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OPTIMIZED NAVIGATION SYSTEM FOR ECO DESIGN MANAGEMENT

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Abstract:

With the contribution of active scientific studies and worldwide promotion, “environmental- friendly” concept have been gradually understood and accepted by the public. They are now not only one of the major concerns of the governments in the world, but also, as an issue of systematic engineering, have been embedded in all industries. Following the development of environment-concern, to have an intelligent “environmental strategy” program, which could analyze the needs of industrial competitiveness and social responsibility, identify the adaptive actions and make project plan of integrated solutions, is now becoming extremely important. This paper introduces a brand new optimized green navigation system. “TArget-hitting Navigation Kit”, named as TA.N.K also, working on the analysis of actual situation, is proposed to support the decision on any environment-concern actions in the enterprises. TA.N.K, involving all the activities and functions in a unique and sharable information flow, could ensure the sharability and readability of preparatory studies, avoid the misunderstanding among different functions and it also provides the possibility of continuous improvement.

Keywords: Eco design, Strategy decision support, Quantifiable, Continuously improvement, Integration

1 Introduction

Awareness of the fragility of our natural capital and the needs to design cleaner industrial systems show the environmental concern as a must. To curb and prevent degradation of the planet, society must change the logic of production and consumption. In order to formulate new socially and culturally acceptable proposals, “environment-concern” mechanism which indicates a framework at industrial level, is aiming to connect “technically possible” to “ecologically necessary”. [1] With the great contribution from numerous scientific studies and strong promotion on environment, the conception of environmental-concern mechanism has been gradually accepted, understood and focused on by the government, the industry and the public.

A “Mintel” (released in 2009) study showed that the green market outperformed the US economy as a whole in 2009 and grew by over 40% from 2004 to 2009. And there are over 370 eco label systems in 214 countries and 25 industry sectors in the world for multi-criteria environmental certificate. [2] These systems could directly provide a panorama for proving that environmental concern conception is now becoming an important part of global economy and it has been embedded into the “blood” of design activities.

On legislation, the industry should face a stricter legislative environment which is under accomplishment over time. Some countries and country unions (such as European Union) have

developed or are developing their environmental laws to accelerate the environmental progress and educate the public to take care of the environment. Legislative framework including directives like RoHS, REACH, WEEE, ERP and Battery etc., which is developed by European Union, could be considered as a great example, and this law system is being copied into some different local versions by other countries.

Additional and also important, enterprises should face a “greener” public. According to a Mintel study in March, 2010, [3] more than a third of US consumers now say they are willing to pay a premium for eco-friendly products, and in some cases this is even higher, for example 53% of US consumers would be willing to pay a premium for a greener television, according to the Consumer Electronics Association. Another example from UK, according to a 2009 Carbon Trust study, 44% of UK consumers want more information on what companies are doing to be green. Final customers focus on environmental issues and also, logically, in Business to Business mode, downstream enterprises need the environmental proof for constructing their green offers (Product/Solution) to answer the requirements of their final customers.

To answer these above-mentioned requirements and enhance the competence of competition, the industry is acting. Till now, it's very difficult to find out an enterprise without any sustainable strategies. Thus, the environment-concern mechanism can be defined as a schematic solution to find a great balance among the technical constraints, environment-concern, and economic requirements to the products or services (Brezet et al, 2007). The actions of environment-concern program or “eco design” should be tailored to the specifics of the companies and their products and be taken into account in all indicators of the value chain. These environmental approaches rely on multi-criteria approaches, multi-steps and multi-actors, which must be integrated into a global structure of piloting the process and balancing the conflicts. An intelligent and strong environmental strategy and related professional action program seem extremely important.

In this paper, by analyzing the actual industrial situation and some definition process inside of enterprises, a new green navigation system has been proposed for integrating all activities of enterprise and optimizing related strategy definition process.

2 The analysis of worldwide industry environmental practices

As mentioned earlier, in order to answer the external requirements and profit some advantages from green strategy [4], the industry is acting. A mass of eco programs have been lunched to declare the environmental characteristics or improve the green performance. The following table (Table 1) presents the survey results of environment-concern program from 33 electric and electronic enterprises. The resource of this table came from the inter-standards, the program presentation and promotion document or the sustainable report of each enterprise. The environmental concern programs are classed in two principal groups by final objective: declaration of environmental impacts and certification of the green performance. For judging the green performances of product/service, there are comparative criteria (compare the new product with a selected reference) and check list with special threshold (such as consumed value, avoidances, life time etc.). All principal environmental indicators have been focused on by the initial activities of enterprise and some enterprises even have developed a higher class environment-concern program to update the strategy to improve the environmental performance, Eco labels system (Check list 02, 04, 06 and 09) in EIZO as an example.

		Energy efficiency	Hazardous substance	Lifetime	Decomposition	Recyclability	Waste treatment	Resource	Document	Manufacture	GHG	Ozone Depleting	Emission	Ergonomics	Package Material	Battery	General Improvement
Type II eco label number: 29		86%	69%	59%	76%	90%	45%	72%	41%	28%	34%	24%	17%	3%	52%	10%	21%
Declaration	Eco Highlights Label (HP)	X		X		X	X	X									
	Green flagship (Philips)	X	X	X	X	X	X	X			X				X		
Comparative	Excellence ECP (TOSHIBA)	X	X	X	X	X	X	X		X	X	X	X		X	X	
	Environmental Label (Yamatate)	X		X	X	X		X	X		X		X		X		X
	Eco Label (OMRON)	X		X	X	X		X		X							X
	Super Eco Product (HITACHI)							X			X						
	Eco Friendly Label (Mitsubishi)	X	X	X	X	X		X									
	Environmental Label (Yokogawa)	X	X	X	X	X			X						X		
	High Grade Green Product (SII)	X	X	X	X	X		X	X	X					X		X
	Ecomagination (G.E.)							X	X		X						
	ECP (TOSHIBA)	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Check List	Eco Product (HITACHI)	X		X	X	X	X	X							X		
	Super Eco product (FUJI)	X			X	X		X	X						X		X
	Eco Product (FUJI)	X			X	X		X	X						X		X
	Green Product (Matsushita)		X	X	X	X		X			X						X
	Eco Symbol (NEC)	X	X	X	X	X		X	X	X		X			X		
	Eco Product 02 (EIZO)	X	X		X		X					X					
	Eco Product 04 (EIZO)	X	X		X	X	X					X					
	Eco Product 06 (EIZO)	X	X		X	X	X						X		X		
	Eco Product 09 (EIZO)	X	X		X	X	X		X				X		X		
	Green Label (Brother)	X	X			X	X	X			X						
	ECO2 (Renault)	X				X				X	X						
	Eco Mark (SAMSUNG)	X	X		X	X		X									
	Eco Friendly Product (TOYOTA)	X	X	X	X	X	X	X	X		X		X		X		
	Recycle Label (RICOH)	X	X			X	X						X				
	Green Product (SII)	X	X	X	X	X		X	X	X					X		
	Eco Symbol (SEC)		X	X	X	X	X	X		X							
	Super Green Product (Sharp)	X	X	X	X	X		X									
IT Eco Declaration	X	X	X		X	X	X	X					X	X	X	X	

Table 1. The situation analysis of environment-concern program in EE enterprises

The analysis of those practices leads to different considerations about the ability of enterprises to share new environmental studies, to choose the right strategies and identify the improvement roadmap.

2.1 *Considerations on the sharability to preparatory studies*

The industry is facing a complex environment, so its analysis (Include the law, directive, custom requirement, marketing potential value/direction and the competition needs) should be prepared for contributing to individual strategy of environment-concern or “Eco design”. But typically, these analysis and those reports are to be processed by different specialists (either in same sustainable department or dispersed in different functions), and the reports and the experiences could not be totally shared among them because of the different structures, approaches, methods and habits. Furthermore, how to compare the results of all these mandatory action requirements, how to define their priorities, and how to continuously modify these results and priorities in future circumstance has to be defined. For improving this part, the industry needs an evaluation system which could:

- make the analysis more readable
- make the analysis more sharable
- completely transfer the evaluation results in contributing to the strategy decision
- make the analysis more comparable
- allow easier continuous modification on the analysis of future results

2.2 *Considerations on the way to select environmental strategies*

The environment-concern program is not only the affairs of our planet, but it is also necessary to contribute to the competition. While achieving similar objectives, the implementing measures could be diversified. The enterprise could straightly focus on the environmental performance via some initial eco innovations, or just answer the mandatory external requirements. For selecting the right implementing measures, the enterprise needs:

- the efficient implementing measures to adapt the needs of the enterprise
- to open the door to the scientific studies to enrich the experience and available solution

- the right formula to avoid the negative impact to existing process
- good cost performance
- to make difference with competitors

2.3 *Considerations on the way to improve environmental strategies*

The circumstance keeps changing with time. So the existing strategy could not be always valid to guide the actual activities without any update. Moreover, the changes happen with numerous indicators. So the enterprise needs a mechanism which could:

- continuously monitor the change of external requirements
- continuously analyze the internal situation
- compare the actual situation with previous
- synthesize the multi-indicators
- define the priorities of the changes
- refine the strategy or program in a right way at the right time
- destroy the actual program at a minimum level

2.4 *Summary for requirements to better consider environmental strategies*

In order to resolve these above-mentioned, a schematic framework needs to be proposed to improve the offer's environmental performance and optimize the enterprise's green approach:

- Provide a unique, quantifiable and sharable evaluation system
- Improve the efficiency of information flow within all enterprise functions (MARKETING, Purchasing, R&D, etc.) by speaking "a same language"
- Provide the quantifiable decision system
- Involve the scientific research
- Ensure the continuous modification and update

3 **Optimized Green Navigation system – "TArget-hitting" Navigation Kit (TA.N.K)**

3.1 *General Architecture*

The original intention is to continuously improve all aspects of environmental issues with a quantified and unified evaluation flow. Our TA.N.K system proposes a quantifiable audit platform to evaluate all environment-concern actions and related enterprise achievement status. By analyzing these audited scores, especially the score's gap between the external requirements and the internal situation [7] [10], this TA.N.K supports the enterprise to set up an adaptive strategy and the prioritized action plan to reduce the gap. So the gap reducing could be considered as a "motor" of enterprise environmental actions of this navigation system. [8]

If it exists a visible gap (the external scores is much bigger than internal) of some environmental issues, which means the enterprise should make a move to respond the external requirements, the adaptive programs will be created to achieve the requirement, meanwhile to reduce the related gap. For the needs of leadership or competition, some advanced program should be created to increase the gap (the internal scores are more and more big than external) of some issues which have not been focused on by extern. Cooperating with the marketing education and promotion plan, such issue's external scores will be increased which will finally re-reduce the gap.

In sum, the TA.N.K will continuously monitor the situation and modify the scores till the gap between the external and internal situation is small enough which leads the related action could be considered as out of the focusing area.

As mentioned earlier, the environment-concern program is a global framework which needs to involve all functions of the enterprise from top management to every project team [6] [7]. Our optimized green navigation system classifies all related activities and related functions to propose a general architecture which includes 6 sub-systems:

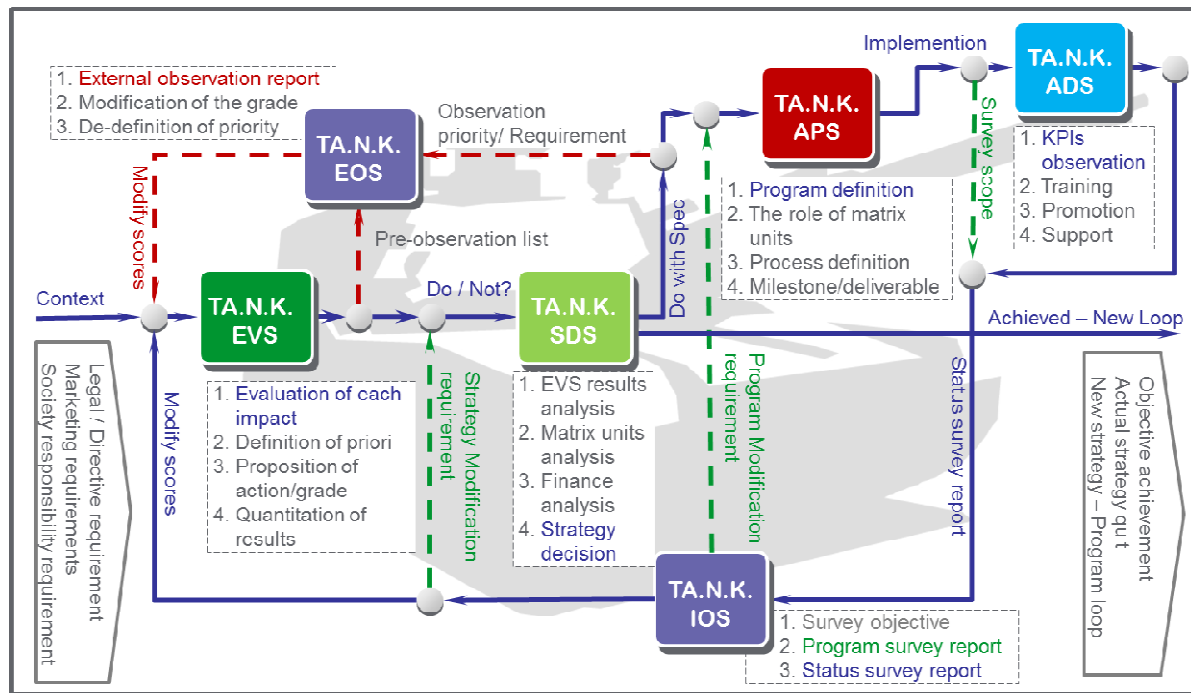


Figure 2 the architecture of proposed TA.N.K. - "Target-hitting Navigation Kit"

With six basic sub-systems, the decision-making flow could be described as follow: When all analysis of the external requirements and the related internal status have been translated by EVS (**E**valuation **S**ystem), the evaluation results are ranked with scores. According to the technical criteria and corporate focusing area definition, EVS exports a selected actions list and related actual status table. These outputs are transferred to SDS (**S**trategy **D**ecision **S**ystem) for a final release (modify the selected actions and fix the final requirements). This final released selection list and related status table are transferred to APS (**A**pplication **S**ystem) to identify the program's implementing details and roadmap. And then, this program is steered and realized by ADS (**A**dministration **S**ystem) and monitored by IOS (**I**nternal **O**bservation **S**ystem). According to ADS program status report and IOS independent monitoring report, IOS continuously modifies the score of the action's internal status and report it to EVS. At last, the EVS analyzes the new status (the observation report from EOS and IOS) and reports to SDS to end the program.

Throughout the process, the selected status table is used as the basis of decision-making for each sub-system in order to the uniform data flow.

3.2 The instruction of each sub-system

EVS sub-system, a scientific **E**valuation **S**ystem, is the first part of TA.N.K system which responds to external requirements. The ultimate goal is to establish an evaluation system, using a quantifiable and continuous improvement solution that assesses all environment-concern actions. After comparing with the company's own internal status, this EVS sub-system could confirm the prioritized actions for strategy preparation. To achieve the above approach needs, EVS sub-system in the macro is divided into two sub-working modules –"Translate" module and "Evaluation" module.

"**Translate**" module provides a unified platform, to ensure continuous improvement and the quantifiable evaluation, to sort, re-combine and quantify each collected analysis report of typical environmental-concern actions. Through this module, we could translate all analysis results with different formula, method or structure into the unique and standardized formula by "common indicators" [5] [11]. Certainly, this Translate module can also be directly used in each new analysis of actions.

All follow-up priority definition and the action plan of entire navigation system depend on the translated indicators of the analysis to environmental-concern actions. Therefore, the quality of

translation is the key point. The selected indicators of this module must be able to integrate the global situation which involves the environmental impacts, cost pressure, the marketing needs, the competition, the feasibility and the society impacts. And also, the indicators should be enough simple, straight and easy to compare. This navigation system, combined with the actual needs of environment-concern issues, defines following three major indicators which could be considered as the reference:

- Indicator G - “gravity”
This indicator is defined to demonstrate the importance of certain environment-concern actions for certain enterprises. This indicator focuses on the total product/service line of enterprise, not only for just one product. According to this importance, the performance is graded by 10 hierarchical levels, from 1 to 10.
- Indicator F - “feasibility”
This indicator is defined to demonstrate the implementing feasibility of certain environment-concern actions. The “feasibility” classifies the technical feasibility in large-scale industrialization and the cost to achieve the required actions. As for the previous indicator, according to the classification of feasibility, the performance is graded and summarized by 10 hierarchical levels, from 1 to 10.
- Indicator V - “visibility”
This indicator is defined to demonstrate the popularity of certain environment-concern actions. The “visibility” grades the marketing and public awareness level of certain actions including the execution of the directive, Law, the common industrial solution / potential innovation and competitive promotion etc. Normally, the performance is graded also by 10 hierarchical levels, from 1 to 10.

For these environment-concern actions, each indicator will be given a score. The multiplication of the above three indicators ($G \times F \times V$) will be considered as the overall assessment of these environment-concern actions.

Logically, according to the need of comparison, a similar approach should also be used in translating the internal situation of enterprise for each environment-concern action. The following three major indicators have to be considered as references:

- Indicator A - “achievement”
This indicator is defined to demonstrate the level of achievement for certain environment-concern action. To work with previous indicator, the achievement level was graded also by 10 hierarchical levels, from 1 to 10. For example, this indicator could be calculated by percentage of the offer achieved or percentage of turnover.
- Indicator I - “Implementability”
This indicator is defined to demonstrate the implementing feasibility inside enterprise. This indicator evaluate whether the actual organization, supply chain, technical competences and the management process could be easy to achieve the objective. It also analyzes the relevant cost, risks etc. to take a global and complete view. To work with previous indicator, the achievement level is graded also by 10 hierarchical levels, from 1 to 10.
- Indicator C – “communication”
This indicator is defined to demonstrate the communication level of each environment-concern action. “The great design is always not good enough”, this indicator will evaluate whether the achievement of such environment-concern action has been promoted to public. It also analyzes the communication performance comparing with competitors. As all the other indicators, the achievement level is graded also by 10 hierarchical levels, from 1 to 10.

. Similar as in the Translate module, each indicator has a score (from 1 to 10). The multiplication of the above three indicators ($A \times I \times C$) is considered as the overall assessment to the inter-situation of the enterprise.

All following up decisions and the creation of program of this navigation system will totally depend on the future analysis on these six indicators. It is important that all proofs and related original reports need to and must be registered for future discussion.

“Evaluation” module of EVS sub-system provides a strategy recommendation including selected environment-concern action to next sub-system. This proposition depends on the priority indicator – Indicator P which is calculated by the above mentioned 6 indicators. The general aim is to filter out and make an order of the actions with the gap between external scores and internal scores. And logically, the order of the gap could be considered as the order of the severeness of environmental problems. The general mechanism is explained as in follow equation:

$$Priority\ Indicator\ (P) = Global\ Score_{external} - Global\ Score_{internal}$$

Meanwhile, the Business Forecast Model and the linear regression are involved into this module to guide out the potential important environmental issues which will be as a reference to identify some precocious program.

Based on these approaches and considering the enterprise’s threshold value, the EVS sub-system summarizes a “selected list” and proposes a draft environment-concern recommendation to next sub-system.

SDS sub-system, an intelligent **Strategy Decision System**, who plays a final decisive role of initial strategy and the future updates, could be considered as the “CPU” of entire navigation system. SDS sub-system, accepting the draft recommendation of EVS as an input, and taking account of current financial situation, market, R&D competences, stakeholder and corporate positioning, etc., [9] [12] re-audits the priority of certain environment-concern actions and modifies the “selected list”. The final released program dashboard including the general goal, the constraints, the requirements and selected action list, will be transferred to next sub-system as a “constitutional law”.

The difference between the analysis in EVS and in SDS is that EVS focuses on the impersonal context and technical feasibility, but SDS, at a strategic height, is more inclined to the company's image, future development, economic situation and corporate culture etc.

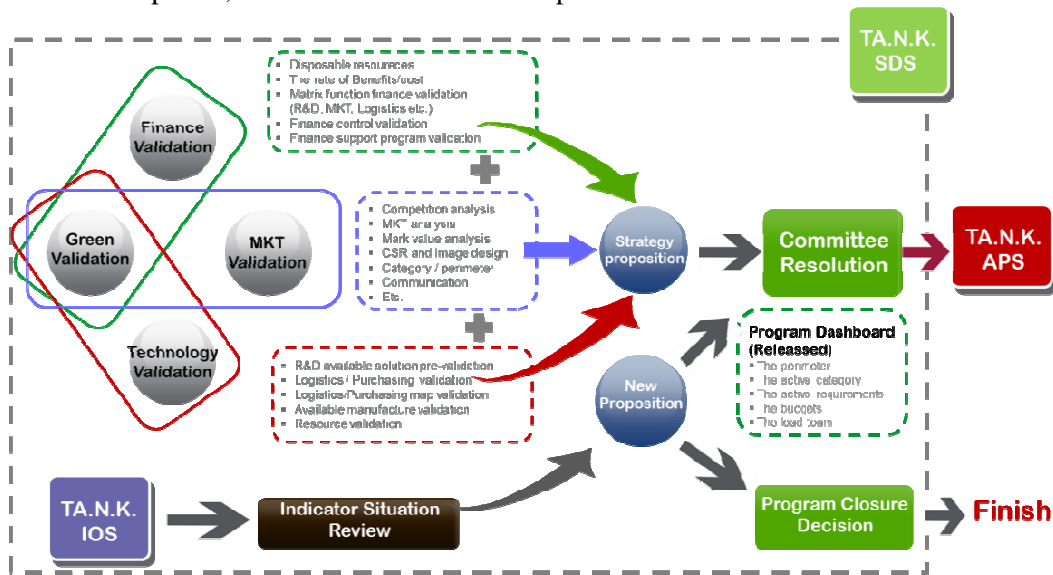


Figure 4 the schematic process of SDS sub-system

APS sub-system, a harmonized **Application System**, is a professional part to construct the detailed implementing measures for each selected environment-concern action. Like any other activities, there are always hundreds of different implementing measures (a sole program, a group of programs or multi-steps programs etc.) for the same objectives or requirements. And also, the program should be considered as a project which will involve multi-functional departments. So APS is going to find out the optimal and robust measures which is not mandatory from the most difficult technology or the most complex formula, but it needs to select the most fitted one, who adapts the actual situation and

punctually (directly or by multi-steps) responds to the requirements of the enterprise with the lowest cost and few impact to existing process and habits. So the major role of APS is to decide the implementing measure and to plan a program which could embed these measures into the existing processes. According to this approach, APS sub-system in the macro is divided into two sub-working modules – “Selection” module and “Planning” module.

Involved with the scientific contribution and knowledge database, “selection” module gives out some default proposals through analyzing the “major characteristics” of each implementing measure relating with the “selected list” from SDS. There are three “major characteristics” defined:

- Execution timing: it describes the estimated finish time of each measure. As default, the scores could be classified as an index (Low/Medium/High) or as a real value.
- Execution technology: it describes the technology or technical level required by this measure. As default, the scores could be classified as an index (Low/Medium/High) or as a real description
- Execution cost: it describes the estimated cost for each measure. This cost includes the technical cost, human resource, and the cost for building new process. As default, the scores could be classified as an index (Low/Medium/High) or as a real value.
- Execution influence: it describes the final influence by executing this measure. It evaluates the influence on marketing and competition, the leadership, the sustainability and the technical advantage etc. As default, the scores could be classified as an index (Low/Medium/High) or as a real description.

For each selected environment-concern action, the “selection” module creates or imports (from an expertise database) all available implementing measures, and evaluates them by three above characteristics. According to the score of SDS or EVS, the selection module decides a measure by following some general rules:

- If there is a great gap between indicator “G” and indicator “A” of the related environment concern action, a fastest measure is proposed.
- If there is a great gap between indicator “V” and indicator “C” of the related environment concern action, a measure requires low technology is proposed.
- If there is a great gap between indicator “F” and indicator “I” of the related environment concern action, a measure with a larger influence is proposed.
- If the selected action is to create the leadership, a measure with a larger influence is also proposed.

Meanwhile, with the constraint of budget, the characteristic “Execution cost” should also be focused on in parallel.

This general mechanism ensures the enterprise could professionally identify the multi-steps program at the beginning (the first step is to quickly respond to the strictest requirements and the following-up will focus on the improvement to accelerate the reduction of the gap).

Combining all selected implementing measures, the “selection” module proposes a global program with general roadmap and schedule plan. These results are translated into “planning” module to build the details.

“Planning” module of APS is to combine and develop the executing details for each selected implementing measure. This module collects and takes a summary of the executing requirements, which elaborates the details of 4Ws (“When”, “Who”, “What” and “Way”) during the entire process. And then, this module needs to embed these requirements into the existing process with minimum and inevitable impact. Finally, a specific implementation dashboard with detail is constructed for implementation.

For these details, APS's planning module should also define the KPIs (in process and as final deliverables) which are controlled, monitored and easy to be achieved. And then the corresponding templates, tools, and the official implementation instructions should be released to guide the process and each measure. This module must ensure that the final deliverable dossiers can be directly converted to as the feedback of EVS sub-system which could continuously modify the internal status of enterprise.

ADS sub-system, a professional **Administration System**, is the real implementation system of this navigation system. It is responsible and accountable to ensure sustainable program to meet the goals defined by APS. ADS could be considered as a giant project. There are some typical activities that could be proposed to improve the program quality:

1. The multi hierarchical steering committees: based on actual needs, the committees are necessary while discussing and analyzing the current problems encountered during the implementation, the feedback for re-assigning the resource, resolving the conflicts and risks and motivating the group to achieve the goal on time. ADS sub-system set up three different committees for such general proposition:
 - The committee at enterprise level - harmonizing with another program and verifying the status / roadmap
 - The committee at branch level - verifying the resource and controlling execution situation
 - The committee or specialist at project level - process control and support
2. Internal/External promotion: To ensure the most efficient implementation, some internal promotion campaign is essential to each enterprise. These campaigns involve two major areas: communicating with top management area to attract the attention and get adequate resource, and promoting to related departments to make sure that all requirements and information have been delivered to targeted individuals.
3. Internal training: environment-concern program will make the environment criteria become one of the major indicators of product design. Therefore, the training on the background, the details of program and the related competences development becomes very important. The training can motivate the enthusiasm of the relevant employees, set up a great implementing environment and augment the anticipation of project resource to ensure efficient operation.
4. KPI daily monitoring: frequently monitor KPI's status to help to reallocate the resource.

EOS sub-system, a continuous **External environment's Observation System**, is to, based on the change of external demands and environmental hot points, promptly evaluate and update EVS results. EOS monitoring includes:

1. Follow-up of existing external changes (laws and regulations, customer demand, market attention)
2. Follow-up of the change of executable environmental actions
3. Follow-up of hot issues
4. Thorough tracking of environment-concern actions selected by EVS and SDS sub-systems

EOS will separate or disperse assesses, and analyze the above detection range. Basing on the common "translate" module of EVS, the monitoring results will feedback to EVS to modify the scores of external status.

- If the action is selected to answer the external requirements (there is a big gap of the scores of indicators), EOS continuously monitors the external change and re-modifies the objective.
- If the action is selected to create the leadership (without a visible gap or the external scores are not significant), EOS continuously monitors the external change to verify if the objective has been achieved.

IOS sub-system, a continuous **Internal Observation System**, aiming at continuous improvement, is the second feedback system for assessing the change of internal status. Following up the process of environment-concern program, IOS continuously analyzes the internal status and reports it to EVS sub-system (harmonized with "Translate" module) to modify the scores of internal part. IOS also monitors and analyzes independently the risks, conflicts and difficult issues during the implementation and reports them to ADS or APS to improve and update the program plan, and even pass to SDS to update the strategy.

Conclusion

In this paper, basing on the analysis of actual situation, a new optimized green navigation system - "TArget-hitting Navigation Kit", named as T.A.N.K also, has been proposed to support the decision of any environment-concern acts into the enterprise. T.A.N.K system involves all activities and functions under a simply, unique and sharable information flow. It ensures the sharability and readability of each study, avoid the misunderstanding of the severeness between different functions and it also provides the possibility of continuous evaluation and improvement.

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