


**THE NEED FOR KAIZEN CULTURE FOR MANUFACTURING INDUSTRIES IN
INDUSTRY 4.0**

Sundararajan Sridhar^A, V.M. Ponniah^B, Sujatha S^C



ARTICLE INFO	ABSTRACT
<p>Article history:</p> <p>Received 31 January 2023</p> <p>Accepted 26 April 2023</p>	<p>Purpose: The study aims to find the need for creativity in industry 4.0, To test whether creativity can be embraced by Kaizen.</p> <p>Theoretical framework: The problem statement is does Kaizen / Creativity to be extended to industry 4.0 and the same is researched with Literature reviews and with a set of Hypotheses.</p>
<p>Keywords:</p> <p>Industry 4.0; Kaizen; Continuous Improvement; Team Autonomy; SMARTKM factory (4.0).</p> <div data-bbox="172 1003 475 1249" style="text-align: center;">  </div>	<p>Design/methodology/approach: Survey questions were framed to check the linkage of creativity and industry 4.0, two hypotheses was tested, 30 samples from Experts in Industry and Academia contributed to the thoughts, and Correlations and SEM were used to conclude the findings.</p> <p>Findings: SPSS was used and principal component analysis with a “t” test was done to look at the correlation of independent variables to the above-mentioned hypothesis, the results revealed that there is a significant relationship with, effective communication, open innovation, Continuous Improvement, transformational leadership, collaboration, Goal clarity team autonomy, attitude, and knowledge enhancement.</p> <p>Research, Practical & Social implications: The sample size is less and can need to be tested on a larger sample size. The study can also be done in employees in industry 3.0 and industry 4.0 to check the effects. The practical implications is well tested in Industry 2.0 and Industry 3.0 The same needs to be continued for industry 4.0 to induce creativity thereby knowledge enhancement and Team Autonomy. Considering human behaviour this closed loop of problems. Kaizens is needed to sustain the innovation and thereby creating a culture of involvement and ownership.</p> <p>Originality/Value: There is active research in present times, researchers are showing keen interest on convincing the needs and benefits of Industry 4.0, but the behavioural aspect and its implications with industry 4.0 need to be explored. The next generation i.e. industry 4.0 will be more challenging, as there would be the challenge of a skilled workforce, and pressure for time/productivity will be high. People will be working in isolation (Sharing of thoughts and ideas will be limited Stalling of thinking approach). This may lead to psychological problems. The present study contributes to bridge this research gap.</p> <p>Doi: https://doi.org/10.26668/businessreview/2023.v8i5.1299</p>

^A Master of Business Administration, Research Scholar, Management, SRM Institute of Science and Technology, Kattakulathur, India. E-mail: ss3753@srmist.edu.in Orcid: <https://orcid.org/0000-0002-6655-7560>

^B Doctorate, Rtd Dean, College of Management, SRM Institute of Science and Technology, Kattakulathur, India. E-mail: vmponniah45@gmail.com Orcid: <https://orcid.org/0000-0001-6537-5477>

^C Doctorate, Associate Professor College of Management, SRM Institute of Science and Technology, Kattakulathur, India. E-mail: sujathas@srmist.edu.in Orcid: <https://orcid.org/0000-0002-6270-5511>

A NECESSIDADE DA CULTURA KAIZEN PARA AS INDÚSTRIAS DE MANUFATURA NA INDÚSTRIA 4.0

RESUMO

Objetivo: O estudo visa encontrar a necessidade de criatividade na indústria 4.0, para testar se a criatividade pode ser abraçada pelo Kaizen.

Enquadramento teórico: A formulação do problema faz com que o Kaizen/Criatividade seja alargado à indústria 4.0 e o mesmo é pesquisado com revisões de Literatura e com um conjunto de Hipóteses.

Design/metodologia/abordagem: as perguntas da pesquisa foram estruturadas para verificar a ligação entre criatividade e indústria 4.0, duas hipóteses foram testadas, 30 amostras de especialistas na indústria e na academia contribuíram com os pensamentos e correlações e SEM foram usadas para concluir as descobertas.

Resultados: SPSS foi usado e a análise de componentes principais com um teste “t” foi feita para verificar a correlação de variáveis independentes com a hipótese acima mencionada, os resultados revelaram que existe uma relação significativa com comunicação eficaz, inovação aberta, inovação contínua Melhoria, liderança transformacional, colaboração, clareza de metas, autonomia da equipe, atitude e aprimoramento do conhecimento.

Implicações de pesquisa, práticas e sociais: O tamanho da amostra é menor e pode precisar ser testado em um tamanho de amostra maior. O estudo também pode ser feito em funcionários da indústria 3.0 e da indústria 4.0 para verificar os efeitos. As implicações práticas são bem testadas na Indústria 2.0 e na Indústria 3.0. O mesmo precisa ser continuado para a indústria 4.0 para induzir a criatividade, aprimorando assim o conhecimento e a autonomia da equipe. Considerando o comportamento humano, esse ciclo fechado de problemas. Os Kaizens são necessários para sustentar a inovação e, assim, criar uma cultura de envolvimento e propriedade.

Originalidade/Valor: Existe uma pesquisa ativa nos tempos atuais, os pesquisadores estão demonstrando grande interesse em convencer as necessidades e benefícios da Indústria 4.0, mas o aspecto comportamental e suas implicações com a indústria 4.0 precisam ser explorados. A próxima geração, ou seja, a indústria 4.0 será mais desafiadora, pois haverá o desafio de uma força de trabalho qualificada e a pressão por tempo/productividade será alta. As pessoas trabalharão isoladamente (o compartilhamento de pensamentos e ideias será limitado. Paralisação da abordagem de pensamento). Isso pode levar a problemas psicológicos. O presente estudo contribui para preencher essa lacuna de pesquisa.

Palavras-chave: Indústria 4.0, Kaizen, Melhoria Contínua, Autonomia da Equipa, Fábrica SMARTKM (4.0).

LA NECESIDAD DE LA CULTURA KAIZEN PARA LAS INDUSTRIAS DE MANUFACTURA EN LA INDUSTRIA 4.0

RESUMEN

Propósito: el estudio tiene como objetivo encontrar la necesidad de creatividad en la industria 4.0, para probar si Kaizen puede adoptar la creatividad.

Marco teórico: El planteamiento del problema se hace Kaizen/Creatividad para extenderse a la industria 4.0 y el mismo se investiga con revisiones bibliográficas y con un conjunto de Hipótesis.

Diseño/metodología/enfoque: las preguntas de la encuesta se enmarcaron para verificar el vínculo de la creatividad y la industria 4.0, se probaron dos hipótesis, 30 muestras de expertos en la industria y la academia contribuyeron a los pensamientos, y se utilizaron correlaciones y SEM para concluir los hallazgos.

Hallazgos: Se utilizó SPSS y se hizo análisis de componentes principales con prueba “t” para ver la correlación de las variables independientes con la hipótesis antes mencionada, los resultados revelaron que existe una relación significativa con, comunicación efectiva, innovación abierta, continua Mejora, liderazgo transformacional, colaboración, claridad de objetivos, autonomía del equipo, actitud y mejora del conocimiento.

Implicaciones de investigación, prácticas y sociales: el tamaño de la muestra es menor y es posible que deba probarse en un tamaño de muestra más grande. El estudio también se puede hacer en empleados de industria 3.0 e industria 4.0 para comprobar los efectos. Las implicaciones prácticas están bien probadas en la Industria 2.0 y la Industria 3.0. Lo mismo debe continuar para la Industria 4.0 para inducir la creatividad, por lo tanto, la mejora del conocimiento y la Autonomía del Equipo. Teniendo en cuenta el comportamiento humano este circuito cerrado de problemas. Se necesita Kaizens para sostener la innovación y, por lo tanto, crear una cultura de participación y propiedad.

Originalidad/Valor: existe una investigación activa en la actualidad, los investigadores muestran un gran interés en convencer las necesidades y los beneficios de la Industria 4.0, pero es necesario explorar el aspecto del comportamiento y sus implicaciones con la Industria 4.0. La próxima generación, es decir, la industria 4.0, será más desafiante, ya que existirá el desafío de una fuerza laboral calificada y la presión por el tiempo/productividad será alta. Las personas trabajarán de forma aislada (se limitará el intercambio de pensamientos e ideas).

Estancamiento del enfoque de pensamiento). Esto puede conducir a problemas psicológicos. El presente estudio contribuye a cerrar esta brecha de investigación.

Palabras clave: Industria 4.0, Kaizen, Mejora Continua, Autonomía del Equipo, Fábrica SMARTKM (4.0).

INTRODUCTION

Introduction to Industry 4.0 may not be required, there is awareness that Industry 4.0 not only helps in driving new technologies and intelligent products, but also supports to expand the production sector. “This also enables conditions for mastering the ever-increasing dynamics and complexity of existing and new markets, few companies that can play a role in multiple areas seem to have a particularly good starting position they are able to leverage, it is also important to recognize the value addition as it also implies high effort that has to be amortized by increased productivity with a corresponding reduction in overall costs” (Thomas, 2013).

“It is important for companies to set their fundamental strategic course at the beginning while implementing Industry 4.0 This is required to gather experience with the corresponding technologies. However, this process requires time and patience because many of the relevant technologies are not likely to mature to full potential for next five to ten years or even longer. Moreover, because of the lack of a clear definition, there is no exact date by which Industry 4.0 will be completely implemented. Instead of talking about an industrial revolution, it may be apt to say its industrial evolution”, (Sridhar, S., 2019)

However, there are challenges, the challenge of resistance, challenges due to lack of new skills, challenges due to teething problems and challenge of boredom (silo Syndrome). There is also a myth that the human mind is less required, all instructions and solutions will be digital. There comes a serious threat to creativity . . .

“There are around 350 People working at Mondelez digital factory at Sri city Chennai, India, their nature of work is limited to the interventions when things are about to go wrong, this is also limited. Mondelez India states its Sri City Plant an “integrated digital factory. “This is SMART^{+KL} Factory”. (PB Goutam (2019), The Hub, Business Today, Feb Issue)

“As a part of social responsibility, it will be needed, to increase the involvement and promote the engagement of employees in terms of using their skills and experience with regard to both creative design and planning processes as well as build and sustain operational working environment, to boost employee’s productivity and provide organizational structures that support individuals’ for their career growth.”, (Prof. Dr. Henning 2013).” Through Industrie 4.0 there will be a paradigm shift in human-technology interaction. It should be machines that adapt to

the needs of human beings and not vice versa. Smart industrial assistance,” (Schumacher, A., Erol, S., & Sihh, W.,2016).

Kaizen is a Japanese word the practice is seen in many companies. The word indicates a process of continuous improvement over the standard way of work (Chen *et al.*, 2000).

It is a compound word involving two concepts: Kai (change) and Zen (for the better) (Jain, A., Bhatti, R., & Singh, H.,2014, March).

Kaizen has a significant correlation with the organization’s culture and team effectiveness. The relationship between team integration and team member satisfaction was significant. The linear relationships were also found between team integration and team leader evaluations of effectiveness and performance were also found significant and positive. There is significant relationships between team integration, team member satisfaction, team effectiveness and team performance all of these support the view that feeling connected as a team to the rest of the organization is a critical step in helping teams define their identity. This finding is consistent and researched in the sociotechnical framework. Within the sociotechnical framework, the work system is regarded as essential, and within this work system, the workgroup is seen as a important factor in optimizing the work system (Toni, Maria, and Eileen 2003)

The author feels that past three decades of successes throughout the world was with the use of creative mind to maximum extent, this was done with the kaizen culture. The TPS Toyota Production System has identified 8 wastes, the one of the wastes is not energizing the peoples mind for the continuous improvement.

The Success of Industry 1.0 was invention of Steam engines etc , the same continued with industry 2.0 with Railways and Aero planes. Industry 3.0 was a revolution of automobiles (demonstration of power of Kaizen by Toyota), coupled with Internet and computerization.

The question than is when all the three-industry revolution was fueled by creativity, do we need this in Industry 4.0?

“In the midst of the changes, the information revolution, and competition in the business environment, characterized by a high degree of complexity and creative chaos, the need has emerged to adopt modern methods, tools, programs and practices to meet these challenges, and to contribute to a qualitative leap in the nature of the organization's products, enabling it to increase customer satisfaction and retention, and increase the potential of them, including evaluating its competitive position and increasing its market share in a way that serves the individual, the organization and society.”(Bahia, T. H. A., Idan, A. R., & Athab, K. R.,2023).

“The technology-mediated interruptions likely have an impact on the quality of life. Considering that at work, this quality of life may be defined as the set of actions within the company that involves the deployment and maintenance of management, technological and structural improvements, and innovations in the work environment (França, 1996), it indicates the need to find new ways to mitigate conflicts arising from technology-mediated interruptions from outside work.” (Maçada,et.al,2022)

The human mind is always looking for an improvement, break status quo , eager to explore, There would be enough time in Industry 4.0 to think , if channelized can be used for improvements.

A questionnaire method was used and 30 experts in academics and industry and were surveyed to understand the following Hypothesis.

Hypothesis 1: H₀: Creativity and involvement important for industry 4.0

Hypothesis 2 Ho: Kaizen culture to be continued to maintain the creativity thereby bringing right culture of excellence in industry 4.0

LITERATURE REVIEW

Review of literatures was done to understand interrelationship between kaizen and creativity in Industry 4.0. There are only few research papers on industry 4.0 talking about challenges and the capability to be built in advance. “The understanding with companies is that the concepts of Industry 4.0 as highly complex with no strategic guidance is explained, Companies also lack a clear understanding of Industry 4.0 resulting in uncertainty on the benefits and its outcomes, Companies fail to assess their own capabilities towards Industry 4.0 which restrains from taking Proactive measures” (Schumacher, A., Erol, S., & Sihm, W.,2016).

“The industry 4.0 objective is the *Augmented Operator*, this includes target setting and use of technological support , this is needed due to the worker has to change the way working in the challenging environment This calls for evolution in production systems. The application of future *Industry 4.0* aspects will require new qualifications and skill sets to overcome the gaps. Industry and supporting partner take account of this fact by developing and providing appropriate teaching and research platforms. There is still a strong demand for future research activities both in the industry and research” (Stephan,Martias,Mortiz & Domnic ,2015)

Motivation is a key enabler to industry 4.0 successes, one way of looking at the possible goal for an employee working is in the field of development and enabler for Motivation would be to require them to give a minimum number of presentations at conferences attended by

experts from outside of the company. This would provide the individual in building capability and encouraging them to subject their own ideas to critical evaluation by third parties. Such a positive environment will strengthen the trust and groom the social relationships This then provides the basis for open, knowledge sharing between employees. A good working environment would build culture, social collaboration, this in turns helps to accelerate knowledge sharing within the company” (Günther Reiner, Jürgen, Michael, Wolfgang, 2017)

The summary of impact is compared with past industrial evolutions: -

Table 1- A summary of impacts, 4.0 compared with earlier versions

Technology impact		Impact to end users	
1.0,2.0 and 3.0	4.0	1.0,2.0 and 3.0	4.0
Innovative product/ processes transformation	Communication transformation	Products very expensive during launch	Products and services with very low cost
Less ROI	High ROI	Resistance by end users	Speed will attract end users
Knowledge centric, Patents	Transparency, consumer engagement		

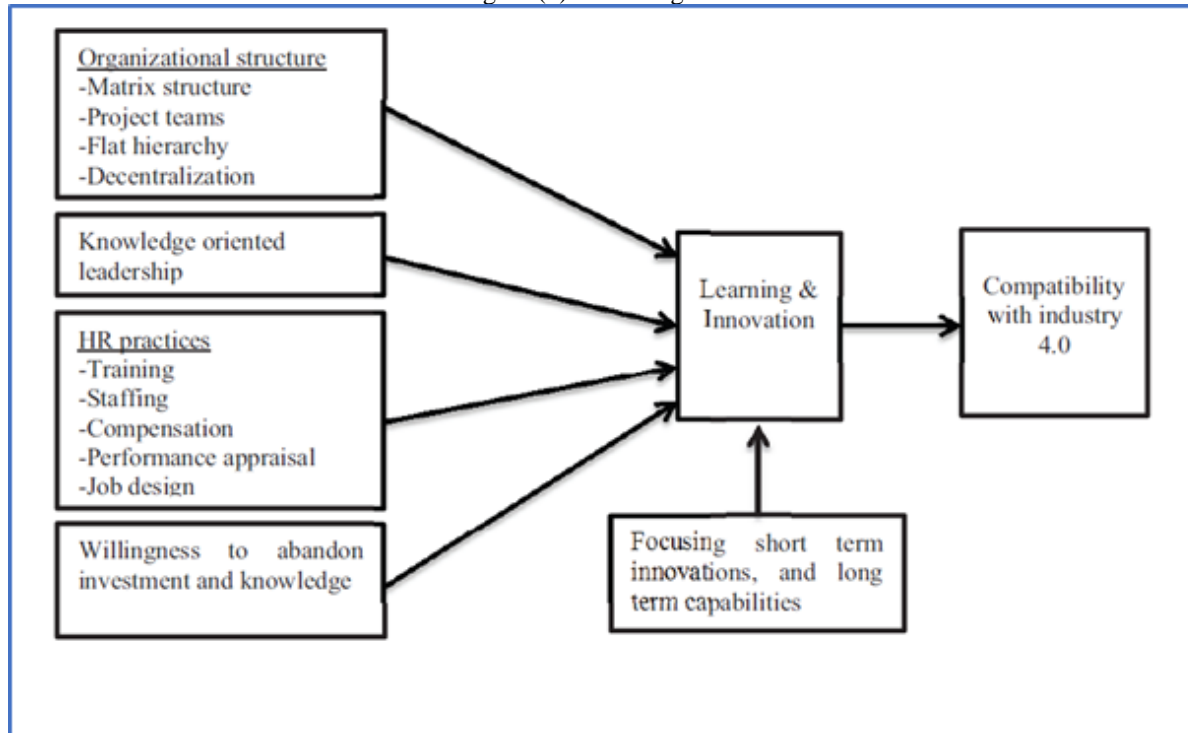
Politics and Society		Impact on Shop floor operators	
1.0,2.0 and 3.0	4.0	1.0,2.0 and 3.0	4.0
No Political move	Started with political advantage	Created job market	Shrink job market
Land lord - income - Wage	Standard of living	Creativity in Workplace	No need of decision making - Creativity lost
War – Population increase	Comfort – ease of work	Shop floor important for the industry	Architectures, Designers programmers important
Resource centric	Conservation of Resources		

Source: Compilation of key points by the author

MATERIAL AND METHODOLOGY

A Model for need of Kaizen culture in Industry 4.0 needs to be researched and the findings need to be incorporated. This paper (A human resource management perspective (Shamim, S., Cang, S., Yu, H., & Li, Y. 2016) aims at offering a standpoint on the best management practices which promotes the opportunity of innovation and learning in the organization, this in turns facilitate the business to match the required pace of industry 4.0.

Figure (1) – Existing Model



Source: Saqib, Shuang, Hongnian (2016), Management Approaches for Industry 4.0, A human resource management perspective, IEE, (6)

(Saqib, Shuang, Hongnian, Yun 2016) Suggests, “The responsibilities lies with managers and Proprietor’s to adopt necessary management approaches to grow in the fourth industrial revolution. This endeavor of this study is to provide implications for the researchers by offering a theoretical framework for the future research.”

One of the conditions to be creative is Problem solving and the extent that one or more of the following conditions are fulfilled (1) The thinking culture has novelty and value (either for the thinker or for his culture). (2) The thinking is unconventional, it needs practice and small successes wherein modification or rejection of previously accepted ideas. (3) To build the thinking culture it requires high motivation and persistence, taking place either over a considerable span of time (continuously or intermittently) or at high intensity. (4) In the shop floor the problem is posed with lack of clarity basically the problem is not well defined so that questions cannot be raised., there are few who donot know how to convey the problem in right way. All of these needs kaizen idea and kaizen culture to overcome.

Questionnaire was designed from standard questions available, the same was administrated with experts, 30 Experts were identified from Academics and Industry, mix of different company, country and institutions were surveyed.

The Likert (1-7 Scale) was used, the questionnaire was designed, these questions were

already validated and statistically significant. The questionnaire was sent by mail and each respondent had responded all questions the data was then put into SPSS and principal component analysis was used to conclude the significance levels.

The Questioner format is attached in the Annexure -1, Likert scale was used 1-7 and 3 questions were of reverse order.

Hypothesis 1: Ho: *Creativity and involvement important for industry 4.0.*

Following intendent variables are considered

IDV1	Effective communication
IDV2	Productivity
IDV3	Open – Innovation
IDV 4	Continuous improvement
IDV 5	Transformational leadership
IDV26	Collaboration

Source: Prepared by the authors (2023)

Hypothesis 2 Ho: *Kaizen culture to be continued to maintain the creativity thereby bringing right culture of excellence in industry 4.0.*

IDV21	Goal clarity
IDV22	Team Autonomy
IDV23	Improvement knowledge
IDV24	Attitude
IDV25	Skill
IDV26	Collaboration
IDV27	Knowledge sharing, Recognize the failures

Source: Prepared by the authors (2023)

Independent variables were identified which has relationship with the above hypothesis, standard questionnaire was used and administrated. SPSS and Principal component were used to arrive on the significance and correlation levels.

A summary sheet of an independent variables is attached, Similar study is done for all the variables.

Principal component analysis using SPSS

All the IDVs were analyzed in similar way, sample is enclosed

Table 5: Impact of effective communication for creativity and involvement for Industry 4.0

Questions	Component
How do you think SMART (4.0) factories will affect the relation of blue and white-collar workers? Do you think there is need of kaizen culture to maintain Shop floor autonomy	
in general, members of our team believe in the value of the kaizen event to continue in industry 4.0	39% (.831))
Our team members value each member unique contribution by doing kaizen	20% (.712))
Our team spent a lot of time discussing ideas before trying them out in the work area. (Reverse scale)	
Most of our team members can communicate new ideas about improvements as a result of participation in the kaizen event	
Innovative behavior is not encouraged in the Industry 4.0 (Reverse scale)	

Eigen values :3.591
Percentage of variance explained = 59.849%
KMO= 0.635
Bartlett's Test of Sphericity :39.801
Approx. Chi-square = 493.700
df = 15
Sig = .000

The impact of effective communication is in an important element to bring industry harmony and for continuous improvement. The study of principle component analysis shows that it is significant ($p < 0.05$), Eigen values is higher, and percentage of variance is more than 50%

Hypothesis 1: H₀: Creativity and involvement important for industry 4.0

Table 2 is the summary sheet of all the variables (IDV1-5, &26) Following intendent variables are considered
Variable impacting the creativity and involvement

IDV1	Effective communication
IDV2	Productivity
IDV3	Open - Innovation
IDV 4	Continuous improvement
IDV 5	Transformational leadership
IDV26	Collaboration

Table 2a: Summary of analysis

IDV	IDV Description	Comp.1	Comp.2	Eigen Value	KMO	Appx Chi Square	df	Sig.	Conclusion
IDV 1	Effective communication	(Sno 6) 39% /0.831	(Sno 9) 20% /0.712	3.591	0.635	493.7	15	<0.001	Significant in bringing industry harmony and continuous improvement.(p<0.001,<0.05)
IDV 2	Productivity	(Sno 4) 36% /0.705	(Sno 18) 28% /0.654	2.532	0.492	5.48	6	0.484	Not significant , eigen values high more samples to be researched(p=0.484,Not less than .05)
IDV 3	Open Innovation	(Sno 24) 38% /0.855	(Sno 6) 17% /0.838	5.634	0.482	5.48	28	<0.001	Significant in bringing creativity and involvement.(p<0.001,<0.05)
IDV 4	Continuous improvement							<0.001	95% confidence level the t=14.794/df29 shows significant contribution towards CI,(p<0.001,<0.05)
IDV 5	Transformational leadership	(Sno 14) 59% /0.728		2.943	0.731	56.408	10	<0.001	Significant in bringing leadership quality this helps in creativity and involvement.(p<0.001,<0.05)
IDV 26	Collaboration	(Sno 22) 36.4% /0.912	(Sno 6) 13.2% /0.901	14.808	0.441	410.4	153	<0.001	The key deliverables of kaizen is collaboration the results hows significant (p<0.001,<0.05)

Source: Data derived from statistical analysis

Creativity and Involvement is needed in industry 4.0, and the enable is Kaizen. The statistical studies show correlation and significance in effective communication, open innovations, and transformation leadership this will lead to collaboration and continuous improvement (Table 2a)

Hypothesis 2 Ho: Kaizen culture to be continued to maintain the creativity thereby bringing right culture of excellence in industry 4.0

Table 3 is the summary sheet of all the variables (IDV21-25, &26) *Kaizen culture to be continued in Industry 4.0*

IDV21	Goal clarity
IDV22	Team Autonomy
IDV23	Improvement knowledge
IDV24	Attitude
IDV25	Skill
IDV26	Collaboration
IDV27	Knowledge sharing, Recognizing the failures

Table 3a: Summary of analysis

IDV	IDV Description	Comp.1	Comp.2	Eigen Value	KMO	Appx Chi Square	df	Sig.	Conclusion
IDV 21	Goal Clarity	(Sno 5) 31% /0.844	(Sno7) 19% /0.750	4.651	0.512	34.11	21	0.35	Significant in Supporting the Hoshin Kanri (TPM), i.e. Goals aligned with the mission and vision and all the people work for a common goal,(p=0.035,<0.05)
IDV 22	Team Autonomy	(Sno 17) 35% /0.903	(Sno 10) 10% /0.883	14.353	0.32	385	153	<0.001	The impact on the team autonomy by kaizen is an important element to bring industry harmony and CI Its Significant .(p<0.001,<0.05)
IDV 23	Improve Knowledge	(Sno 14) 78% /0.858		2.34	0.682	43.064	3	<0.001	Building knowledge and capability will be fundamental responsibility for any organisation , the same will be required in industry 4.0 its significant .(p<0.001,<0.05)
IDV 24	Attitude	(Sno 10) 40.5% /0.892	(Sno 22) 16.5% /0.868	9.217	0.739	177.129	66	<0.001	Building right attitude is the fundamental of culture building or culture nurturing , this is important for industry 4.0 also significant ,(p<0.001,<0.05)
IDV 25	Skill	(Sno 7) 0.596	(Sno 9) 0.596	1.193	0.5	1.041	1	p=-.307	Not significant , eigen values is also low (p=0.307,Not less than .05)
IDV 26	Collaboration	(Sno 22) 36.4% /0.912	(Sno 6) 13.2% /0.901	14.808	0.441	410.4	153	<0.001	The key deliverables of kaizen is collaboration the results hows significant (p<0.001,<0.05)
IDV 27	Knowledge sharing , Recognize the failures	(Sno 13) 63% /0.812		2.515	0.709	46.249	6	<0.001	The key impact of knowledge sharing and learning form failures is an important element to bring capability and will support on the continuous improvement journey, the results how's significant (p<0.001,<0.05)

Source: Data derived from statistical analysis

Kaizen mind to be continued to build the right culture for industry 4.0. The statistical studies show correlation and significance in Goal clarity, team autonomy this will lead to better Skill and Attitude (right culture) and also build Collaboration and Knowledge (Table 3a)

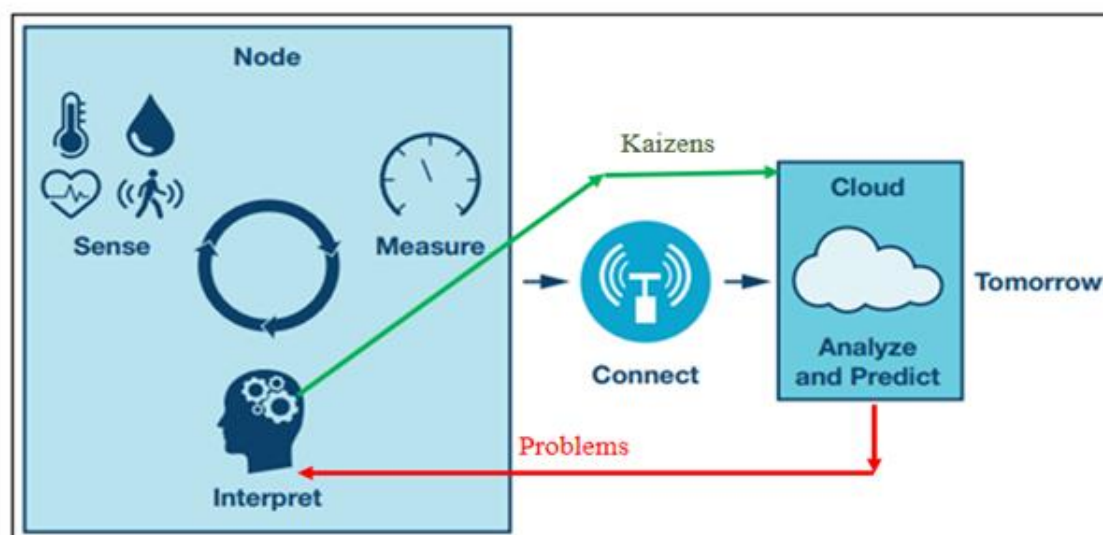
RESULTS AND DISCUSSION

Analysis was done based on the survey data, two hypotheses were questioned and the results are as follows

Hypothesis 1: H_0 : Creativity and involvement are important for industry 4.0, are significant and there's no effect in the population. Kaizen helps in transformational leadership, collaborative approach, and Effective communication leading to continuous improvements. Yes creativity and involvement are more needed in industry 4.0 as the no of employees at the site will be less, cohesion and a collaborative approach is required for continuous improvements

Hypothesis 2 H_0 : Kaizen culture to be continued to maintain creativity thereby bringing right culture of excellence in industry 4.0 significant and there's no effect in the population. Kaizens build team autonomy, and collaborations, builds right attitude and keep focused on the Goal (Goal Clarity) , hence excellence approach to be continued with Kaizen mindset in Industry 4.0

Figure (2)



Source: Thomas (2018), How Important Is Industry 4.0 for the electronics Industry? Analog devices

The author agrees to Thomas brand engineering model for industry 4.0 implementations, but feels

that the consideration is needed on the human behavior to overcome the closed loop of problems Kaizens is needed to sustain the innovation and thereby creating a culture of involvement and ownership.

The study of impact of phycological issues and its remedy is very nascent stage, the importance given to exploit human mind is not encouraged or nor understood, in the mad rush toward building industry 4.0 platform.

The learnings and success of industry 2.0 and 3.0 was due to involvement, collaboration and team harmony should not be overlooked, lot of research and industry preparedness is

required.

Building availability and culture is lacking and industry 4.0 will hit us in 5-10 years, we need to do more research and implement the findings

CONCLUSION

Each of the industry revolutions (i.e. 1.0 to 3.0) was a complete transformation which had depended on innovation. There was resistance for change in each transformation but each of them had opportunity for creativity and improvising the same hence involvement and acceptance followed. Industry 4.0 will be no different as far as human behavior is concerned, but it has challenges, the myth of no thinking or improving the status quo would lead to failure. Innovation and continuous improvement will be needed to succeed, the hypothesis has proved that the same needs to be continued. A culture of excellence would be more needed and enough training and handholding is required to implement and sustain.

Future research can focus on a larger sample size to ascertain the impact of kaizen on creativity, the complexity of Industry 4.0 and its relation to Kaizen culture.

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DEFINITIONS

CI – Continuous improvement

OPL – One-point lesson

JIPM – Japan institute of planned maintenance

SMART^{KL} **The Smart Factory**,^{can} be recognized as the first European vendor-independent, factory laboratory for the industrial application of modern, ICT (Information and Communication Technologies)

TPM – Total productive maintenance

ANNEXES

Annexure 1:

Sno	Question	Ref.	Relationship
1	By not having the kaizen culture ,what organizational risks do you think will arise through the realization of SMART (4.0) Factories	Fabian (2015)	IDV2,IDV4, IDV26,IDV21
2	How do you think SMART (4.0) factories will effect the relation of blue and white collar workers ? Do you think there is need of kaizen culture to maintain Shop floor autonomy	Fabian (2015)	IDV1, IDV 26 IDV 22,IDV24
3	What could be the new role for the remaining human workers in SMART factories , What skills will they need , What daily routines do you think they might do and how will they execute them , for these do Kaizen culture help ?	Fabian (2015)	IDV 4,IDV 26,IDV 21,,IDV 22,IDV 27,IDV 23
4	in your opinion will the kaizen culture be strategic focus in Smart factories ?	Fabian (2015)	IDV2,IDV4,IDV5,IDV22,ID V26,IDV27,IDV21
5	Companies fail to assess their own capabilities in Industry 4.0 which restrains from taking any coordinated measures	Andreas , Selim , Wilfried (2016)	IDV4,IDV22 ,IDV21
6	in general ,members of our team believe in the value of the kaizen event to continue in industry 4.0	ACC1	IDV1,IDV3,IDV4,IDV5,IDV 26,IDV22,IDV28
7	Most of the our team members think that this kaizen event is a good strategy for the work area	ACC2	IDV3,IDV4,IDV22,IDV24,ID V26,IDV25,IDV21
8	How often does this employee... pay attention to issues that are no part of his daily work?	Lake (2016)	IDV 5,IDV2,IDV26
9	Our team members value each members unique contribution by doing kaizen	IP2	IDV1,IDV3,IDV26,IDV22,ID V24,IDV25
10	Our team did not gain respect on each others opinions ,by doing kaizen	IP3	IDV26,IDV22,IDV24
11	Our team had a lot of freedom in determining what changes to make to this work area	TA1	IDV4,IDV26,IDV22,IDV24,I DV21
12	Our team spent a lot of time discussing ideas before trying them out in the work area .	A04	IDV1,,IDV4.IDV22,IDV21
13	Overall the kaizen event increased our team members knowledge in line with to continuous improvement .	UCI1	IDV4,IDV21,IDV23,IDV27
14	In general the Kaizen event increased our team members knowledge of how continuous improvement can be applied	UCI2	IDV5,IDV4,IDV23,IDV27
15	Most of our team members can communicate new ideas about improvements as a result of participation in the kaizen event	SK1	IDV1,IDV26,IDV22,IDV24
16	Most of ou team members gained new skills as a result of participation in this kaizen event	SK3	IDV26,IDV5,IDV23,IDV24,I DV27
17	in General our team members are comfortable working with others to identify improvements in the work area	SK4	IDV26,IDV3,IDV22
18	In general this kaizen event motivates the members of our team to perform better.	AT1	IDV26,IDV2,IDV5,IDV22,ID V24
19	Overall, this kaizen event increases our team members interest in our work	AT3	IDV26,IDV22 ,IDV24
20	How often does this employee... systematically introduce innovative ideas into work practices?	Lake (2016)	IDV 5,IDV3,IDV4,IDV26,IDV22, IDV26
21	How often does this employee... mobilize support for innovative ideas?	Lake (2016)	IDV 24,IDV4,IDV22,IDV26
22	The reward system encourages innovation and hence it needs to be continued in Ind.4.0 (<i>Helps IWB -Innovative Work Behavior</i>)	PA19- Yeoh , Sethela & Rosli (2013)	IDV3,IDV4,IDV22 ,IDV26,IDV24
23	The organization publicly recognizes those who are innovative. (<i>Helps IWB</i>)	PA20- Yeoh , Sethela & Rosli (2013)	IDV3,IDV4,IDV22 ,IDV26,IDV24
24	Innovative behavior is not encouraged in the Industry 4.0	PI-1 Yeoh , Sethela & Rosli (2013)	IDV3,IDV22 ,IDV1
25	Will the organization (industry 4.0) be open and responsive to change	PI-19 Yeoh , Sethela & Rosli (2013)	IDV4,IDV22 ,IDV24,IDV26