Effort of Knowledge Management about space system development

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1 . Background

One effective method of reducing any potential risk is learning constructive lessons from not only yourself but also other people. Until now, we experienced many successes and failures in the development of space systems.

We JAXA already reserved and spread out valuable experience as "**Reliability information**" or "**Design standard**"etc. At the same time, mechanism of these systems was not effective enough.

In order to make space development more efficient and more stable, we have started considering effective knowledge management.

2 . Guideline of this activity

(2-1) Define Knowledge

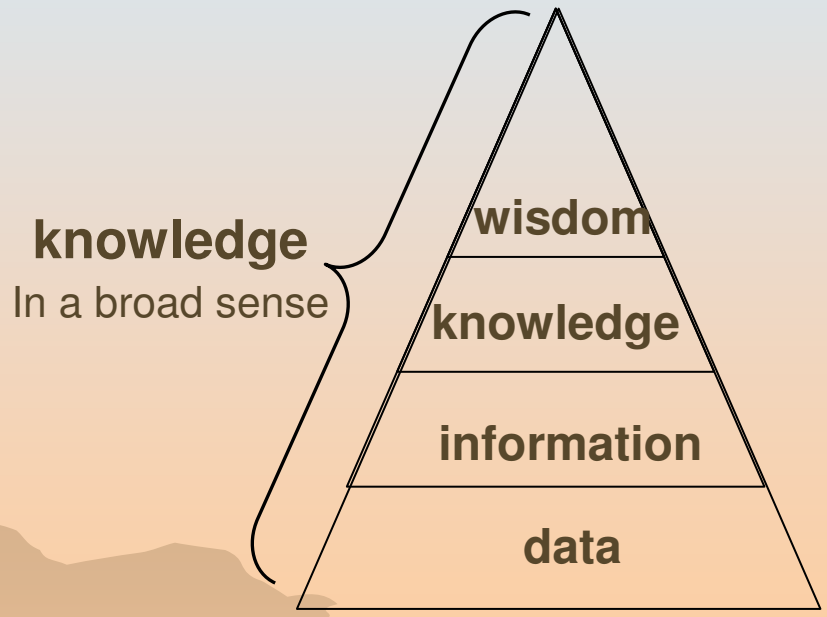
(2-2) Narrow down a target

(2-3) Aims of Knowledge Sharing System (KSS)

(2-4) Guideline of work

2-1 What is “knowledge” in JAXA

“Knowledge is a whole intellectual property of organization”
(in a broad sense)



・・・ exists in a person

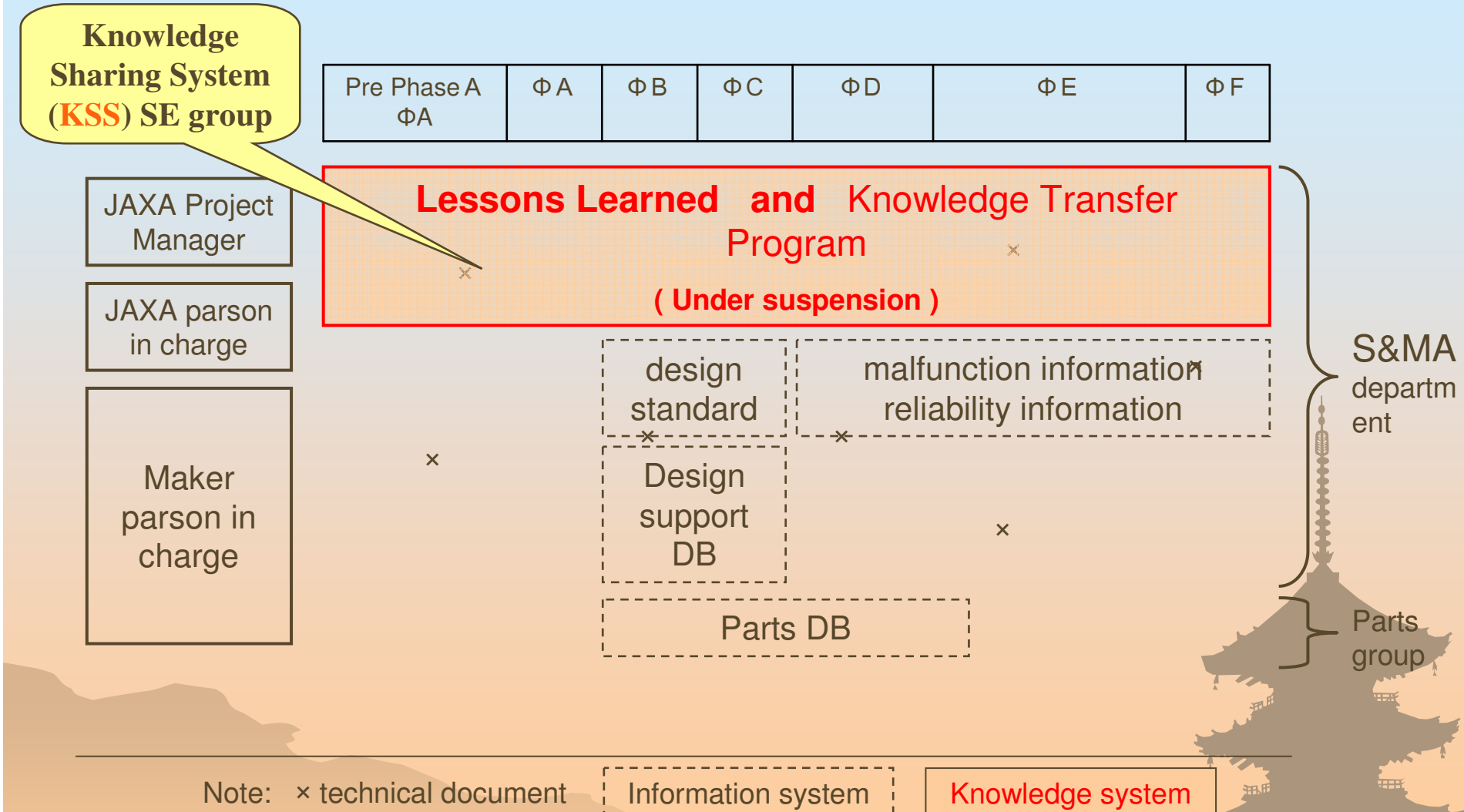
・・・ lessons learned,
Knowledge Transfer Program (KTP)

・・・ malfunction information,
reliability information, design standard .etc

・・・ telemetry data, operation log,
test data .etc

Knowledge pyramid and JAXA’s example

2-2 Narrow down a target to PM knowledge



Knowledge systems of JAXA (in broad sense)

2-3 Aim of Knowledge sharing system (KSS)

activation of heritage (document & experience)

effective accumulation and utilization of knowledge

2-4 Guideline of Activity

Direction of work

- improve quality of lessons learned
- make commonly-used structure

Policy of work

- attempt in confined area, if effective, progress to a bigger spacious environment
- IT is a tool, not a purpose

3. Result of considerations

(3-1) The13 project managers hearing

- what PM should be aware of
- what lessons learned and example
- idea of effective use of KSS

(3-2) consider structure of KSS and making prototype

(3-3) consider operation concept of KSS

lessons learned links to checklist (utilization)

Hearing to Project Manager (accumulation)

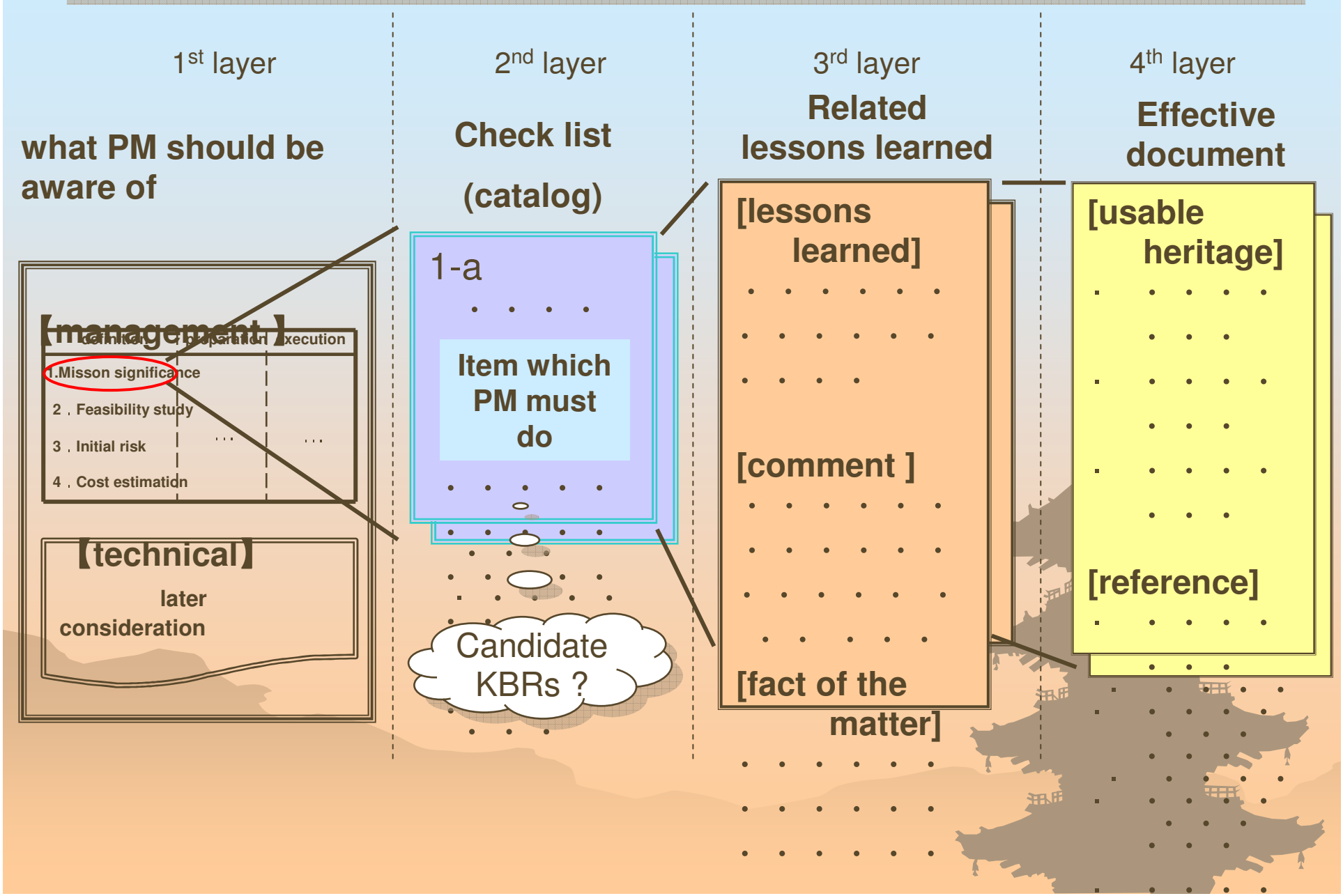
3-1 what PM should be aware of (1st layer)

Focus on here

what PM should be aware of

Definition stage (pre φA)	Preparation stage (φA, φB)	Execution stage (φC ~)
1. Visualization of mission significance and value ・ success criteria ・ requirement analysis 2 . Feasibility study • TRL • trade off 3 . Initial risk • initial FMEA • Sample of common risk 4 . Cost estimation • margin • budget	5 . Decision of development policy • Engineering Model • Reliability –Single point failure • teiloring of standard • Verification –End to End test 6 . Design • concept of operation • traceability 7 . Project plan • WBS • contingency 8 . Contract	9 . Project management • schedule / cost / person • maker cooperation 1 0 . Risk management • critical technology 1 1 . Design review • viewpoint of assessment 1 2 . Evaluation of verification data • viewpoint of data evaluation • viewpoint of validation 1 3 . Response to malfunction • impact analysis • formulation of structure

3-2 Structure of KSS



Example of checklist (2nd layer)

1. Visualization of mission significance and value	
1 - a.	Organize real end-users who are responsible for accountability
1 - b.	Make clear, simple and consistent requirement
1 - c.	Find a feasible system
1 - d.	Share usage image with users
1 - e.	Share operation image with operators
1 - f.	Fit together to higher requirement like program requirement
1 - g.	Attach the priority and reasons to requirement
1 - h.	Attach the verifiability to requirement
1 - i.	Set clear success criteria view point from not only data users but also citizen (refer to success criteria guideline)
1 - j.	Agree on the purpose of review between stakeholders

Example1 of LL and effective document (3rd & 4th layer)

2nd layer

Check list

1- d .
Share usage image with users

3rd layer

Related lessons learned

< lessons learned >
「Stimulate potential requirements of end users by bringing up a concrete data. 」

< comment >
Bringing up a concrete data will find out who use this data and what is the users requirements. It prevents argue in a circle. If you define who is users, your study will progress concretely.

< fact of the matter >
In case of Disaster Monitoring Satellite, ALOS data made argument with the ministry who never used satellite data much more concrete and effective.

4th layer

Effective document

< usable heritage > **「GCOM-W1 Concept of Operation」**

1. GCOM-W1 concept of operation summary

2. GCOM-W1 concept of operation
   - 2.1. launch preparation stage
     - 2.1.1. end to end test
     - 2.1.2. Y-0 rehearsal
     - 2.1.3. look over Satellite system
     - 2.1.4. Y-0 operation (before X-4hr)
   - 2.2. launch stage
     - 2.2.1. Y-0 countdown (after X-4hr to liftoff)
     - 2.2.2. liftoff to satellite separation
   - 2.3. initial stage
     - 2.3.1. critical operation
     - 2.3.2. initial checkout
       - 2.3.2.1. AMSR2 development
       - 2.3.2.2. disbandment of sensor launch lock
       - 2.3.2.3. AMSR2 initial run up
       - ・・・
   - 2.4. operation stage
     - 2.4.1. framing operation plan
     - 2.4.2. satellite tracking
     - 2.4.3. receive and storage mission date
       - 2.4.3.1. product handling
       - ・・・
   - 2.5. extra operation stage
     - ・・・
   - 2.6. contingency operation
     - ・・・

Example2 of LL and effective document (3rd & 4th layer)

2nd layer
Check list

1- i .
Set clear success criteria from a view point of not only data users but also citizen

3rd layer
Related lessons learned

< Lessons Learned >
『Don't seek only after merit and interest of stakeholder. Ask the need to citizen』

< comment >
In case of satellite development, think of not only satellite but also grand system, application system, researchers and citizen. For example in application satellite, thinking about how to be useful in society is important. This point of view is also important when you set success criteria.

< fact of the matter >
In case of GOSAT project, users had made remarks from the view point of there own interest. Not being affected too much by laud users and formulating a system of thought, in other word, proposing a creation of value judgment are important for project manager

4th layer
Effective document

< usable heritage > **【GOSAT Success Criteria】**

JAXAが担当
環境庁が担当

Objective	Minimum Success	Full Success	Extra Success
目標① 温室効果ガスの全球濃度分布の測定 (1000kmメッシュ、3ヶ月平均相対精度1%)	雲・エアロゾルの影響のほとんどない条件において、SWIRで1000kmメッシュ、3ヶ月平均相対精度1%程度で、CO_2気柱量の陸域測定ができる。 【判断時期 :打上げ 1年半後】	雲・エアロゾルの影響のほとんどない条件において、 ①SWIRの1.6μm、2.0μm帯で、SNRが300以上で観測できる。 ②SWIRのサングリント観測またはTIRの10または15μm帯で、SNRが300以上で海域を観測できる。 ③そのデータからCO_2気柱量を、1000kmメッシュ、3ヶ月平均相対精度1%以下で算出できる。また、CH_4気柱量を、1000kmメッシュ、3ヶ月平均相対精度2%以下で算出できる。 【判断時期 :ミッション期間終了時】	下記の何れかの成果が得られる。 雲・エアロゾルの影響を補正し、SWIRでCO_2気柱量を、1000kmメッシュ、3ヶ月平均相対精度1%以下で測定できる。 TIRでCO_2気柱量を精度1%程度で算出できる。 TIRでCO_2濃度の高度分布を精度1%程度で算出できる。 TIRでCH_4、H_2O、気温、長波長放射、O_3等の物理量が測定できる。 【判断時期 :ミッション期間終了時】
目標② CO_2吸収排出量の亜大陸規模(約7000kmメッシュ)での推定誤差の半減	CO_2の吸収排出量の亜大陸規模での年当りの推定誤差を低減できる。 【判断時期 :打上げ 1年半後】	CO_2の吸収排出量の亜大陸規模での年当りの推定誤差を半減できる。 【判断時期 :ミッション期間終了時】	下記の何れかの成果が得られる。 • CO_2の吸収排出量の3000kmメッシュ規模での年当りの推定誤差を半減できる。 • CO_2の季節ごとの吸収排出量の亜大陸規模での推定誤差を半減できる。 • CO_2の吸収排出量の亜大陸規模での年当りの推定誤差を大幅に低減できる。 【判断時期 :ミッション期間終了時】
目標③ 温室効果ガス測定技術基盤の確立	GOSATの技術を拡張することにより、国単位での吸収排出量の測定が可能であることが示せる。 【判断時期 :開発終了時】	左記に加え、下記の要素技術の何れか一つを軌道上で実証できる。 •90km ~ 260kmメッシュ(中緯度域)での測定 •高SNR (500以上)での測定 •サングリント観測 •広波長測定 (SWIRとTIRの同一地点・同時測定) 【判断時期 :打上げ1年半後】	左記の要素技術を二つ以上、軌道上で実証できる。 【判断時期 :打上げ1年半後】

< reference > **【Success Criteria Guideline】**

- clear up scope of the system
- set success criteria from a view point of not only data users but also citizen wherever possible
- set success criteria from several view point if necessary.
- write down the timing of judgment clearly
- disclose the reasoning behind each criteria

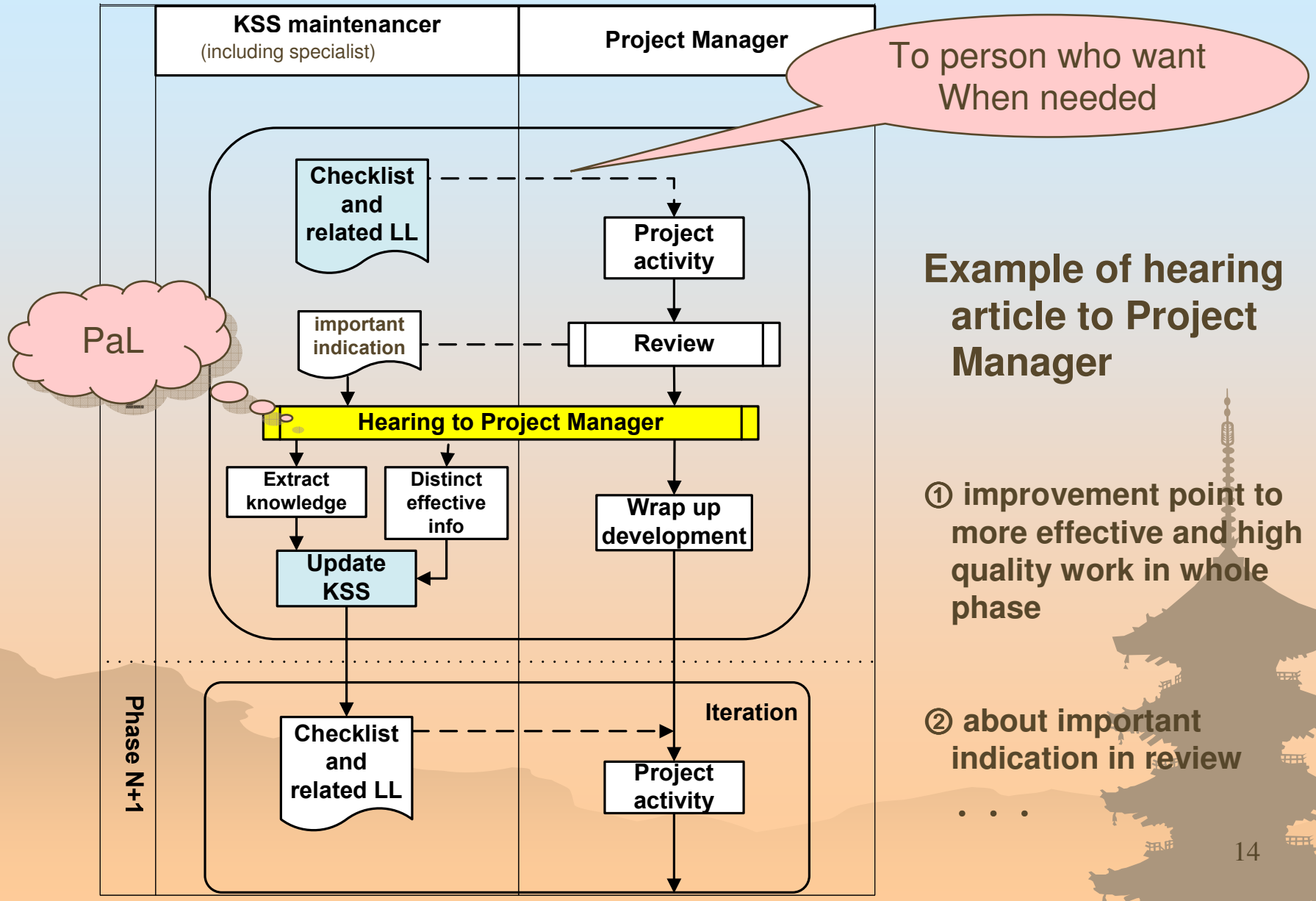
『rough indication of **full success** from view point of users』
finish the planned operation and satisfy user requirements on mission requirement document (perfect score)

『rough indication of **minimum success**』 (score 60)
satisfy minimum amount of requirement.

※ minimum success criteria depend strongly on project. Setting minimum success itself is creative activity.

『rough indication of **extra success**』 (score more than 100)
beyond full success and lamp of fruits in a way.

3-3 Image of KSS operation



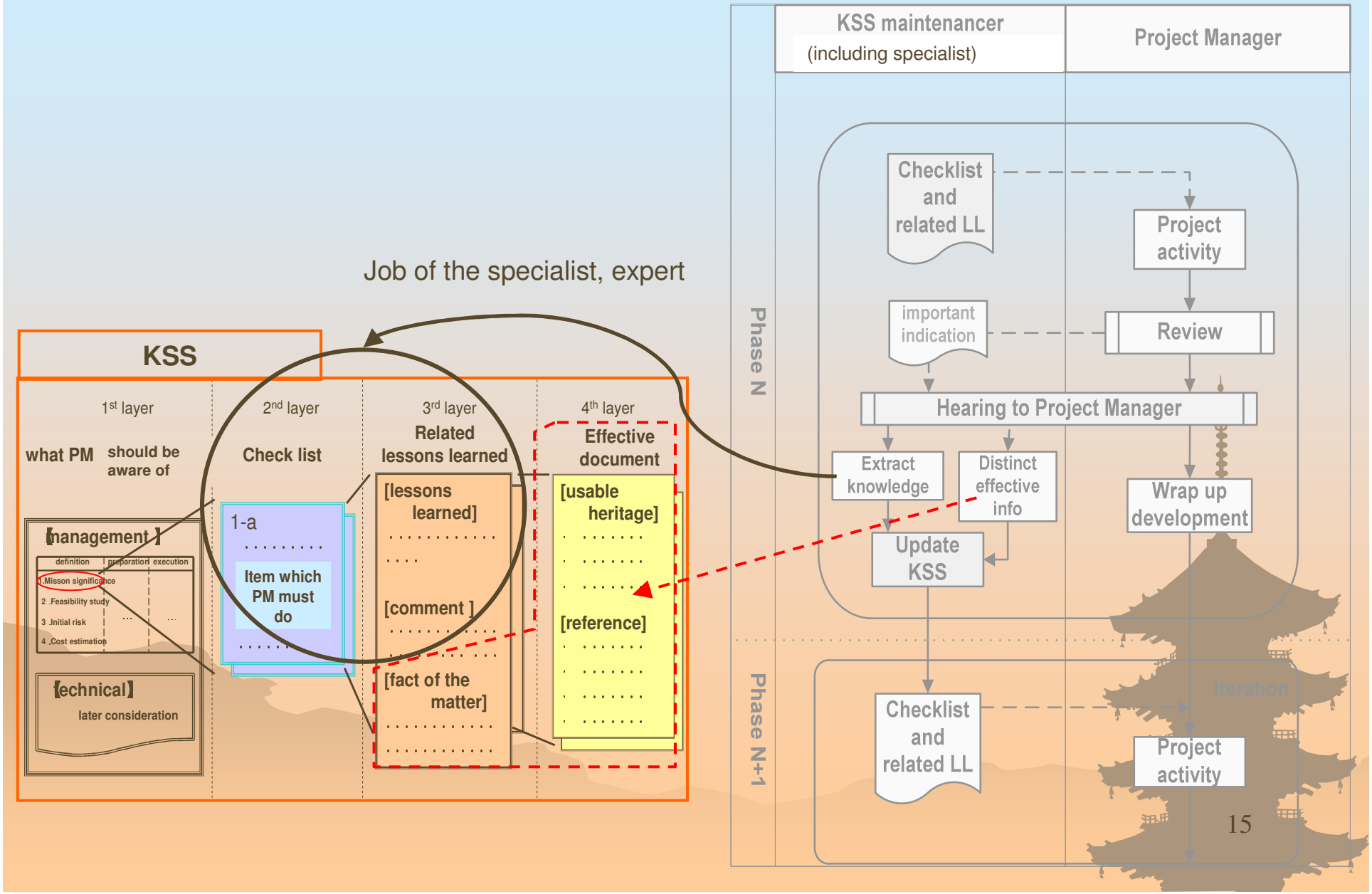
Example of hearing article to Project Manager

① improvement point to more effective and high quality work in whole phase

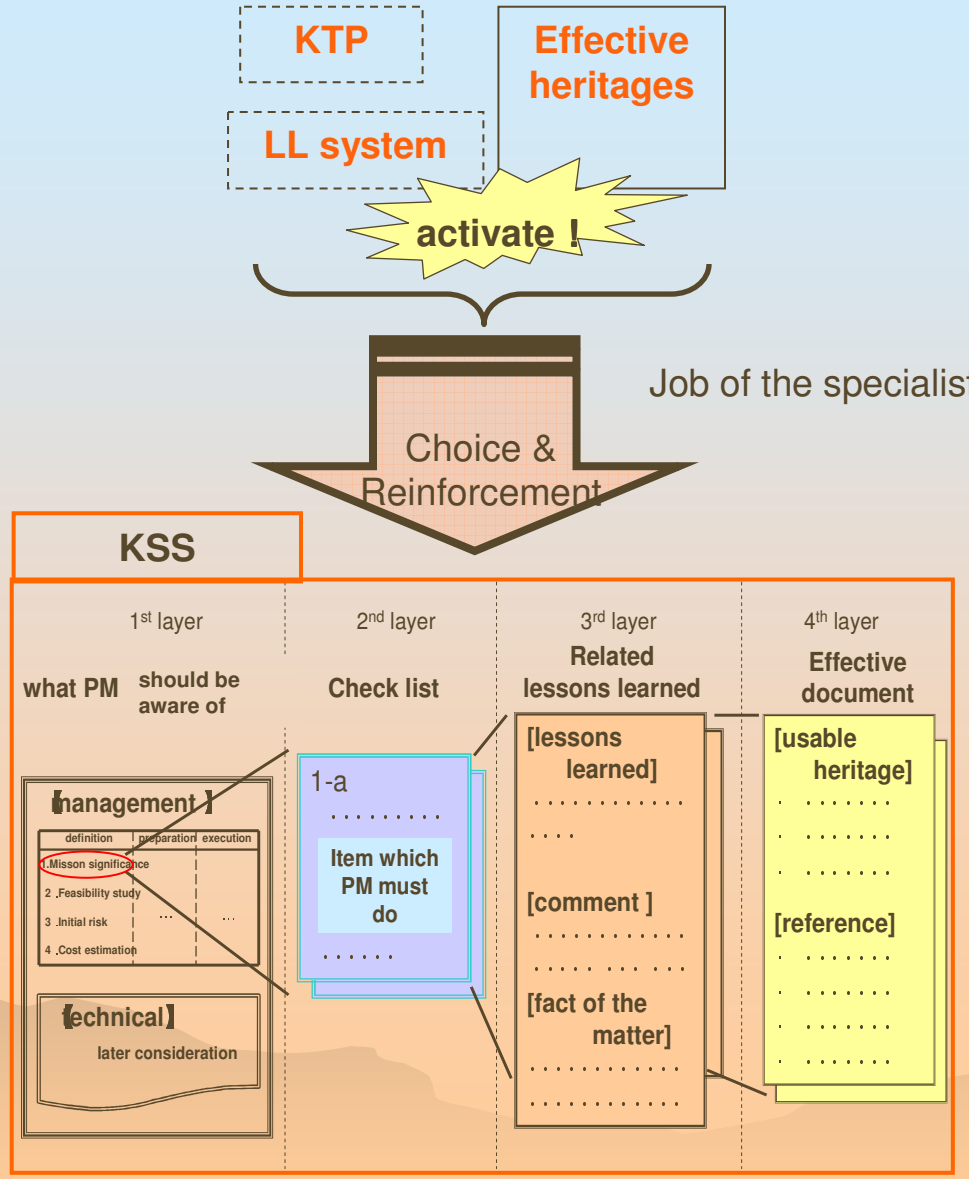
② about important indication in review

・・・

Storage location of extracted knowledge



Activate the effective heritage



4 Issue

- **Extraction of essential lessons learned:**

  Changing information to knowledge needs experienced worker's wisdom. We try to extract essential lessons learned which can be found in the checklist (in other words, catalog) in cooperation with specialist.

- **Devise of knowledge provider's merit :**

  We are using our brain to how knowledge providers feel useful. For example:

  putting a name to LL in order to build ties among people

  evaluating LL by users

schedule

4/B 3/E 7/E 12/E

1 . Confirmation of effectiveness

2 . Line up experts

3 . Improve lessons learned

4 . Concept study of IT system as needed

5 . Design of IT system as needed