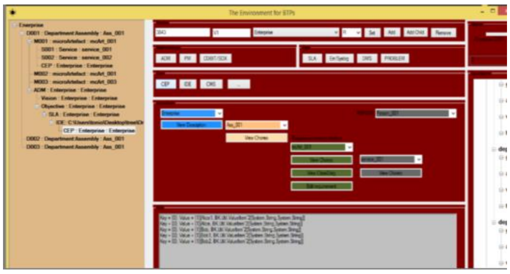

Fig. 12: IHIPTF's user and implementation interface

The NLPE is used to implement HDT scripts in-order to process Projects CSA(DT)s. As already mentioned, Intelligence and HDT are based on the APMM4EPM to offer recommendations. The CPoC has three Phases.

6.2 Phase "1"

Sets-up, models, and prepares the EPM fields and corresponding IHIIDSs (and their import/export interchange formats). Such formats are used by IHIPTF's modules like APMM4EPM and related PMMs. This CPoC and associated Applied Case-Studies (ACS), shows the integration of EPMs and APMM4EPM where CModels, PMMs and IHIIDSs are the fundaments. EPMs use IHIIDSs in various TDM phases [15]. As shown in Figure 13, the APMM4EPM, Intelligence, and PRWC use an evaluation definition-table or the . The and using the CSA_DT's Tables Weighting and Rating Enumerator (CTWRE) shown in Fig. 13.

CTWRE Label	Limit's Value	Description	Color
Proven, Mature	9.01-10.00	Success	Green
Possible, Feasible	8.51-9.00	Success	Green
Risky	8.01-8.50	Important Risk	Yellow
Complex	7.01-8.00	Unclear	Red
VeryComplex	5.01-7.00	Will probably fail	Red
Impossible	0.00-5.00	Failure	Red

Fig. 13: CTWRE's defined-values

The APD that is the usage of EPMs, CModels and related CSA_DTs, which contain RDP's CSAs' evaluations, where a specific CSA corresponds to an important RDP (or Project's) subject. RDP's Phase "1" CSA_DTs' evaluations are stored in the PRJ's DT (PRJ_DT). The mentioned evaluations use EPMs, CModels, FMS/PRWC, and selected Factors to enforce Entity' Intelligence, and to predict possible XHFRs by using EPM. IHIPTF(M) Constant-enumerators are used to RDP's CSAs (or CSA_DTs) and PRJ_DT's evaluations, using the following formulations:

- CSA_DT=AVG(∑CSF_KPI) (3.1).
- PRJ_DT=AVG(∑CSA_DT) (3.2).
- Phase_1=PRWC(PRJ_DT) (3.3).

- IF EVAL(PRJ(Phase_1)) < PSL (Go/Nogo) (1.8).

CSA Category of CSFs/KPIs	Transformation Capability	Average Result	Table
The RDP's Integration	Mature	From 1 to 10. 9.50	1
The Role of IHIPTF(M)	Feasible	From 1 to 10. 9.00	2
The Role of AHMM4EPDC	Feasible	From 1 to 10. 9.00	3
The Role of CModels	Feasible	From 1 to 10. 9.00	4
EPDC's Integration	Risky	From 1 to 10. 8.50	5
Phase's 1 Outcome	Feasible	From 1 to 10. 9.00	6
Evaluate First Phase			

Table 1. The RDP's outcome is 9.00

Using the IHIPTF(M) Cms/modules, to link EPMs to HDT's nodes. And Table 1, shows Phase's 1 outcomes, which confirms that it can "Feasible". Having an important constraint which is: CSAs that have an average result "<" "8.00" are cancelled. As the outcome is satisfactory CPoC's net step is relating CModels to EPMs.

6.2 The ACSs, CModels, and EPMs

CPoC's uses ACSs and the ArchiSurance case is used to demonstrate a legacy system, and its modules. For the EPMs, APMM4EPM, and CModels, this case is usable for showing basic performances, that result from a complex merger of various systems important data/ICS redundancies, CModels' functional overlaps, and complex 3T systems integration [41]. CModels include various aspects like AISMs, CEAMs (like EA Models and BPMs), and this CPoC uses a EDPC Viewpoint that shows a high-level approach to Projects. And as shown in Figure 14, ArchiSurance's CModels like: 1) Issuing new policies; and 2) Handling claims.

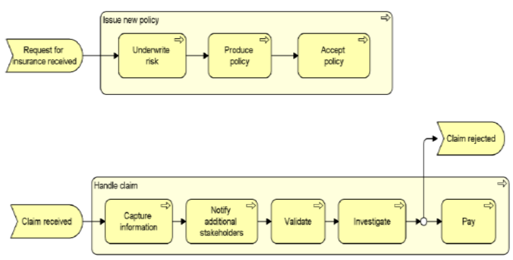

Fig. 14: The BPVB [41]

6.3 Inter-Operability and Exchanges

IHIPTFM that includes EPMs, supports inter-operability and exchanges by [41], [42]:

- Exchanging CModels and other artefacts for evaluations.
- Used NLPEs and EPMs tools are very heterogenous, limitations, and efficiency-issues.
- IHIPTF offers an interchange support.
- A Project's Polymathic approach that is synchronized by the TDM.
- VCPs/GAPA uses CModels like the Application Communication Diagram (ACD) offers transformed CModles for applications.
- Supports Target Technology Architecture for ICS' infrastructure.
- …

6.4 Phase "2"- Solving an EPM Problem-Type

Intelligence supports EPMs problem-solving, in which actions are used from HDT-nodes. And for that the action CSF_EPM_Feasibility_Procedure was run and has returned a list of solutions. Solving EPM problem-types related to Project's Development and Operations (DevOps). The HDT has an Objective Functions (OF) which: 1) In Phase 1, implements NLPE scripts (to evaluate CSA_DTs, EDPCs, and associated CPoC's rules/constraints like CSF_EPM_Feasibility_Procedure; 2) Intelligence is configured and uses the PRWC and FMS to support the HDT; 3) Links HDT-node to data-structures; and 4) The HDT executes the CSF_EPM_Feasibility_Procedure to deliver solutions. Solution-nodes activities are: 1) NLP-scripts are called-executed by IHIPTF's modules like the GAPA, FMS, and PRWC; 2) These NLP-scripts are executed in the background to offer values; and 3) These resultant-values are converted into actions, conclusions, and recommendations.

6.4 Phase "3" EPMs Execution

Phase "3" explains EPMs integration and the use of the presented classes. These classes interface the EPM Monitoring, Tracing, and Logging-System (EMTLS). The ICS needs continuous monitoring and its AISs that includes tracing users' activities, inputs to AISs, detecting security-breaches, overloading, performances, availabilities…

Fig. 15: Various types of LS (Raza, 2024)

The EMTLS and EPMs interfaces are implemented for validating [44], [45]: 1) Performances, robustness, stability, and availability; 2) Reliability (and recovery); 3) Security-threats tracing; 4) Common performance-controls; 5) Access to various types of Logging-Systems (LS) that are huge; 6) Processing, collection, and persistence of EPM data; 7) Persists various types of events, like performances' analysis; 8) Decrypts best practices; 9) Improves support and troubleshooting (blocks service-disruptions); Enables GAPA by searching, and comparison; 10) Logs session-activities, like processes' statuses; and 11) Transactions' performances. But EMTLS' has issues and constraints like [44], [45]:

- Inaccurate LS files that are limited.
- Uses ICS-clocks for getting timestamps .
- Uses LS levels that are difficult to standardize.
- Complexities in collecting-aggregating, ICS' Cms like network-nodes, services...
- Managing heterogeneous information - sources.
- Proactive detection of violations.
- Managing different-types of LSs as illustrated in Figure 15.
- Issues related to multi-cloud environments.
- LS huge data volumes are unpredictable.
- RT aggregations of users, applications, and ICS' interactions…

As shown in Figure 11, the EDPC executes the following methods:

- getData() method which fetch's data from the EMTLS or other data-source.
- V_All=cICS…; which calculates the overall EPM value.
- If this value is greater than the defined limit (EPM_Performance_Limit), then the status is satisfactory.
- Otherwise there is a major issue.

7 Conclusion

Classical MMs that are mainly quantitative, and AMMs in this article are based on [48], [49]:

- The lack of a Polymathism and conceptual approaches are the main reasons for the XHFRs which is reaching 95%. So where if the mathematical rigor ?
- Actual modelling methodologies and languages are in fact high level mathematical modelling languages.
- This article has a Polymathical approach that combines the latest technological fields, high level methodologies, complex mixed research methods, and other.
- It is not a quantitative (statistics) research model that delivers "rigorous numbers".
- To understand such an approach there is a need to have profound knowledge in This technological fields, existing methodologies (like UML, Archimate…) , complex mixed research methods, and other.
- It delivers an abstracted model that the author will refine in future articles. And the probable name for such an environment will be the Mathematical Modelling Language for Transformation and Complex Projects (MML4P).
- MML4P based engineering for complex ICTS and other types of systems.
- MML4P is a graphical approach for complex models' generation.
- The adopted concepts of "models" and related "effects" which are created, tested, and (re)simulated.
- The graphical modelling approach models abstractions to understand and simplify and ease engineering perspectives.

This article focuses on the EPMs and its related APMM4EPM; in which the APMM4EPM Projects and ICS' performance. This RDP offers the following recommendations:

- The IHIPTF's has guides, and Project's fundamental documents are: 1) AHMM4PROJECT [1], [2]; 2) IHIPTF Guide [4]; and 3) IHIPTF Glossary [5].
- This RDP is based on HDT which uses Factors is used by the APMM4EPM.
- The Project/RDP starts with implementing the PMM4GP that is also for VCP. VCP enables Project's evaluations.
- The APMM4EPM enforces a mainly qualitative concept.
- The APMM4EPM relates various CModels and supports Intelligence.
- CModels use/integrate, and interface IHIIDSs, ICS modules, OOM (or UML) to support: 1) CEAMs, AISMs, AISs, and associated services; 2) Unbundles/extracts NLPE scripts of choreographies); and 3) Standard Project artefacts.
- The IHIPTFM aims to support performant CModels, and reuses existing methodologies.
- PMMs and APMM4EPM support the VCP (integrity-checking, feasibility, modelling, GAPA...) and EPMs.

Acknowledgement:
The APMM4EPM and associated PMMs are to be used to define an adequate platform in the near future. This platform will be IHIIDS based as an alternative for current binary or quantic computers.

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