T e Be efis of Modulari y i I dus rial Produc io

By Dipl. -Ing. Jakob Dück, Global Industry Segment Manager, HARTING

Modular approaches in machinery and plant operations are growing more successful. Interfaces play a key role in these designs, streamlining products and making them as efficient as possible.

Machine i h ey add n modu es as par f he pr duc i n ine.

The principle of modularity can be illustrated by LEGO building blocks. A nearly infinite number of variations can be created from a few basic bricks and defined connecting elements. This approach is now being established in industry for products with a far greater degree of complexity and variability.

The platform strategy of the automotive industry is a typical example. Depending on the engine, transmission, axles, and chassis, various types and brands of cars can be built. In industrial control and drive technology, systems like PLCs, IPCs, HMIs, and drive components can be customized from individual "slices" or several remote I/O blocks and customized to suit the machine or plant to be automated. They can be expanded or modified in the future without any major input.

It can be argued that modularization of complex products can only be successful if they are produced in the thousands (industrial controls) or even millions (automotive) of times over. But, can a modular approach also prove successful if only a few hundred units of a certain type are made per year?

Benefits of Modularity

There is currently no alternative to modularization in mechanical engineering. According to the VDMA, "Standardization and modularization are aimed at a portfolio with less variance and complexity and an overall lower cost level, without reducing the breadth and individuality of the product range." There are a number of typical market demands and requirements in the market for manufacturing systems.

Production systems call for a high degree of variability, enabling the manufacturing of a wider range of products even in small to medium unit quantities. These systems must be scalable and offer options for subsequent expansion in both capacity and output.

While the main focus used to be on net productivity, mechanical engineering customers are now expecting more variability and expandability. In other words, it is not "highly sophisticated" systems for the production of components in high volumes that are in demand, but rather systems that can flexibly manufacture different products in smaller quantities.

The competition in mechanical engineering is forcing the OEMs of production systems to expand their business models. In today's B2B market, it is no longer good enough to adopt products, sell them to operators and then wait for service and maintenance orders.

TCO models for the profitability of investments, which were often used in the past, are more and more frequently extended by lifecycle cost (LCC) models. This allows for new forms business, including predictive maintenance and retrofit services, to be performed transparently.

It is easier for machine builders to convince users that the extended offering, in connection with the lifecycle of a plant, is more advantageous.

HARTING's Smar ac ry "HAII4YOU" pi and dem ons ra i n p an .

The rising demand for subscription models on the customer side confirms this overall trend. In terms of OEMs, it also makes financial sense to turn to benefit- and service-oriented models. While the average margin in the new machine market stood at 5.4 percent in 2018, this margin was over 40 percent in the service industry. Demand for service is far less cycle-dependent than the demand for machines.

Especially in the case of expensive capital goods, it is often much more cost efficient for users to expand existing machines or to renew individual units or subsystems than to invest in an entirely new machine.

Also, in so s o r s ors of h hani al ngin ring ind s ry, h r is a wid spr ad xp a ion ha om hin mo d l s and s bsys m fro diff r n s ppli rs an b mo in d in o a prod ion lin wi ho many a jor iss s, and wi ho losing hni al apabili y or bili y.

All of h r q ir n s an b if prod ion sys m ar onsis n ly d lariz d and n work d.

Fa tors to Consider

Bas d on HARTING's xp ri n wi h s o rs, OEMs sho ld onsid r h following poin s wh n ma king h d ision o go mo d lar. Th o al s i d inp and xp ndi r for a n w, onsis n ly d lar prod ion sys m a ma xi , b so high ha i an b pla sibly in rod d wi hin a nor l i fra , and i as s ng worsm a rk d v lop n .

Th hni al hall ng s of h plann d division of a ma hin or plan in o individ al d l s wi h ransi ions and in rfa s sho ld b ass ss d as g n rally f asibl by all gro ps involv d, in l ding hani al, l ri al and saf y ngin rs. All op ra ional f n ions involv d in h f r s rvi d liv ry pro ss sho ld b pr par d o align h ir hods wi h h d lar d sign of h ma hin s.

To wha x n sho ld a ma hin or plan b divid d in o mo d l s, and wha is h g n ral pro d r o b follow d? Th r al g ni s of LEGO bri ks is no h bri ks h m lv s, b in h ir in r onn ions. Th in r onn ions id r n h gran lari y of h division and ar also a li m ing fa or for h onn ion of b ilding blo ks.

mo In d lar prod d sign, h in rfa s ns r h oh r n and xp di n joining of vario s par s. A h sa i , h y s g aran h prop r f n ioning of h n ir sys m — a singl om p on a ma hin , as w ll as an n ir prod ion lin .

Drawing Boundaries

To b gin wi h, h ini ial sys m sho ld b onsid r d in r ms of i s f n ions. Th s in l d : k y f n ions, whi h r fl h o m p o n of h OEM; basi f n ions, s h as arri rs orranspor s ha x nd a ross h n ir sys m; and addon or a xiliary f n ions, whi h ar o r in lin wi h h g n ral s a of h ar and ar of s onda ry i m p or an o h OEM. A a in a n of ov r- ngin ring in h ma hin d l s, wh r h o m p o n is ar on rn d, is always an advan ag .

Th n, h f n ions sho ld b organiz d in o mo d l s, b only as gran larly as n ssary. All asp s of possibl mi op i za ion ff s and hang s o q ip n sho ld b fa or d in — bo h for h ma n fa r r and h s r. I is also i m p or an o in l d as ma ny s ag s of s rvi provision along h ma hin lif y l , as w ll as o n ry-sp ifi f a r s, as possibl .

For all l n s of h ma hin ha anno b s para d f r h r, s h as s nsors, a a ors, HMIs, driv , ., and ha r q ir pow r, signal or da a onn ions sho ld: display h f n ional r l van for h n wly d fin d ma hin graphi ally; b assign d o a orr sponding lay r of a ypi al a o a ion pyra m i d; and hav all n ssary in rfa s for h onn ion of a h l n assign d o h r sp iv a ma hin d los and lis d.

This will r s l in a ma rix vi w wi h all h mo d l s of h sys m. Th hi rar hi al arrang n of h l n s wi h asso ia d in rfa s, in l ding r l van for o m on ma r m hin d l s is also visibl .

This approa h provid s a basis for h val a ion of f asibili y, hni al risks and h r q ir d d sign of in rfa s. Transpar n y is gain d by w ighing h i m p or an of h mo d l s for h f sys m. Bas d on h lis , all fra ions involv d, as w ll as f r h r sp ifi a ions and s ps for mo d l and pro ss d v lop n an b d riv d.

ma This rix vi w also h lps in d iding o wha x n h on rol of a mo d lar ma hin or plan sho ld b d sign d n rally or d n rally. Sys m s wi h a high d gr of q ip n variabili y in h ir k y f n ions and hos ha ak p a l a rg a n of spa ar g n rally q ipp d wi h d n raliz d I/O sys m s. Co n in d s r h m o or s ar r ff iv for ma s ll r, highly variabl sys m s. In h s sys m s, h basi on rol of k y f n ions is n raliz d and addi ional f n ions ar on roll d i h r n rally or d n rally, d p nding on h ir o m p l xi y.

In h as of s a ll, rl a i v p l y or si m p l sys m s wi h low variabili y, a p r ly n ral on rol sys m is mo r os ff iv .

Defining Stru ture

Wh n d iding on a s r r , n ral sys m s g n rally n ail low r os s for o m p on n s a or rials. By on ras , however, h rea e he o a d re our e requ red for bo h produ o a d alla o a he e d u omer. E ha eme a d re rof a al o be more me- o umi g a d o - e ve, wh le he ame appl e o erv e a d ma e a e.

All moder o rol, dr ve a d HMI y ems e able he omple e epara o of he phy al level from he log al level . h appl e bo h o par ularly fa a d pre e eque e , a well a o h ghly e ve afe y-releva or erl ked y ems.

h v r ually ab olu e freedom afforded by he modular za o of produ o y ems de vely hara er zed a d flue ed by he erfa e . HAR ING prov de olu o a d produ for all ype of power g al or da a erfa e ha : a alway be de g ed o mee he e e ary requ reme ; a be aled reme ally bo h he e h al parame er a d ze a d umber o ea h ma h e module; a d are able o mee d ffere o a g, a embly a d pro e o requ reme , a well a u g he proper ma er al a d egra g al er a ve ra mi o med a, u h a f ber op a d ompre ed a r.

Co e modular za o , ba ed o he arge ed op m za o of all o a d erv e prov o pro e e hrough he e re LCC model e able OEM s o ma ufa ure ma h e a ord g o a modular de g — g f a ly lower g o a d me pe . he u er he be ef a hey re e ve a o - a d dema d-op m zed ma h e. HAR ING prov de T olu o for all erfa e requ red moder o rol, dr ve, HMI, a d ommu a o e h olog e for produ o y ems, order o mpleme modular za o w hou fu o al re r o .

Co a : HAR ING, I ., 1370 Bowe Road, Elg , IL 60123 ☎ 877-741-1500 fax: 847-741-8257 E-ma l: T hr a. ha f eld@har g. om Web:h p://www.har g. om

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