

INFORMATION AGE VIEW OF THE OODA LOOP

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Abstract: *In this paper I present a point of view of OODA loop from an engineering perspective. In my opinion, Jon Boyd was right when he splinted the processes which change the environment in four parts, Observation, Orientation, Decision and Action. Also he was right when endorsed the Orientation as key of his loop. For this reason he gave a more attention to Orientation part of the loop. In Orientation phase of the loop did he elaborate components like: Cultural Traditions, Genetic Heritage, Analysis/Synthesis, New Information and Previous Experience. All of these elements are interconnected and have a great influence on Orientation phase. Based on his previous experience Boyd created his loop. He used a feedback way in order to create close loop system but he put this four phases in a linear way which create all confusions related to OODA loop. In fact in order to use the feedback in a proper way as the nature created and used it in so many examples we should put the Observation in a feedback way of the loop. In this way we put the OODA loop in accordance with control theory. Also the Observation phase is not a step in a loop is a continuous process because it is focused on the exterior of the loop. An analysis of this new configuration of OODA loop will be presented in this paper using tools from control theory.*

Keywords: *Observation, Orientation, Decision, Action, Control Theory, Feedback, Information Age*

1. INTRODUCTION

In order to find a way to increase the victories ratio in air fight during the Vietnam War the pilot Jon Boyd discovered the four steps which are applied to every confrontation. Later he observed it can apply his loop to other situation or systems. He paid more attention in order to refine his OODA loop and he recognized the importance of orientation. For this reason he gave a more attention to Orientation part of the loop.

In Orientation phase of the loop did he elaborate components like: Cultural Traditions, Genetic Heritage, Analysis/Synthesis, New Information and Previous Experience. All of these elements are interconnected and have a great influence on Orientation phase. Also he was right when he represented his loop. Instead to put all four phases of the loop in a circle he was wise and depicted a feedback way from action to observation like in fig. 1.

2. OODA LOOP IN INFORMATION AGE

Before to make any commentary to OODA loop first let present every step of the loop. First step according to Boyd's loop is Observation.

During this step the information are collected. In order to keep things simple let assume the information refer to real word. This information should give us a picture of real word very close to reality.

Even if this step was depicted first in OODA loop it is true the Observation do not stop. It is a continuous process which never ends. By putting Observation as first step lead us to a wrong way. For this reason a lot of people represent the OODA loop like a circle.

This is a big mistake an also do not respect Boyd's representation of the loop. The action of gathering information always implies the existence of a sensor.

Generally speaking in order to complete the Observation step we need some sensors to measure the outcome of process and to give us the most real picture.

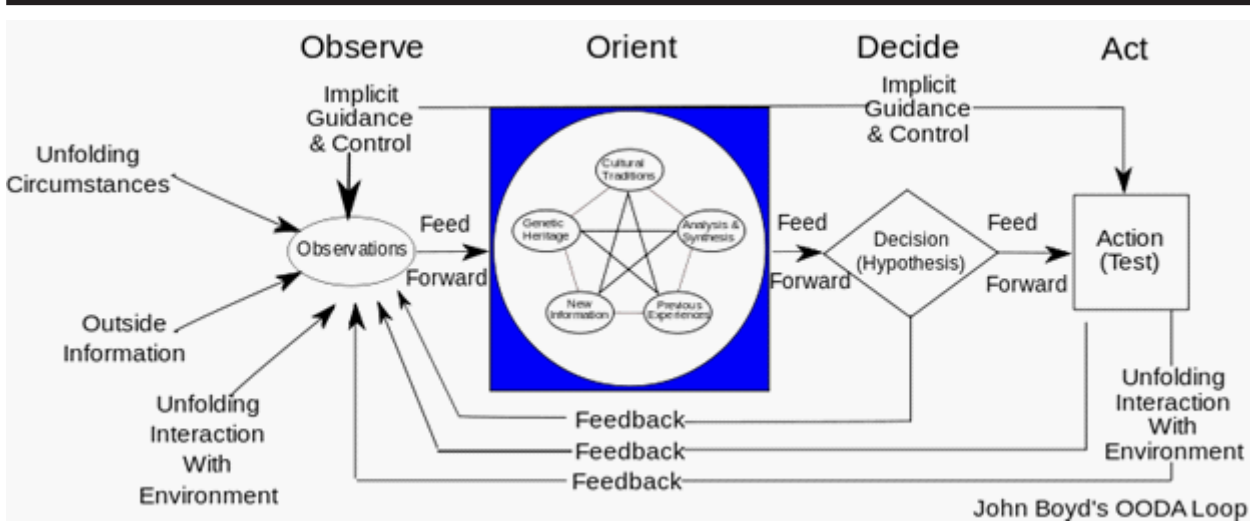


Fig. 1 John Boyd's OODA loop

Now I hope is obvious the Observation is a continuous process which never ends. The Observation has a great influence on the speed of the loop.

The OODA loop create a lag and if this lag is bigger than time of the outcome process change the Action will be based on a reality which is no longer available. The speed of changes of outcome process is measured during the Observation and this information is feed forward to Orientation phase of the OODA loop.

Based on this information the speed of OODA loop can be adapted to the speed of changes of outcome process in order to achieve a great efficiency and effectiveness of the loop.

We should take into account the OODA loop is used in Information Age. For this reason the Observation phase is more important than Boyd predicted.

Now the Orientation phase does not make prediction based on little information, during the Orientation the large amount of information provided by the Observation should be analyzed in order to extract the valuable information and this is not an easy task.

Here I agree with dr. Donald A. Maccuish and I support his analyses related Orientation phase in the paper "*Orientation: key to the OODA loop – the culture factor*" but his analyses is based on how certain organization use OODA loop even if they are aware or not about this.

If an organization alter the OODA loop because of cultural traditions that do not mean the loop is wrong. Instead to try to change the OODA loop in order to be adapted to our organization we should change our organization to become much agile and this is not an easy task.

What is the general purpose of Orientation phase?

From my engineering point of view Orientation phase should create an error signal. In order to provide this error signal two information should be compared.

First is the mission of the organization which represents the entrance of the loop.

This information should be compared with information provided by the Observation phase.

How this process of comparison should be done is another story but at a very general level this is the meaning of Orientation phase. From here result also the importance of Orientation phase; an error at this level can lead entire organization in to a wrong way. Even if the goal is right and the information about real world are very accurate because of Cultural traditions and Genetic Heritage the result can be wrong. These mistakes are possible because at this moment of development the computers cannot replace yet the humans involved in this phase. Finally the humans will be replaced because the amount of information provided by the Observation phase will increase and in order to process this large amount of information we have two ways: to increase the number of people involved in process (less efficient) or to use computers.

If we put computers in Orientation phase the general purpose emerge and all discussions related with this phase are useless.

Even with this assumptions the Orientation phase remain the main important phase of the OODA loop because all available information should be analyzed and only the valuable result should be forwarded to the Decision phase.

At the beginning I want to stress the fact that the Decision phase is only for humans' even if they can be helped by a computer program. At the end the decisions belong to humans.

During this phase the difference between the reality and our goal is analyzed and proper commands are issued forward. From this point of view we can see how the importance of Decision phase increase and Orientation phase decrease but Boyd are still right.

All components from Orientation phase would by find in Decision phase, Cultural Traditions, Genetic Heritage, Analysis/Synthesis, New Information and Previous Experience, because we can find these components where the humans are involved.

At the end the Boyd's OODA loop is still available but should evolve according to the evolution of information technology. We must adapt the OODA loop to the Information Age.

With proper commands issued, during the Action phase we will use the available tools to change the reality according to our dreams. According with all this the Information Age OODA loop will look like in fig. 2.

In fact the loop is the same but the importance has shifted to the Decision phase.

All external actions to this process are represented by Disturbance. That Disturbance can affect all phases of the loop but for simplicity were represented after Action phase because at the end the result of Disturbance will affect the interaction with environment.

3. FEEDBACK ANALYSES

If we depicted the OODA loop in this way we got a strong feedback. The Observation phase represents the feedback of the process.

This feedback will protect the system against the external disturbances and also against the malfunction of one of these phases. In order to prove this affirmation let make some notation on OODA loop like in fig. 3.

Where:
 G – Goals; E – Errors; R – Results; S – Sensors;
 C – Commands; D – Decisions; A – Actions;
 T – Tools; P – Perturbation.

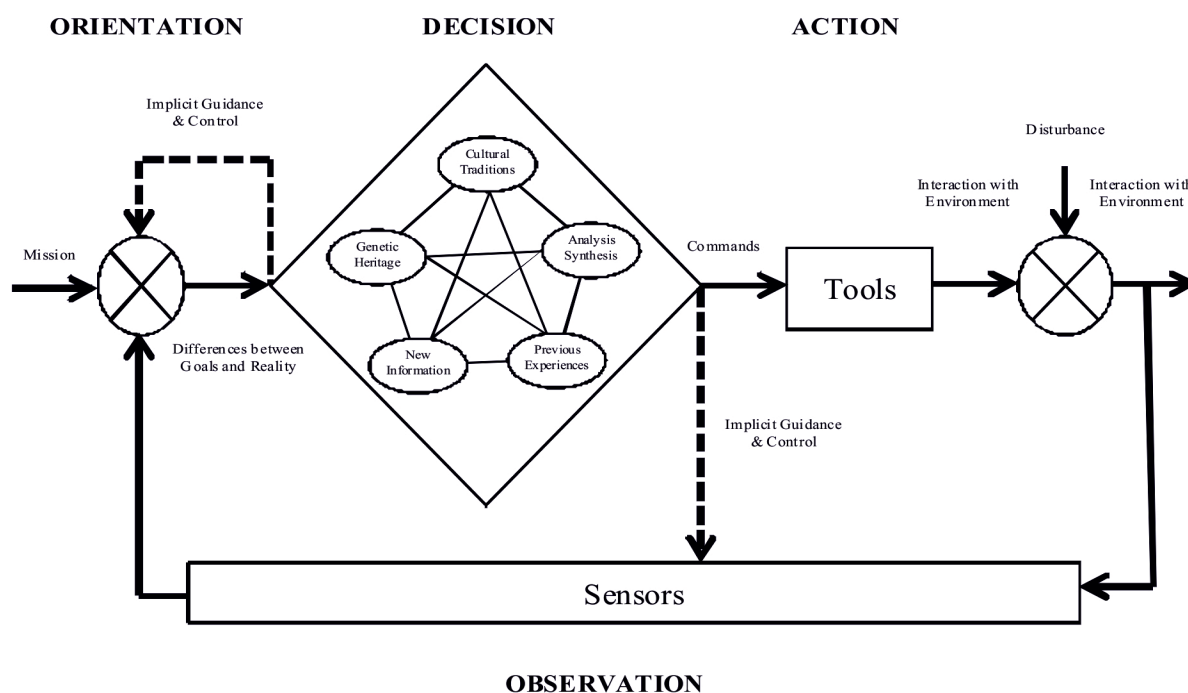


Fig. 2 Information Age OODA loop

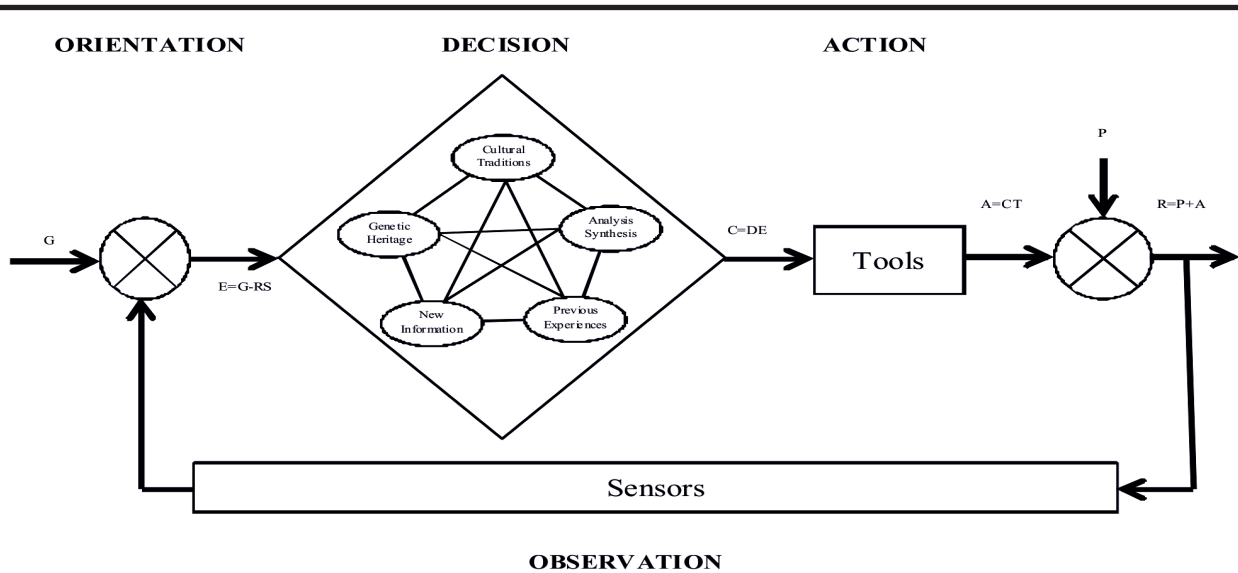


Fig. 3 Feedback analyses of OODA loop

According with these notations we can write:

$$E = G - RS \quad (1)$$

$$R = P + A \quad (2)$$

$$A = CT \quad (3)$$

$$C = DE \quad (4)$$

From 2, 3 and 4 result:

$$R = P + DET \quad (5)$$

And from 1 and 5 result:

$$R = P + DT(G - RS) \quad (6)$$

$$R = DTG - DTRS \quad (7)$$

$$R + DTRS = P + DTG \quad (8)$$

$$R(1 + DTS) = P + DTG \quad (9)$$

$$R = P / (1+DTS) + DTG/(1+DTS) \quad (10)$$

$$R = P 1/(1+DTS) + G DT/(1+DTS) \quad (11)$$

The values of DT product are 1 for bad decision and improper tools and 100 for best decision and proper tools. Let assume the value of S is 1. That means the sensors measure the reality very accurate.

First analysis is about the influences of perturbation in the result in two cases 1 and 100 for DT product.

$$R = P 1/1+1 + G 1/1+1 \quad (12)$$

$$R = P 1/2 + G 1/2 \quad (13)$$

We can observe only half of the perturbation affect the achievement of goal. The perturbations are cut in half even in the worst scenario with bad decision makers and improper tools.

$$R = P 1/1+100 + G 100/1+100 \quad (14)$$

$$R = P 1/101 + G 100/101 \quad (15)$$

We can observe the perturbation influence the result with only 1 % and the goal is achieved in proportion by 99 %. In this way the loop is protected against external perturbations but is also protected against bad decisions and improper tools.

We assume the difference between results (reality) and goals (desires) during Orientation phase is correct. In fact this difference must be correct because the output information of sensors should be presented in such a way to be easy to compare with goals.

4. CONCLUSIONS

The Boyd's OODA loop should be changed to fit the requirements of Information Age. The Observation phase should be the feedback of the loop in order to protect the loop against external disturbances.

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