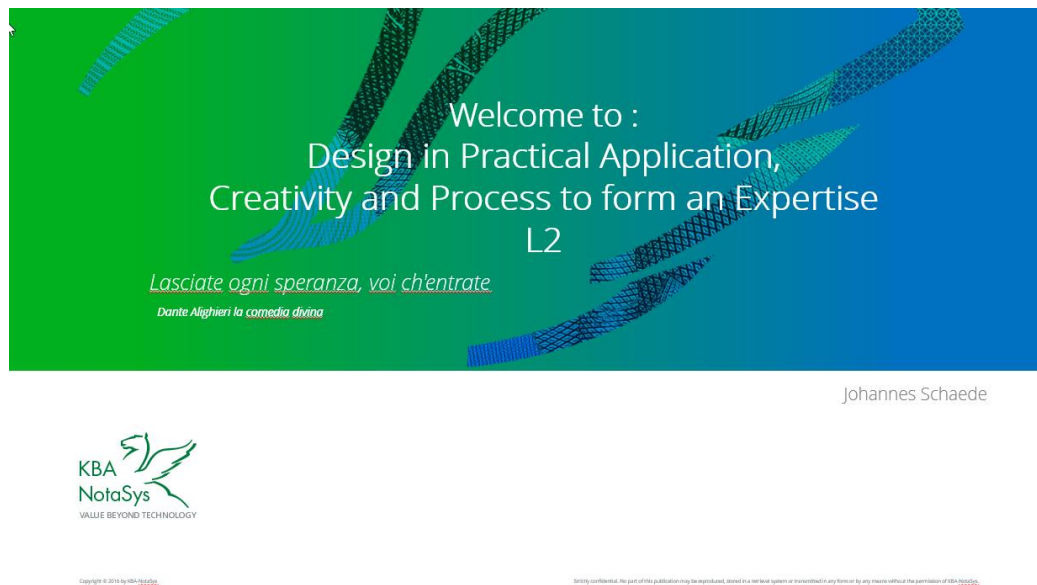


Design in Practical Application,
Creativity and Process to form an Expertise
April 2020 Johannes Schaede



Hello Again!

Still we are in lock-down and regretfully you have to dig today through some more dry than exciting matter. Hoping that you are all well, I trust you can follow without being stressed.

L2 Structures inside

1. Departments and their roles
2. Product Creation Process
3. Challenges of implementation



Today's lecture shall give you an insight of what departments and contributions you will find in a company building large machines or industry sites. I believe that the challenges for cooperation in any company are roughly the same. It all comes down to the question how you perceive our colleagues and whether you are able to work with a wide variety of personalities. Always remember, nobody is perfect, criticism and dispute is positive as long as it refers to the objectives in a constructive way and do not expect to always play with the nation's top scorers in every field (if you wish for this, be careful what you wish, it could be granted)

Lamentable engineering

The solutions are not for our market !



New developments take far too long !

Engineers have no clue about costs !

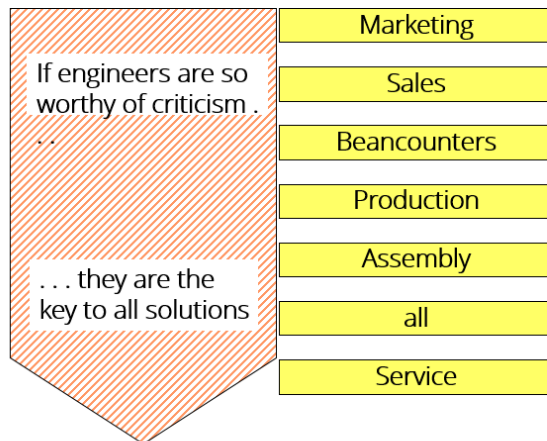
This cannot be produced, efficient !

Is it really possible to assemble this ?

What about a comprehensible documentation

Nobody can order the right spares !

tbc ...



© sj 2006/2007/2008/2010
Update V1_2e may 2016

Remarks from the wooden siege

1. Departments and their roles

On how you will be probably seen by your future colleagues is summarized here. It is a reflection of the echoes I keep receiving on my performance for the last 40 years, no matter what part of our company, no matter whether in Franconia, Saxony, the US, Spain or France. Whatever you will do as an engineer, will not be perfect in the eyes of the others.

A short, reflection for you: If this is so lamentable, what does it mean for the selection of engineers to be successful? It is important to you, because sooner or later you will be asked to hire engineers.

Waterfall vs continuous improvement

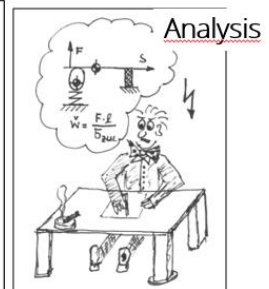
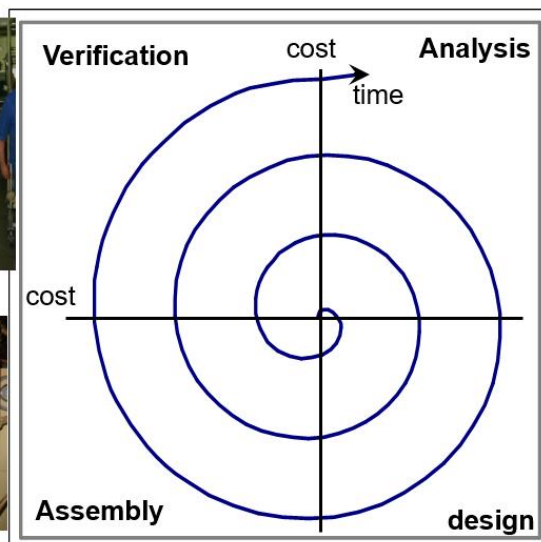
Verification



Assembly



© sj 2006/2007/2008/2010
Update V1_2e may 2018



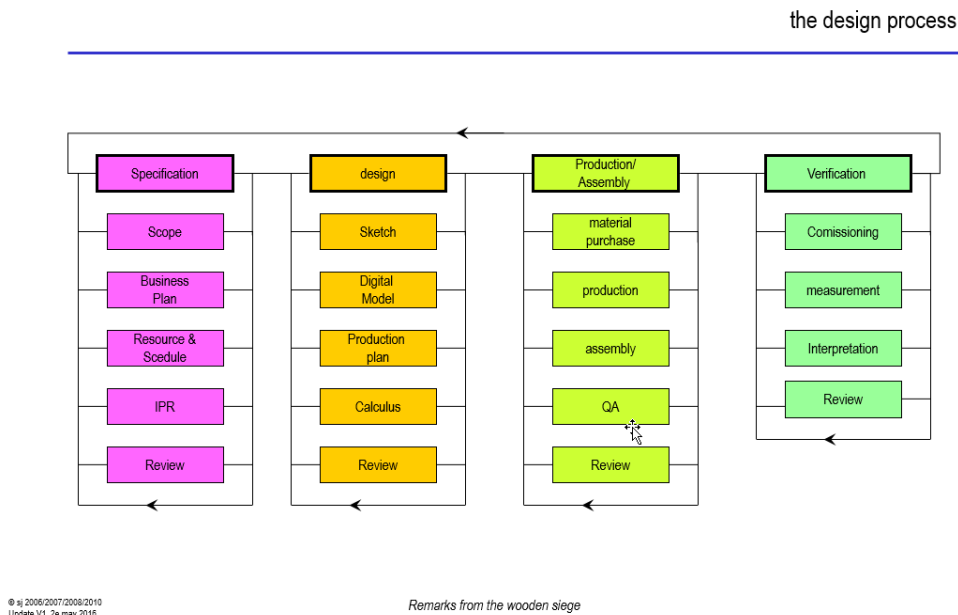
1. Departments and their roles

Before we move on to the different contributions of the departments, it has value to understand how successful complex developments are managed. In the centre of the slide you find a graph on the consumption of – financial - resources over the course of a R&D project. The axes expand into

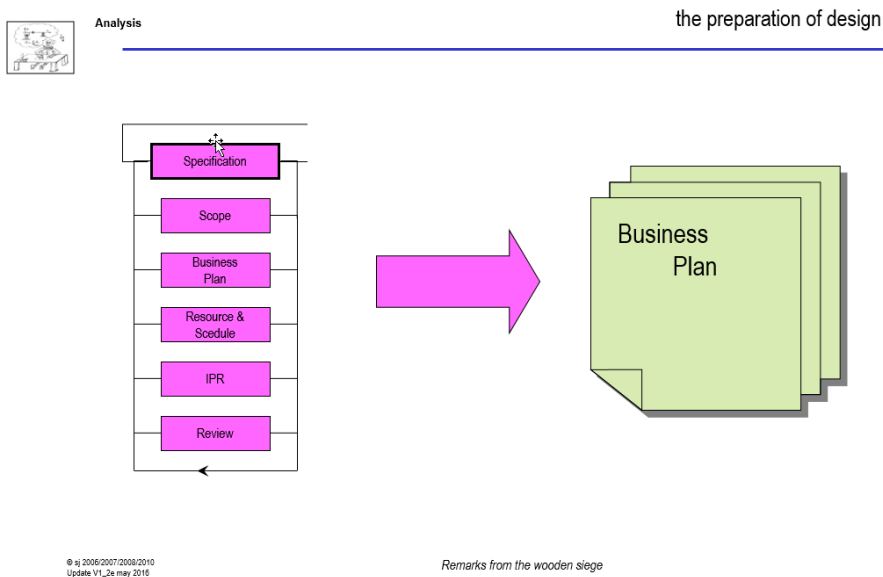
the accumulated cost space whilst the blue graph (this apparent snail) progresses along time. Any R&D has basically 4 phases as shown.

Questions :

1. why did I present 3 full circles instead of just one and called it continuous improvement?
2. What would be a waterfall R&D in contrast
3. Why can we reasonably assume that method 1 is better than method 2?



Here you see the overview of the entire product design and realisation process for a reasonably complex product. It should be read like a syntax diagram of e.g. PASCAL (yes I am an old fart from Zurich, admittedly) but the beauty is that any combination and extension of the individual steps and sub-steps can be constructed.



As a first step you have to write up a specification which may consist of all or more combined elements of the Diagram.



1. Project description on LCD level
2. Technical description of the development
3. Conflicts with existing and potential **new** IPRs
4. Required internal and external resources
5. Task & responsibility assignment to r&d and production
6. Resource plan and schedule
7. Risk analysis
8. Financial plan

© sj 2006/2007/2008/2010
Update V1_2e may 2016

Remarks from the wooden siege

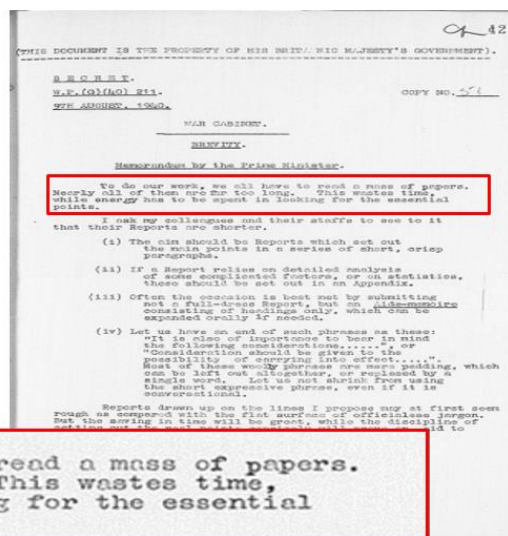
To compile a meaningful specification/business plan you will regularly all those elements mentioned here.



1 Project description on LCD level max. 1 page !!

Winston Churchill : ONE page Memo

S ynopsis
F acts
A lternatives
R ecommendation



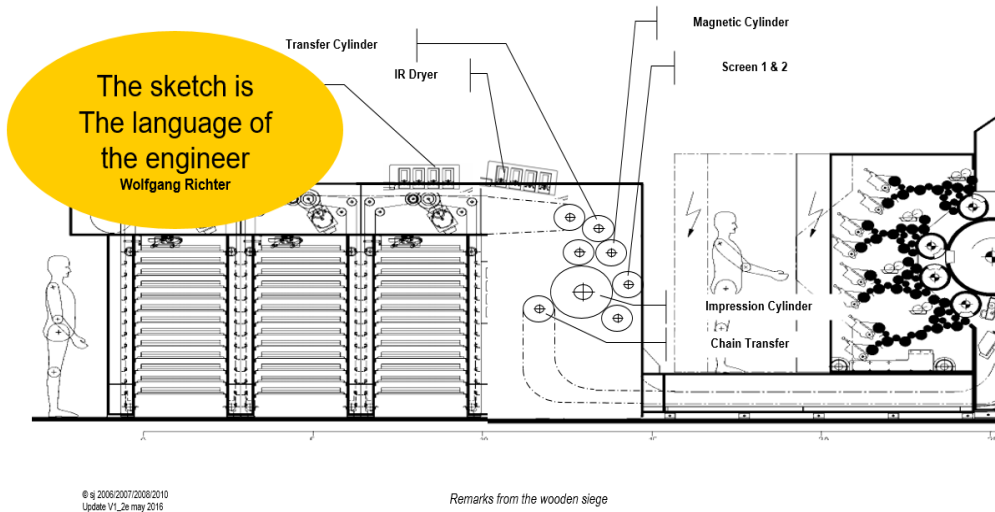
© sj 2006/2007/2008/2010
Update V1_2e may 2016

Remarks from the wooden siege

A project description on LCD (Laymen, Children, Directors) level is needed to communicate especially to the powers to be, what your project is about. When somewhere down the road you will be a director yourself you will have some understanding that anything longer than one page, will probably not read and understood completely, if even partially. Someone who perfectly understood this challenge was Winston Churchill. As war premier he had to take an unbelievable amount of fateful decisions every day. He introduced the instrument of the OPM (original communication enclosed.) The strictest form uses the four elements as above. If you attempt to write such Memo you will find that this takes much more thinking (not necessary time!). You may want to train this art as it will come in handy later. For example, write an OPM for your professor on your favourite Project to be accepted for your Master Thesis.



2 Technical description of the development



In most cases a sketch is the best short form of a technical description. It has to be complete and meaningful to the knowledgeable manager (if you top management does not understand sketches in the domain of your company, you are doomed. Alternatives: look for another job or replace the person with yourself asap). The example shows a real machine as we created it on the fly at a conference with the customer and sold it. (some time ago)



3 Conflicts with existing and potential new IPRs

- Patent rsearch (competition, regions, categories)
- Novelty/strength of potential new IPRs
- Decide for formal application or trade secret
- Timely application (get the priority)
- Conscious publications ONLY

The topic of iPs may apply even if you ignore it. There is a defensive aspect, that you should not step into the trap of previously existing formal iPs. The offensive part is, that you may be able to protect interesting USPs against untimely copy by competition. In some cases, customers want from your company a liability and a FTO (Freedom To Operate) declaration. In case of the latter nothing is better than a granted active Patent. DO NOT use any of your novelties in public before the decision on filing has been made. Be careful with suppliers and 3rd parties as they may be tempted to file your invention against you. In such case and if you do not want to file yourself a conscious filing is a good idea to maintain your FTO by having published prior art.



4 Required internal and external resources

- what can I do with resources “on bord” ?
 - Minimal : IPRs
 - Maximal : value chain
- what can / has-to-be done by partners
- how to integrate all partners

© sj 2006/2007/2008/2010
Update V1_2e may 2016

Remarks from the wooden siege

For your specification / Business Plan you need to demonstrate the economy of your venture. You have to define all internal and external resources you will need. If you work with external partners, you need to maintain as a minimum control over the iPs. In the best case you control the value chain.



5 Task & responsibility assignement to r&d and production

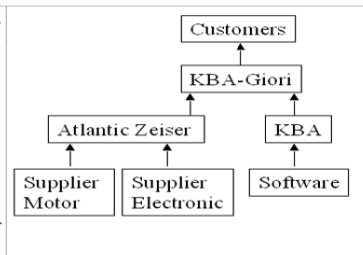


5.2. Production model

For the production phase, we plan to propose a tender to Leibinger and to Atlantic Zeiser for the manufacturing of our new numbering box. This strategy will give a stronger position for negotiation.

KBA-Giori will continue to sell the products directly to the customers and maintain exclusivity with the suppliers of the critical components, such as the motors and the electronic.

If the development of the electronic with KBA-Bielefeld starts, they would be the official supplier of all the electronic, control unit and of the software.



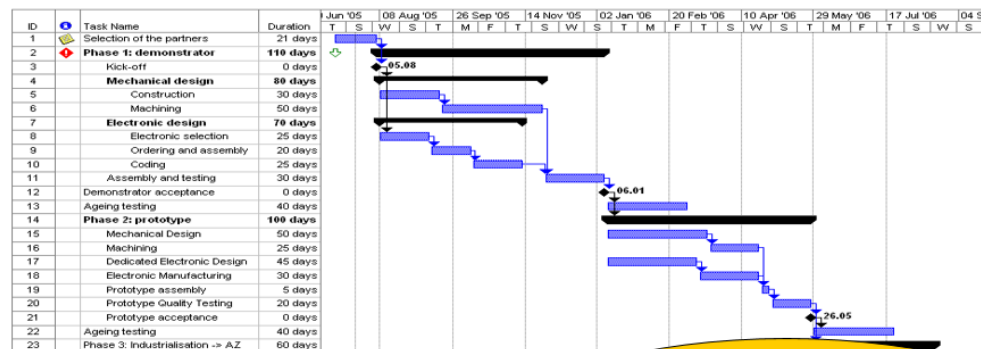
© sj 2006/2007/2008/2010
Update V1_2e may 2016

Remarks from the wooden siege

In this early stage you are well advised to structure external cooperation concerning R&D and production. This example shows a simple case we have implemented at one point in time. These structures may become more complex as the number of contributing companies increase. Just bear in mind, that the quality of a commissioning is proportional to the inverse of the square of the number of contributors.



6 Resource plan and schedule



Warning :
Der Mensch denkt
Gott lenkt !

© sj 2006/2007/2008/2010
Update V1_2e may 2016

Remarks from the wooden siege

Wie heisst die Vergangenheitsform ?

Your management will want to know, when you will be ready with your product. A Gant chart can represent such planning in an easy way. In reality, as with all planning you will have to find the fine edge between overly optimistic estimation (you may be asked to perform according to promise) and too careful safety margins (you will not be allowed to do the development as it eats to many resources) In case of doubt use the estimation method of the Swiss artillery, we have to be careful in our exercises not to shoot outside their small country.



8 Risk analysis

- CYA
- What can go wrong :
 - Laws of physics in application
 - Production
 - Market
- Murphy's Law
- Baden Powell
- What is the most useless possession in the world ?

© sj 2006/2007/2008/2010
Update V1_2e may 2016

Remarks from the wooden siege

A solid risk analysis helps to find weaknesses and to defend your project:

CYA – American Slang: Cover Your Ass

Murphy's law: what can go wrong, will go wrong

Baden Powell: Be Prepared! (who was this guy, by the way?)

The most useless possession in world is: (have your pick in this context!)



9 Financial plan



8.3. Financial summary

8.3.1. Profit & Loss statement (CHF 000)

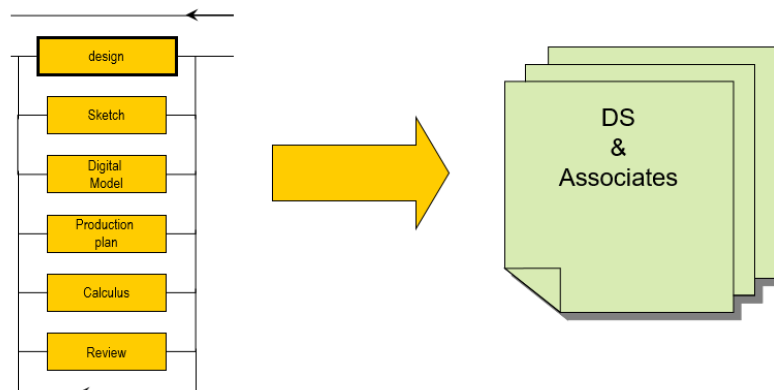
	2005	2006	2007	2008	2009	2010	2011	2012
Sales								
NumBox	0	0	480	1'920	3'360	3'840	4'800	2'400
Spare parts	0	0	12	60	144	240	360	420
Training service	0	0	24	96	168	192	240	120
Total Sales	0	0	516	2'076	3'672	4'272	5'400	2'940
Cost of good sold	0	0	246	990	1'752	2'040	2'580	1'410
Gross Margin	0	0	270	1'086	1'920	2'232	2'820	1'530
Operating expenses								
Product overhead costs	0	0	96	384	672	768	960	480
Training costs	0	0	12	48	84	96	120	60
R&D internal	100	200	0	0	0	0	0	0
Development costs external	120	330	50	50	50	0	0	0
Total operating expenses	220	530	158	482	806	864	1'080	540
EBIT	(220)	(530)	112	604	1'114	1'368	1'740	990
Net Income (15% taxes)	(220)	(530)	112	513	947	1'163	1'479	842

© sj 2006/2007/2008/2010
Update V1_2e may 2016

Remarks from the wooden siege

Finally, you should set up a financial plan for your project. It is always re-assuring if you plan to make money with your efforts. The period of ROI (Return On Investment) may vary from business to business, but be realistic and it is always good to be better than promised (use reserves in your favour)

All this may appear to you a little bit lengthy and not very technical. But your ability to apply your creativity extends to the formal documentation on what you want to achieve, more so than you may believe.



© sj 2006/2007/2008/2010
Update V1_2e may 2016

Remarks from the wooden siege

Finally we are getting serious to design something and start again . . .



1. Design Specification DS

Agg	item	explanation	BGR	BGRname	date	rev
DW	Numerierwerkskurven	Die Numerierwerkskurven können mit der Numerierwerkskurve entnommen werden.	202	Numerierwerkskurven	2003-03-11	4/1
DW	Entnahme	Alte auf Quick release device in Farbwerk.	204	Numerierwerkskurve	2003-03-11	6/1
DW	Numerierwerkskurven	Die Numerierwerkskurven können mit der Numerierwerkskurven entnommen werden. Alte auf Quick release device in Farbwerk. Die Anschlüsse von BNC etc. sind für die schnelle Entnahme (ohne Stecker) auszuführen.	207	Register Verstellung	2003-03-11	11/2
DW	Numerierwerkskurve	Seiten und Umfangsregister der gesamten Seite +/- 1.0 in Lauf verstellbar. Achtung mit Numerierwerkskurven überprüfen.	253	Reinigungs-einrichtung	2003-03-11	11/2
DW	Reinigungs-einrichtung	Die Reinigungs-einrichtung ist zu verbessern. Die manuelle Reinigung ist als Vorbild zu nehmen. Eventuell dünner Film der Reinigungsflüssigkeit aus PVV bestehen. Die Bewegung ist einstellbar.	276	Vormontage-einrichtung	2003-04-11	6/1
DW	Numerierwerke Justieren	Die Numerierwerke werden auf ihre endgültige Position im Druckwerk positioniert. Minimal in Seite und Umfang 3.0 mm. Vorseitensicht durch Tool in Ausserbereich der Seite.				

assembly
or
functions ?

© sj 2006/2007/2008/2010
Update V1_2e may 2016

Remarks from the wooden siege

. . . with a specification. Before you start designing, please give every engineer in your team the respect to explain and document what is expected, with which budget in resources and manufacturing costs and until when.



2. Open Points List OPL

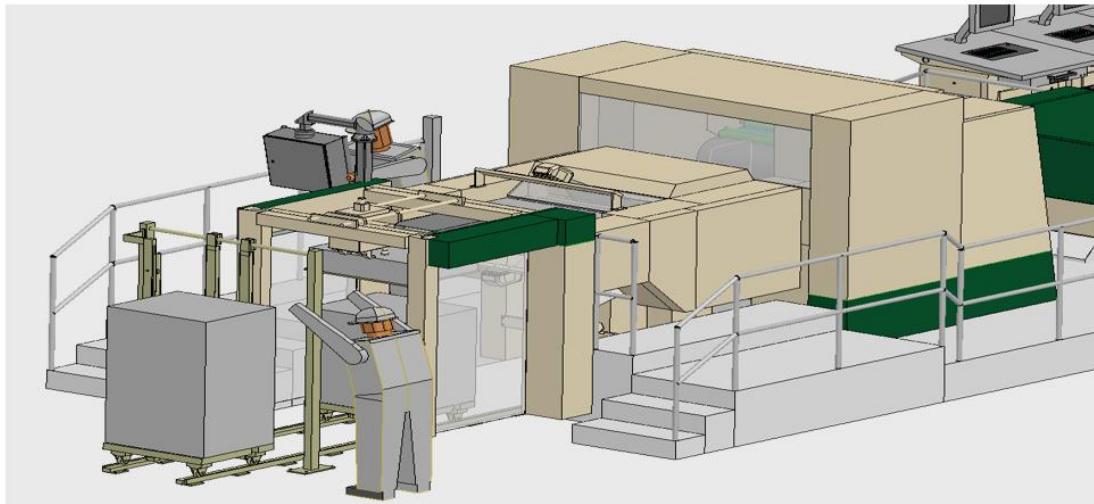
Nr.	Open Points	Solution	Parts	Responsible	63402401	finished	63402402	finished
1	Emission capture system	Modification as discussed with Volkmar and Michael	new	Ch. Krappert / K. Pappenscheller	6/06/2005		7/5/2005	
2	new Plexiglas doors for the linking unit	new Design / Modification	new	Ch. Krappert / K. Pappenscheller	6/06/2005		7/5/2005	
3	Modification of his lever (combine with the Emission capture)	new Design / Modification	new	Ch. Krappert / K. Pappenscheller	6/06/2005		6/25/2005	
4	Duct handles must be improved - safety	new Design / Modification	new	Ch. Krappert / K. Pappenscheller	6/06/2005		7/5/2005	
5	Hydraulic blade spray - change to old system	new Design / Modification	new	K. Pappenscheller	6/06/2005		7/5/2005	
6	Replace the blade control (Hydraulic) of the wiping tank.	new Design / Modification	no	R. Gendenschütz / K. Pappenscheller	6/17/2005	6/14/2005	6/17/2005	6/15/2005
7	Change the ink fountain to the Standard Colotronix System	new Design / Modification	no	K. Pappenscheller	6/17/2005	6/14/2005		6/15/2005
8	Overshoot area needs to be made of Plexiglas or perforated metal	new Design / Modification	new / rework	Ch. Krappert / K. Pappenscheller	6/19/2005		6/19/2005	
9	Gripper control: Support with a new guide and new timing point for gripper opening	new Design / Modification	new / rework	K. Pappenscheller	6/19/2005		6/19/2005	
10	This point has been resolved with point No. 11	new Design / Modification	new	K. Nagler / K. Pappenscheller				
11	Installation of ventilators in the modular delivery	new Design / Modification	new	K. Pappenscheller	6/21/2005		6/18/2005	
12	Modular delivery - lengthen the chain from the plate board	new Design / Modification	new	K. Pappenscheller	6/27/2005			
13	On / Off Position of wiping cylinder - movement problems on side 1 - rework of the hydraulic cylinder holder	new Design / Modification	new	K. Pappenscheller	6/17/2005	6/14/2005	6/17/2005	6/15/2005
14	new wash position of linking unit (new bar and limit switch)	new Design / Modification	no	K. Pappenscheller	6/17/2005	6/15/2005	6/17/2005	6/16/2005
15	Rework of the ink agitator	new Design / Modification	new	Ch. Krappert / K. Pappenscheller	6/20/2005		6/20/2005	
16	Valve for front air control to be reworked (new position of the air)	new Design / Modification	new	K. Nagler / K. Pappenscheller	6/17/2005	6/16/2005	6/17/2005	6/16/2005
17	add emergency stop on the drive side of the press	new Design / Modification	new	K. Pappenscheller / J. Hühnsch	6/15/2005	6/15/2005	6/15/2005	6/15/2005
18	Install all safety relays, relays and all emergency stop buttons	new Design / Modification	new	K. Pappenscheller / J. Hühnsch	6/16/2005	6/16/2005	6/16/2005	6/16/2005

© sj 2006/2007/2008/2010
Update V1_2e may 2016

Remarks from the wooden siege

Following up your development you should maintain an Open Points List not to forget anything and to remind the team of given commitments

3. Model (3D?)

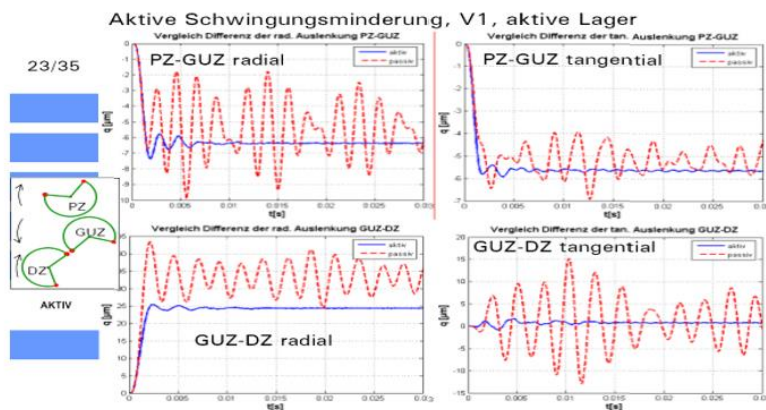


© sj 2006/2007/2008/2010
Update V1_2a may 2016

Remarks from the wooden siege

Your design needs to be properly documented. In today's time is certainly digital. The tools shall be adequate to the purpose and have the necessary compatibility with all other iT systems of your company. You should be suspicious on efficiency, when the number of iT Systems to be mastered by engineers becomes $n > 2$

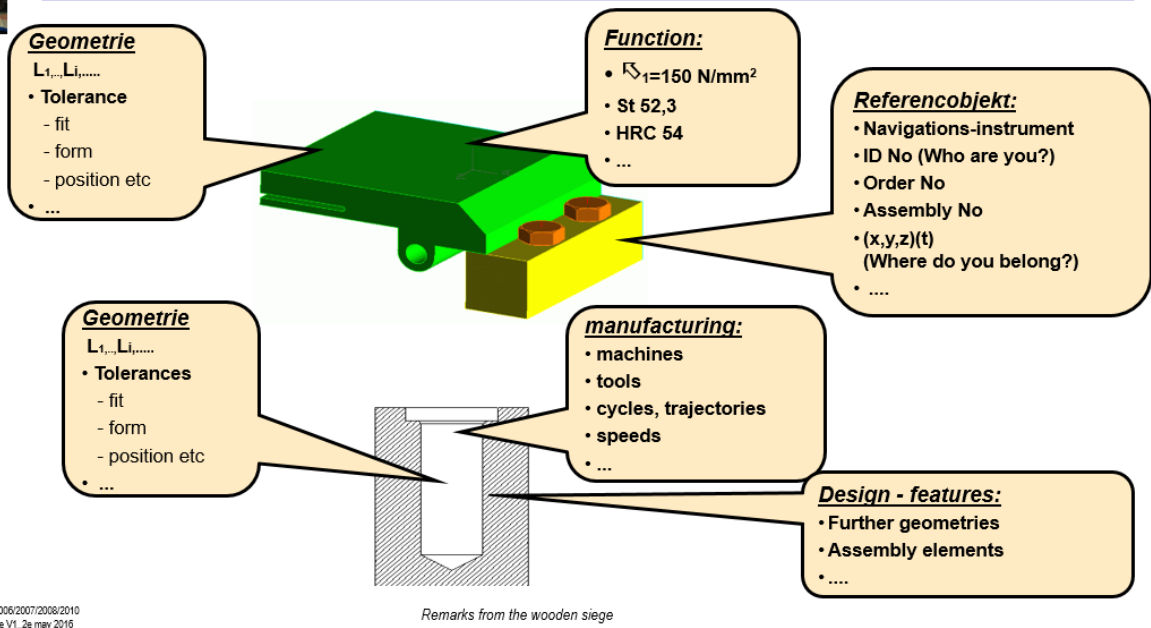
4. Calculation



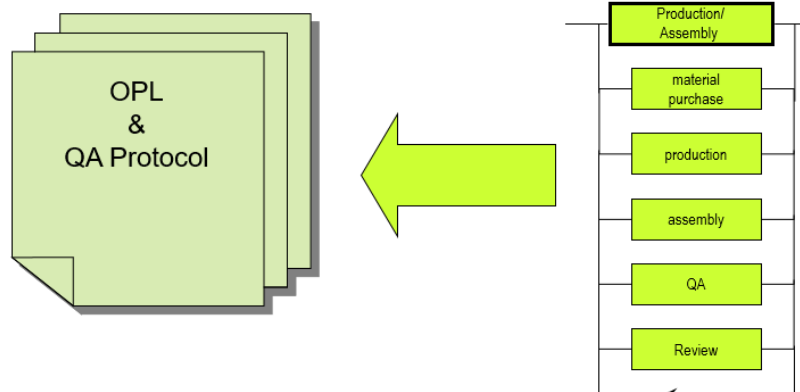
© sj 2006/2007/2008/2010
Update V1_2a may 2016

Remarks from the wooden siege

Engineers are mostly capable to predict their functionality by simulation. Wherever feasible use these methods as they shorten your timeline and save costs. Just make sure that you stay tight with the verification between simulation and reality. In case of doubt verify. And : any simulation without plausibility in a second avenue is : FALSE



A lot of additional information is carried by your design objects. They concern production, purchasing, logistics, standards etc. Just make sure that the data is maintained by those responsible for their content. Do not waste engineer time on administration as far as possible. A perfect example is compliance with export control regulations. If logistics or service need them, let them take care of it.



© sj 2006/2007/2008/2010
Update V1_2e may 2016

Remarks from the wooden siege

Once we reach the stage of production, engineering will follow up as far as required. It is now in the hands of the operative executive. In case of doubt you will be recruited to help with decisions. Some of them really interesting, when production has messed up a part, but not so completely that it is unusable. This is when you will be super-hero of production when you help to save it or their doom as they have to swallow loss and quality costs. Let aside to catch up time. By the way a proven method to blackmail the engineers . . .



1. Open Points List OPL

Nr.	Open Points	Solution	Parts	Responsible	63402401 finished	63402402 finished
1	Emission capture system	Modification as discussed with Volkmar and Michael	new	Ch. Kapper / K. Pappenscheller	6/06/2005	7/5/2005
2	new Plexiglas doors for the linking unit	new Design / Modification	new	Ch. Kapper / K. Pappenscheller	6/06/2005	7/5/2005
3	Modification of link leveler (combine with the Emission capture)	new Design / Modification	new	Ch. Kapper / K. Pappenscheller	6/06/2005	6/25/2005
4	Duct handles must be improved - safety	new Design / Modification	new	K. Pappenscheller	6/06/2005	7/5/2005
5	Hydraulic blade spray - change to old system	new Design / Modification	new	V. Schwedisch / K. Pappenscheller	6/06/2005	7/5/2005
6	Replace the blade control (Hydraulic) of the wiping tank		no	R. Gerdtsch / K. Pappenscheller	6/17/2005	6/14/2005
7	Change the ink fountain to the Standard Colortronic System		no	K. Pappenscheller	6/17/2005	6/14/2005
8	Overhead area needs to be made of Plexiglas or perforated metal	new Design / Modification	new / rework	Ch. Kapper / K. Pappenscheller	6/19/2005	6/19/2005
9	Gripper control: Support with a new guide and new timing point for gripper opening	new Design / Modification	new / rework	K. Nagler / K. Pappenscheller	6/19/2005	6/19/2005
10	This point has been resolved with point No. 11	new Design / Modification	new	K. Nagler / K. Pappenscheller		
11	Installation of ventilators in the modular delivery	new Design / Modification	new	K. Nagler / K. Pappenscheller	6/21/2005	6/18/2005
12	Modular delivery - lengthen the chain from the pile board		new	K. Pappenscheller	6/17/2005	
13	On / Off Position of wiping cylinder - movement problems on side L, rework of the hydraulic cylinder holder		rework	K. Pappenscheller	6/17/2005	6/15/2005
14	new wash position of linking unit (new bar and limit switch)		no	K. Pappenscheller	6/17/2005	6/15/2005
15	Rework of the ink agitator		rework	Ch. Kapper / K. Pappenscheller	6/06/2005	6/20/2005
16	Valve for front air control to be reworked (new position of the job)		rework	K. Nagler / K. Pappenscheller	6/17/2005	6/16/2005
17	add emergency stop on the drive side of the press		new	K. Pappenscheller / J. Bönisch	6/15/2005	6/15/2005
18	Install safety valve on all emergency stop buttons		new	K. Pappenscheller / J. Bönisch	6/16/2005	6/16/2005

© sj 2006/2007/2008/2010
Update V1_2e may 2016

Remarks from the wooden siege

Again an OPL will help you to follow with the production team to the final date of completion



2. QA Protocol

ABNAHMEZERTIFIKAT

DIESES ABNAHMEZERTIFIKAT WIRD IN GEGENSEITIGEM EINVERNEHMEN
ZWISCHEN DEM AUFTRAGGEBER UND DEM AUFTRAGNEHMER ERSTELLT
UND LEGT DAS DATUM DER ERFOLGREICHEN ABNAHME FEST.

1. AUFTRAGGEBER	Papierfabrik Louisensthal GmbH Louisensthal 1 Postfach 1 185 83701 Gmund am Tegernsee, Deutschland
2. AUFTRAGNEHMER	KBA-GIORI S.A. 4, rue de la Paix CH-1003 Lausanne, Schweiz Ref. des Auftragnehmers: 220596
3. BESTELLUNGSNUMMER UND DATUM	4500044321 / 17. August 2006
4. ERKLÄRUNG	Beide Parteien erklären hiermit, dass die nachstehend aufgeführte Maschine die Inbetriebnahme Funktion registerhaltige OVI erfolgreich bestanden hat und somit vom Auftraggeber akzeptiert wird.
5. ANLAGE	1 (ein) WebSave Inspektionssystem
6. ORT UND DATUM	Gmund am Tegernsee, den 28. 08. 2006

UNTERSCHRIFTEN

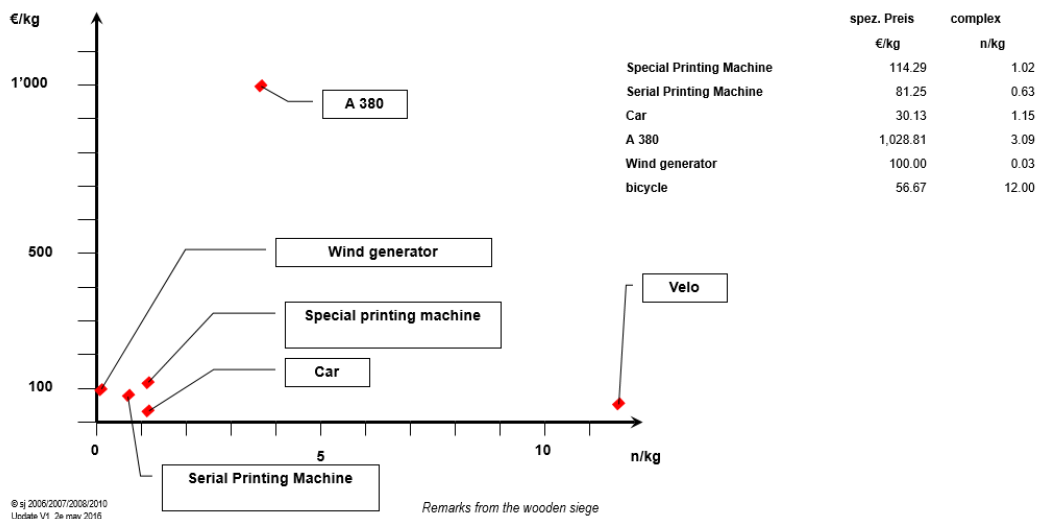
 FÜR DEN AUFTRAGGEBER PAPIERFABRIK LOUISENSTHAL GmbH	 FÜR DEN AUFTRAGNEHMER KBA-GIORI S.A.
---	--

© sj 2006/2007/2008/2010
Update V1_2e may 2016

Remarks from the wooden siege

As responsible person for the project you may have to follow the QA procedures. More often than not you may have to assist production in setting up the right QA procedures. Though this may be tiring, it is only once you are at the necessary level. God help you if the faulty quality is distributed worldwide. Just be aware the certificate is only meaningful if it reflects the actual action. It is good practice to test this from time to time (SPC!).

cost



A small excursion on cost: what do I do if I have to estimate the unknown? I have no or little data on my new machine or device. Also there is little historic data to support. Still sales need a budget long before you have started to design. The magic wand is : Price per weight. This is surprisingly constant within a certain business / machine type / design principle. The difference is the complexity.

Question : Why are the cluster points of complexity versus price/kg spread as they are for the examples given?

When are changes in design allowed ?

1. Does not work !

- It does not work as intended; trap : correct Analysis
- The customer requires a different (better?) functionality ; trap : customer abuse as whip

2. Too expensive !

- The competition is so much cheaper ; trap : miracles are the monopoly of gods not engineers
- The customer does not get the required ROI; trap : trimester-bean-counting-acrobats
- The savings come back immediately; trap : missing facts



All other reasons are PURE waste

© s 2006/2007/2008/2010
Update V1_2e may 2016

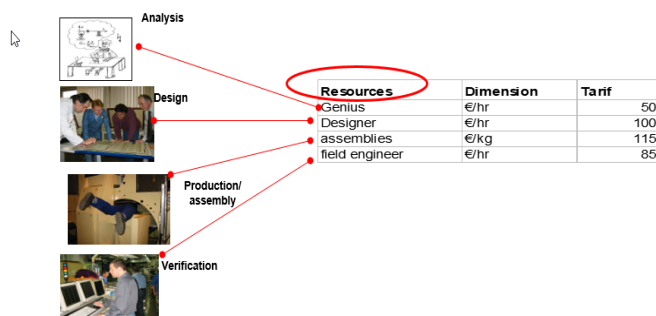
Remarks from the wooden siege

One additional remark on cost. One of the most disastrous drivers in cost in special machinery (and other industries) are changes in design. Above you find the only two justifiable reasons for a design change.

Just reflect two questions:

1. Under which category above do you find a product improvement or even a new product?
2. Have you ever experienced a design change on a product you are using which does not fall under the two categories above and which you perceived a nuisance?

How to estimate project costs ?







© s 2006/2007/2008/2010
Update V1_2e may 2016

Remarks from the wooden siege

If you have to estimate a more complex design project the following estimates, I am using in my field may serve as an orientation on how you may set up your own set of tools of project cost estimation. Admittedly you will not find this very helpful in your today's work, but I am sure you will remember it when the time comes and someone forces you to make such estimates before he is willing to liberate your R&D or project budget.

The first slide gives some rough estimation of cost/hr for the 4 phases defined. They may need to be adjusted from time to time and also vary according to the industry.

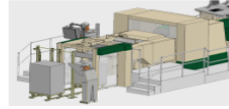
cost


Analysis

Design

Assembly

Verification

description	example	per assembl Analysis [hr]	average values design 3D CAD Para [hr]	Assembly[%]	Verification [hr]
more than 30% new parts; basically different function	Change from gear to separate servo drives	8	200	50	60
max 30% new parts, function is basically identical	Change of bearing due to supplier constraint	4	100	30	40
max 10% new parts; function identical; variant is foreseen in parameter set of the basic function	Adaptation of diameter of plate cylinder for Offset web press	0	16	10	5
max 3% new parts, function and design remain identical	change of paint due to customer specification	0	8	0	0

Here are typical budgets on typical functional groups and their depth of change. You may notice that the cheapest resource receives the smallest budget in hrs. As a matter of experience any additional hour spent on the analysis – given you find an ingenious idea – is well invested and has a substantial leverage on execution time and success of the development.

model calcul special print machine		2,800,000 €
weight	24,500 kg	
No. of assemblies	250 -	
average assembly weight	98 kg	
average assembly cost	11,200 €	



machine project	no of assembl	Analysis	design	assembly	verification
completely NEW	250	100,000 €	5,000,000 €	4,226,250 €	1,275,000 €
specific changes	0	0 €	0 €	0 €	0 €
adaptation	0	0 €	0 €	0 €	0 €
maintain/repeat	0	0 €	0 €	0 €	0 €
Total	10,601,250 €	100,000 €	5,000,000 €	4,226,250 €	1,275,000 €

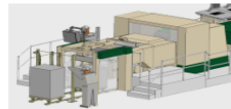
machine project	no of assembl	Analysis	design	assembly	verification
completely NEW	50	20,000 €	1,000,000 €	845,250 €	255,000 €
specific changes	50	10,000 €	500,000 €	732,550 €	170,000 €
adaptation	50	0 €	80,000 €	619,850 €	21,250 €
maintain/repeat	100	0 €	80,000 €	1,127,000 €	0 €
Total	5,460,900 €	30,000 €	1,660,000 €	3,324,650 €	446,250 €

machine project	no of assembl	Analysis	design	assembly	verification
completely NEW	20	8,000 €	400,000 €	338,100 €	102,000 €
specific changes	70	14,000 €	700,000 €	1,025,570 €	238,000 €
adaptation	70	0 €	112,000 €	867,790 €	29,750 €
maintain/repeat	90	0 €	72,000 €	1,014,300 €	0 €
Total	4,921,510 €	22,000 €	1,284,000 €	3,245,760 €	369,750 €

All New

new main
aggregatesNew
main assemblies

model calcul special print machine		2,800,000 €
weight	24,500 kg	
No. of assemblies	250 -	
average assembly weight	98 kg	
average assembly cost	11,200 €	



machine project	no of assembl	Analysis	design	assembly	verification
completely NEW	0	0 €	0 €	0 €	0 €
specific changes	30	6,000 €	300,000 €	439,530 €	102,000 €
adaptation	60	0 €	96,000 €	743,820 €	25,500 €
maintain/repeat	160	0 €	128,000 €	1,803,200 €	0 €
Total	3,644,050 €	6,000 €	524,000 €	2,986,550 €	127,500 €

machine project	no of assembl	Analysis	design	assembly	verification
completely NEW	0	0 €	0 €	0 €	0 €
specific changes	0	0 €	0 €	0 €	0 €
adaptation	0	0 €	0 €	0 €	0 €
maintain/repeat	250	0 €	200,000 €	2,817,500 €	0 €
Total	3,017,500 €	0 €	200,000 €	2,817,500 €	0 €

Customer adaptation
In parameter setMaintained
Series

Here you find the model estimations for the different cases of a complex machine design and update project. As you will see the costs of the project rise almost exponential when you do everything from scratch. Not that this may not happen, just be aware of the magnitude of risk you bear and have to cope with. AND: do not forget to remind your bean-counters that even maintaining a product is NOT for free. You have to replace EOL (End Of Live) elements and adaptations driven by production and logistic chain.

Problem-Solving fatal exception 0E



© sj 2006/2007/2008/2010
Update V1_2e may 2016

Remarks from the wooden siege

At the end of this lengthy unit you do not have to read another book. It is just a recommendation coming from experience. If you have run with your project into a real road block and you believe that there is no good way out, order a good meal and open a good bottle of red wine (or whatever you like to drink) and sit down with the team. In this (historic 2003!) photo the five gentlemen (I am taking the photo) are obviously enjoying a luxurious lunch and seem pretty relaxed. In fact they have run into a major brick-wall with a brand new vision analysis system. At the end of the lunch – which was longer than regular – the problem was analysed and the way forward defined. The product is still in use today – with adaptations and changes nota bene.