

Requirements: “Head in the Clouds” or “Where the Rubber Meets the Road”?

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Abstract— You join a project in a leadership role on "day one". The concept is already approved. Some of the team members have been involved in the concept phase and are ahead of the game, work has started and you need to run fast and try to catch up. This is the reality of many industrial project developments.

When multiple components are developed using mixed technologies or different lead times it can be particularly difficult to get an overview of project opportunities and risks.

Such complex puzzles can evolve rapidly, the situation being further complicated because, in the early stages, many of the pieces simply do not fit together. There are knowledge gaps.

Innovative work is by nature not fully thought through and will evolve as the project progresses. Perhaps some of innovations need “enablers” in the foundations of the project. These are the very foundations that are developed early due to long lead times (i.e. custom silicon).

In order to understand your knowledge gaps you need an understanding of many scribbled designs and research prototypes before you can understand what needs to be done when. Actions can be better defined when you know of what you do not know. When you understand your knowledge gaps you can direct your architects and requirements engineers to fill these gaps and, by doing so, reduce project risk. In short, you need to be agile at system level.

An instrument is proposed which helps to develop and communicate a simple and clear view of the project. It gives strong pointers towards prioritization of work. It also provides simple and effective mechanisms for assessing project performance throughout the project lifecycle.

Keywords—idea maturity; innovation; coping with technical risk; evolutionary requirements; transparency;

I. INTRODUCTION

A. An illustration

You are the decision maker. You need to decide which of two projects, A or B to commit to. Where would you invest?

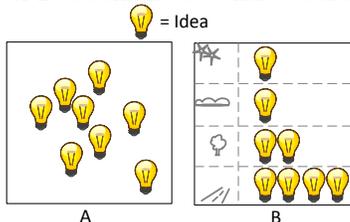


Figure 1. Two Project Views

Figure 1 points towards a significant gap in current practice as well as a compelling analysis and communications solution. Project A, it is not easy to assess from a risk perspective. Conversely Project B presents an accessible summary of the project, even without understanding the intention behind the various icons. In short, the second increases transparency allowing any reader to assess project risks, especially those associated with the uncertainty caused by incomplete knowledge.

B. Origin

This view of maturity evolved in the context of a high volume / low cost consumer electronics business. Bringing four primary brands to market, the firm employs 7000 people worldwide, about 200 of which are developers. Up to 100 new products are launched every year.

Products comprise custom silicon, hardware, embedded software, and pc applications. Once developed, the silicon remains as static as possible whereas embedded software and pc applications can be more fluid. The static components are reused by all brands; brand specific functionality is introduced in software and configuration.

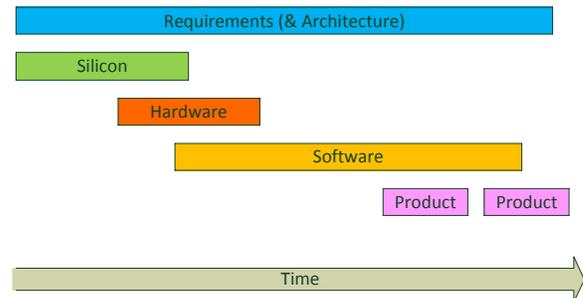


Figure 2. Time Line Illustration

Periodic re-engineering of the static components is a significant effort (up to five years from inception to first product launch). If research lead times are added the lifecycle becomes unrealistically long. A better approach is needed.

C. How did the business innovate in the past?

Conflicting timelines used to be managed by developers taking a view of current research early in development process. So called “innovation candidates” were identified and considered during the silicon design phase. Immature

ideas were informally introduced into the development process.

However, as the firm developed into a multi brand business this became more and more difficult, especially with geographically dispersed teams making informal processes much harder to sustain. Initial attempts to manage this were described in [1].

D. Formalising the process

Current development practice does not accommodate immature ideas. Also, in practice, as soon as an idea is mentioned, the DNA of a developer drives them to analyze, decompose and implement a solution.

A mechanism to formally record immature ideas without comprehensive explanations is clearly needed. If these can then be used to derive low level technical requirements at a very early stage, even better. This represents a step change in thinking about requirements. We are promoting a move away from requirements being “desirable and feasible”.

How the team works with these ideas needs to be tailored according to the maturity of the ideas. This also points towards a need to assess the maturity of ideas at various stages in the process.

E. Motivation: unclear maturity

The motivation for this work is to make maturity transparent to all parties and to use this maturity to support the requirements negotiation process. Specifically, stakeholders need to understand that there are multiple levels of maturity and that the negotiation and actions should be related to maturity level. The maturity should create:

- Goal 1. Transparency of technological risk involved and thus the technological work still needed (research, development, integration, validation);
- Goal 2. Transparency of commercial risk and thus the work needed (market research, field studies, service and product development, etc.);
- Goal 3. Transparency of the readiness of the organization to accept ideas into products and thus the work needed before build decisions can be reached (what to build, how and when to build it);
- Goal 4. A framework to establish the actual cost of maturing ideas and how they could be used by the business; and
- Goal 5. A common understanding by stakeholders from very diverse backgrounds.

F. Inspiration: Readiness

NASA, ESA and other agencies use nine levels of technical readiness starting with the observation of a basic principle until the system is proven through several space missions [4], [5]. These readiness levels are defined based on the breadth and depth of the technical implementation and validation. An approach like this seems to address technical risk and can be interpreted as how ready for a mission the equipment is. It addresses the technological risk involved

(Goal 1), but it seems not to satisfy the Goal 5 as the language used is far too technical, especially in our context.

The term unit readiness level in a US military context [7], indicates how much time it will take a unit (of personnel) to be ready to perform a task. Together with the readiness of the unit a clearly defined state of the equipment is implied. As such it is related to the organizational readiness and provides ideas on how to deal with Goal 3.

II. THE CONCEPT OF MATURITY

Our observations lead to a concept we call maturity of an innovation.

A. Maturity depends on risk and creates transparency

Maturity indicates the risk of an innovation item. The following three categories of risk are identified:

- Technological risk: The uncertainty whether a solution is possible or at least to what degree it is possible. The technological risk is related to the technical readiness level.
- Commercial risk: The uncertainty whether a solution can be delivered to customers and will it then generate enough revenue to favor it over another solution.
- Decision risk: The uncertainty whether the organization is willing to build and sell a solution. This risk is related to the organizational readiness and depends mainly on what stakeholders have been involved.

The purpose of maturity is to change the way people think about items in the innovation process and make the consequences of a specific level of maturity or the cost of changing levels transparent to all parties involved.

B. A simple metaphor: from the stars to the road

Our proposed approach for maturity is to classify items in four levels from stars to road, as illustrated in figure 3.

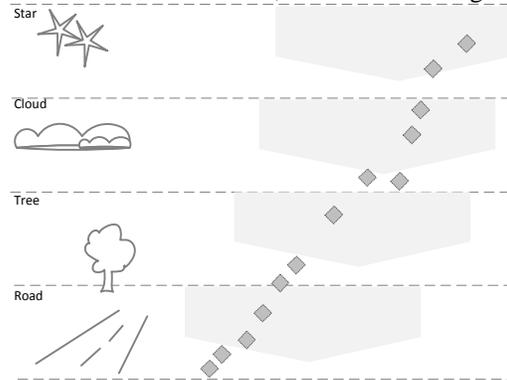


Figure 3. Stars to Road

For an idea to be at star level there must be agreement that the idea is worthy of further exploration without necessarily having clear goals. Ideas on this level typically have a narrow focus and explore the potential of a market, of a target’s group experience or of a technology without considering other aspects in great detail. Ideas presented may seem to be far-fetched. People involved have difficulty to tell

a convincing story about the idea; some part is always a bit awry. It may even be difficult to choose the right focus, as new and conflicting ideas pop-up. In general, only parts of the ideas discussed here will make it in a product, quite often in an unexpected way.

An idea on clouds level has much more substance and a plausible story of customer benefit created can be told. There is some evidence available for example a laboratory prototype or market research. The risk involved is still substantial: what to do and how to do it is neither completely clear nor fully agreed. Some important stakeholder may still be unaware of the idea, some may even oppose it. The technology may not be ready yet, it may be unclear how to integrate with a key system, the product to launch may be undecided and more.

For an idea on tree level, the product and the application is agreed upon by the stakeholders. The benefit and costs of the solution can be estimated to a degree, that the organization is ready to assign budget for development. The vision is clear and agreed. The organization is confident it can realize the idea. The people involved are mostly focused on detailing and implementing the solution.

An idea on road level is already developed. It exists in a product and ready to ship. The team can pick road level items up and hold them. Road items are reuse candidates. In the ideal world, the requirements for these items already exist and can simply be reused without change.

III. OUR INITIAL EXPERIENCES

We gathered initial experience based on the intuitive understanding of the people involved about the maturity levels. We primarily focused on content rather than method.

We started by making the maturity of ideas transparent in workshops and discussions. In our first discussions we informally explored the rating of ideas whilst stakeholders discussed their projects. The reaction and arguments to this rating then resulted in interesting discussions, e.g. when the idea owners tried to argue an idea from star into tree level and finally realized it really was at star level. How several people thought and argued about maturity and what they concluded from the maturity was important input into a more formalized concept. We later started to differentiate aspects of an idea, e.g. technological side, the market and business side, the end user's side and realized that the projects team quite often stress some aspects and more or less ignore other aspects, putting an idea at high risks.

We also started to rate several related ideas, e.g. for a research program or a development project. For this we used post-it notes to place ideas on the wall at the appropriate maturity (vertically). In the discussion with the participants the horizontal dimension was immediately assigned to time and discussion started about appropriate planning, once the maturity of each item was agreed upon. Work do be done, decisions to take, as well as dependencies between items changed how the participants in such workshops talked about items and their project's plan.

Besides the many arguments about why something could be on what maturity level, we learned a few important lessons:

A. Participants redefined the levels

In the discussions the participants redefined the maturity levels. In the context of our initial experience this did not matter. We even assume that this was good and necessary for the participant to perform such a step in order to understand and adopt the proposed concept. This is an indication of ownership.

Participants also introduced new levels of maturity. Especially the low hanging fruits were discussed from a technology point of view. In a context where products are based on common foundation, low hanging fruit is something that can be easily provided for. In contrast an item on tree level needs some major work in the foundations.

B. At least three aspects: technical, business and decision maturity

The discussion quickly showed that participants distinguished between technical maturity (can we do it) and business maturity (do we understand how to sell and deliver it). Maturity thus consists of two ratings: desired by the market (value proposition) and technological feasibility.

We later also observed, especially inspired by the definitions of readiness, that the viability of a decision, i.e. to what degree the different stakeholder support the idea, is a third important factor.

C. Maturity is not linear

We followed items and features for some time with the maturity rating and observed that maturity is not linear. Figure 4 shows an exemplary development of an item's maturity.

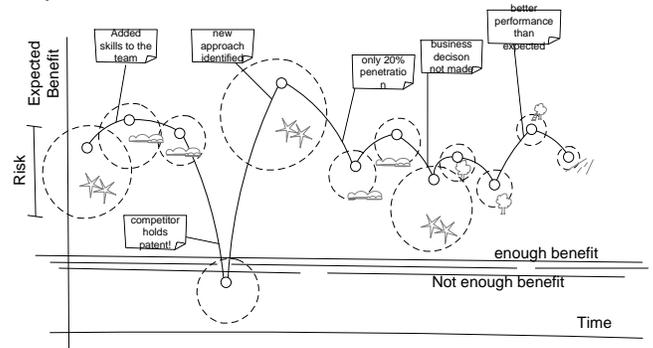


Figure 4. Maturity of an idea evolves over time

The curve shows the estimated benefit of an item. Each point on the line represents a new benefit estimation point. The larger circles around each estimation point represent the estimated risk. The maturity is indicated with the icons within the larger circles. The annotations contain the rationale for the change of estimation.

We realized that ideas can change quite drastically as they mature from stars to road. While working on an idea, the team learns about both the problem and solutions. This newly acquired knowledge helps the idea evolve.

We then realized that project teams cannot identify all risks involved from the start. For example an IP search may identify foreign patents or a business stakeholder may not be

able to make a key business decision or perhaps the market changes. Such events may cause step changes in the assessed maturity.

IV. FINDINGS

A. Maturity facilitates conversation

The concept of maturity helps the conversation in several ways. The team can draw up maps (time vs. maturity) of items to give an overview of upcoming innovations. Such maps can steer the business in a similar way to a backlog or a roadmap.

The metaphor from stars to road together with this visualization enables us to draw from the intuitive understanding of our stakeholders and supports communication with both technical and non-technical staff.

When defining products, the maturity of the features provides transparency over the risks. For example, a product concept with a short time-to-market goal needs to contain mostly items with maturity on road and tree level. Different types of projects have different maturity profiles. For example, too many road items indicates high reuse. It can also be seen as a sign that the product lacks spice (it has been done before). A very innovative product will have more items on clouds or even star level, however, this brings risk, especially if timelines are short.

B. Three aspects: business, technology, and decision

When looking at the maturity of an innovation consider the perspectives outlined in goals 1 to 3: Business, technical and decision maturity.

We often see situations like A and B in figure 5:

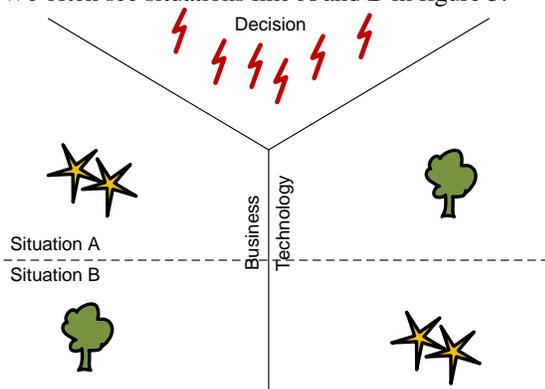


Figure 5. Business, technical and decision maturity triage.

In situation A the team knows how to build something and could write precise technical requirements, however the business does not really know how to make use of it. A typical situation is when developers push new technologies into a product. Common statements from the business side are: “this is not what we need”, “Sounds nice, just do it and we will decide if we want it when we see it” In practice the business simply will not use it. From the technological side of the company, statements like “they do not see the value of what we do” or “they lack the vision to use it” are typical.

In situation B business has a precise understanding of what it wants to achieve and could write precise business requirements, but the technology teams have no idea how to build it. The business side can be heard to complain about developers, saying they should operate as a service provider rather than blocking things they do not like. The technology side just complains that business is again far from reality or perhaps arguing that doing something like this is simply insane and should rather focus on the low hanging fruits instead of wild ideas and dreams.

Both examples show people simply doing their best, however a lack of understanding of current maturities makes reaching a decision difficult. Perhaps one side leads the discussion on tree level, the other on star level.

As a general rule of thumb, it is best to deal with an item on the highest level, i.e. on star level in the above situations.

C. Maturity facilitates requirements negotiation

If items are handled according to their maturity level the process changes and discussions get much easier.

For an item at star level, the team should have some early statements about purpose, goals and application area as well as an initial glossary entry (if the team is not able to write a glossary definition of an item the item does not really exist). Discussions on star level need to have an exploratory nature. They deal with exploring ideas and combination of ideas to identify a first promising goal and approach to take. There is no point debating technical details at this stage.

For an item on clouds level the team would have some first studies at hand that allow them to have more precise and verifiable goals, purpose and application area. In addition, the team should be able to roughly describe the desired behavior. Negotiation in this stage centers on estimating benefits and costs of different solutions and choosing an approach that best suits the company’s needs and abilities.

For an item at tree level, the team should have a clear idea (ideally proven) of how to realize it with the target technology and in what product context it will be used. In addition to updated and sharpened goals, the team should now be able to agree verifiable targets for development. In addition, the major technical constraints should be made visible. Product developers should be willing to accept this item into their planning. Negotiation on this level of maturity now centers on the details on how to best realize the agreed goals.

This correlates with “level of detail” in the twin peaks model [8].

V. APPLICATION

As a concept alone, the maturity is helpful as it makes stakeholders aware of which topics to discuss and to some extent how to discuss them. We have used and applied instruments based on the concepts described above. The three tools discussed in this paper help facilitate collaboration and have been shown to work very well in workshop settings.

A. Maturity rating

This is a simple methodology to rate the maturity of an innovation item, as shown in figure 6:

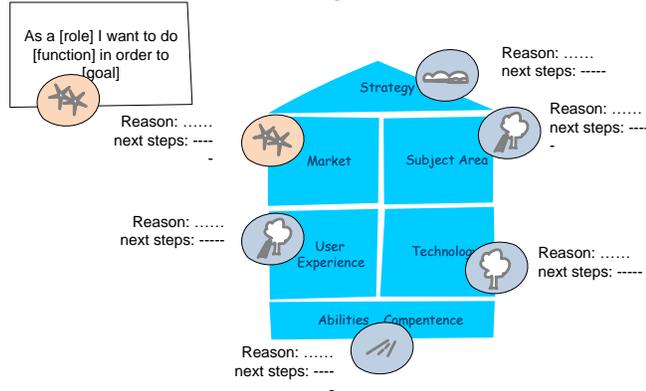


Figure 6. Maturity aspects

A group of people assess an idea considering the six maturity aspects shown in figure 6. They are based on the four knowledge areas: market, subject area, experience and technology discussed in [2]. People from the business are invited who are able to rate the project strategy (is the idea mature from a business vision perspective?), market (do we know how we can make money from it?), user experience (how mature is our understanding of it in the context of our target audience?), and abilities (are we able to develop, produce, sell it?). From the technical side people able to rate the technology are included (do we know how to build it?) and subject area (do we understand it from a domain point of view?).

First discuss and rate an item by aspect. For each aspect, the group records the rationale why the item is at a particular maturity and the steps that need to be done to bring an item down to the next level. As a second step, the group agrees on the overall maturity, the rule of thumb is to assign the highest maturity level (stars in the illustration above). As the third step, the group decides on how to continue with this item.

A number of positive effects were observed. Both technical and business people became aware of serious gaps and started to address them strategically. Bringing people with the different skills to the table also created a common understanding of the idea and helped to choose the right level of granularity when talking about an item at a given time.

There is no need to force structure in how ideas should progress through the levels. It may be useful to deep dive in some of the aspects (e.g. technology) and leave other on higher level.

B. High-level negotiation

A development project in general does not only deal with one item, but usually a system of related innovation items or features. Based on the maturity rating of an individual item and the interdependency, a team can negotiate different options on how to proceed. Figure 7 shows an example situation with a system of ten features on a combined view of maturity ratings with project phases.

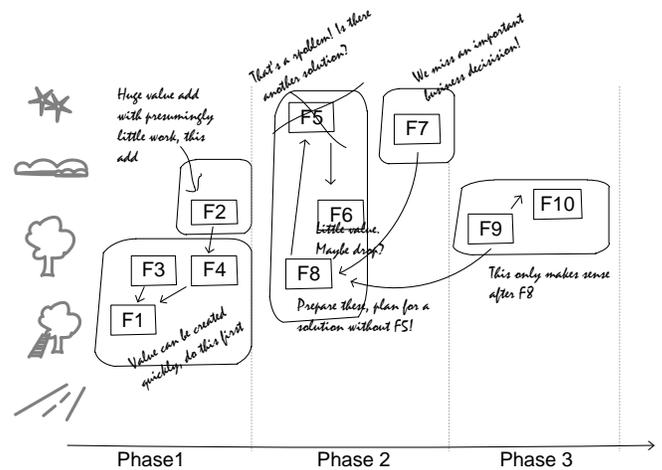


Figure 7. Maturity rating time line

The arrows show dependencies between features. Features that form a compelling package for a product release are clustered. They may be tagged with the market story they enable. Rationale and decisions are made visible with annotations. This simple diagram presents an evolving market story, the enabling features as well as flagging the hot spots on the high level schedule (if a critical component of a story slated for release next month is still in the stars, there is a problem).

The participants, decision makers and experts from the different areas of expertise use such a planning board to negotiate options for the upcoming releases in a very agile way without the need to interpret hundreds of microscopic items on a Gantt chart.

As a precondition to this negotiation phase the features have an agreed maturity rating. Assessing maturity during the negotiation phase would not make sense as there would be a tendency to “negotiate maturity” as part of the process.

The participants thus understand the features and know the rationale behind the rating and the steps needed. The participants now discuss dependencies, options and when to deliver what feature and market story and build up the board (a white board with sticky notes is helpful here). The negotiation that now starts is driven by business’ needs and the development resource constraints. The maturity ratings influence this negotiation. In the illustration above, the features F5 and F7 are still in the stars and need special considerations. F5 appears to be too risky; the participants agree that it would be best to have a backup plan. F7 seems to be lagging behind with the decision risk. A good outcome could be to push for a decision to unlock F7 and kill F5. We observed other effects. Some features were exchanged for others in order to manage risk, even though some value was lost in the process.

The board combines the features, dependencies, phases, marketing stories and maturity which allowed for an integrated negotiation that included all these aspects. This had, according to our observations, the effect that it encouraged participants to think strategically about eliminating high risk items and focused how to bring a

specific item down to road during the meeting. This happened much more so than with a risk list commonly used in isolation from the core project team. We also observed that participants were actively looking for other, less risky, solutions that still allow them to tell a compelling market story.

C. Progress assessment

Simple periodic analysis of maturity levels gives interesting information on project performance. If an idea is rated in the clouds for a protracted period of time without reason it is likely there could be something wrong and detailed analysis of the root causes is called for. This is a good trigger for renegotiation as project risk is not being reduced.

VI. CONCLUSIONS AND FUTURE WORK

We have identified a major barrier to effectively managing innovation: a lack of transparency of the maturity of an item. This omission is a major contributor to many communication and project management issues we observe and an indicator that requirements / architectural negotiation should be improved.

The approach we have chosen to work on uses a visual and easy to grasp metaphor. This was effective in creating transparency of the maturity of items for all stakeholders involved.

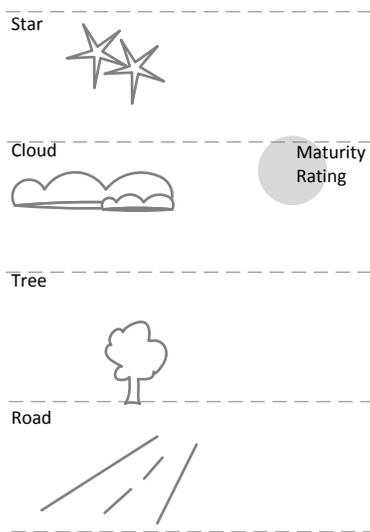


Figure 8. Stars to road

Explicit thinking about maturity of ideas is a new concept to us. Thinking of how this will be used continues to evolve. To date, nobody has questioned whether it should be used,

instead the teams are discussing how to use it and are applying the technique in many ways. Despite our early wins, this remains a work in progress and the subject of an ongoing change agency [3] effort.

Our finger in the air assessment of the maturity of this work against our own levels is that our approach must be somewhere in the clouds. We will need multiple project iterations and by definition quite some time before we could claim this technique to be “on the road”. Through this process we welcome input from external sources.

A selection of our open questions are:

- Are there other approaches that help us deal with the inefficiencies caused by the unclear maturity of items?
- What are the right maturity levels? Do we need more / fewer levels?
- How should we assess maturity? How do we assess the maturity of ideas that combine blue sky thinking with already delivered functionality?
- How should we combine technical risk, commercial risk, and readiness?
- Does it make sense to align processes with maturity level? For example, can we use maturity levels as planning milestones in long term plans?

Finally, can you contribute to this effort? The problem we are trying to address is, by its very nature, related to long product lifecycles which makes it difficult for us to test these ideas. We are currently prototyping these maturity assessments in a number of projects. It would be very interesting for us to learn from other projects working in this space. If you would like to contribute you can download our tool kit from [6].

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